Freight transport: at any price?

Effects of transport costs on book and newspaper supply chains in the Netherlands

Cover illustration: Hens Runhaar sr. and Minke Runhaar-Zwaan
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Effects of transport costs on book and newspaper supply chains in the Netherlands

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Forget the cost
We've got to choose
We're running in a race
That we can only loose

UB40, Forget The Cost, *UB44* (1981; Virgin Records)

Preface

This dissertation is about the role of transport costs in logistical decision-making. The topic is related to the economic theorem of 'efficient pricing', which has for a long time been of interest to me. According to this theorem, producers and consumers of transport services should pay the full cost of transport in order to maximize the efficient use of scarce resources, including the environment. Yet, in the current market situation, many of the costs that transport incurs, e.g. pollution, are not included in prices. Like many transport economists and policy makers, I was of the opinion that this had led to an over-consumption of transport services, in particular the most polluting ones (cars, trucks, airplanes). Incorporating the real cost of transport in prices therefore logically would lead to less traffic and a larger market share of less polluting modes of transport!

After four interesting years in Delft, it became evident that the above reasoning was too simple. Indeed, reality proved to be more complex and less predictable than I first imagined. This forced me to take a critical and fresh look at the issues. Among other things, I learned a lot about the positive effects of (freight) transport, which taught me to take a less one-sided and dogmatic look at transport behavior. In this respect I'm still learning, however…

There are many people that I would like to thank for their support, suggestions, critical comments, and contribution to a fine working climate. First of all, I thank my promotor, Bill Melody. By means of critical and fundamental feedback, Bill taught me how scientific research should be conducted. The weekly seminars that he initiated and in which the PhD students were expected to participate by means of presentations and feedback, were another important way in which he contributed to my work. Finally, I am grateful for the freedom he gave me in choosing a topic and in organizing the study.

I also thank my daily supervisor, Bart Kuipers. After he left our section in 2000, Bart continued supervising me, largely in his own time. I am most grateful for that and for his excellent supervision. Not only did he provide me with literature, information, and contacts that otherwise would have been largely out of my scope, his support and the warm atmosphere that he created were equally if not more important!

My second promotor, Rob van der Heijden, also left Delft but continued supervising me. Despite his other commitments, including many other PhD students, he always had time to read and discuss drafts. In addition, during our meetings, Rob was always well prepared and lively with his comments and time. I learned a lot from him, in particular the making and justifying of methodological choices.

Without the help of over 120 practitioners in the field of logistics management, working at transport firms, shipping firms, research institutes, universities, the ministry of transport, and elsewhere, this research would not have been possible. It is impossible to thank them all individually, but the names of those that co-operated in the two surveys I conducted and those that were interviewed are mentioned in the annexes. Thank you all!

I would also like to thank the members of the defence committee, Professor Van der Hoorn, Professor Roos, Professor Ruijgrok, and Professor Van Wee. Their useful comments and suggestions helped me to improve the final draft of this dissertation and prepared me to defend all the choices that I made along the way.

Next, I thank my colleagues and former colleagues in the Economics of Infrastructures section. Not only did they provide me with many comments and suggestions during the weekly seminars; they also made for a very nice group of people to work with. Additionally, there were many other colleagues that made the four years in Delft an interesting and pleasant period. Special thanks go to Koen Dittrich, my officemate, and to Gert-Jan Muilerman, who graduated two years ago.

The TRAIL Research School provided assistance in various ways. First, they put me into contact with other researchers in the field and, during the annual conferences and lunch seminars, gave me the opportunity to present my work. Second, in the final stage of my project, Mirjam Zuil-Miedema helped me to get this dissertation published.

Hens Runhaar sr. and Minke Runhaar-Zwaan, my parents, designed the illustration on the cover of this dissertation, whereas Joke Herstel (Wenk) took care of the final cover design. I am very happy about the results and therefore thank them for their excellent work!

Last, but by no means least, I acknowledge my girlfriend Marieke, our son Pieter, my parents, our friends, and other family for the interest that they have showed in my work and for teaching me, purposeful or not, that it is wise not to devote all time and attention to my work.

Hens Runhaar

October 2002.

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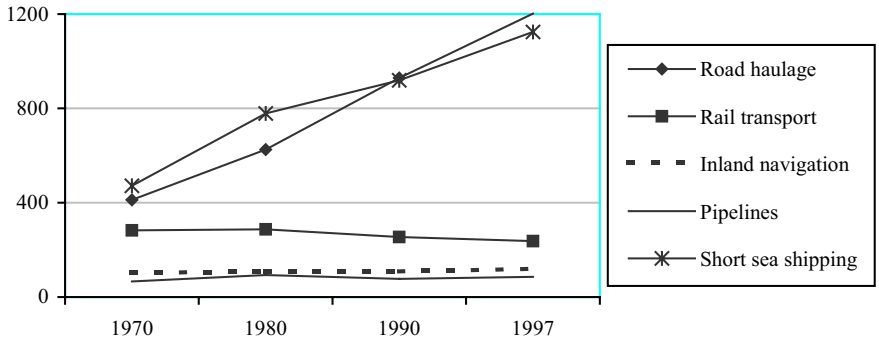
PART I: INTRODUCTION

1 Introduction

1.1 Background: the ambivalent role of freight transport

Freight transport is considered an important condition for successful economies. A well-functioning and low-cost transport system facilitates international trade, which subsequently may increase economic efficiency through gains of trade and specialization (Banister *et al.,* 2000: 13). In addition, an efficient transport system allows firms to optimize their production and distribution processes (Beuthe and Nijkamp, 1999: 1). Through these and other mechanisms freight transport, and transport in general, accommodates processes that bring positive welfare effects to society (Hafkamp and Geerlings, 2002: 7). Transport at the same time is a growing source of concern since it produces substantial negative social and environmental effects, including air pollution, noise, congestion, and traffic victims. In this context, freight transport by road in particular is considered problematic, because the negative effects per unit of road transport (e.g. ton-kilometer) are relatively high, compared to other modes of transportation. Due to its dominant position in total freight transport (see Figure 1.1) road transport therefore contributes disproportionally to the above negative effects generated by transport.

Figure 1.1: Trends in freight transport in Europe (in million ton-kilometers)



Source: EC, 1999: 45.

Forecasts indicate that the negative effects that are produced by transport will only increase in future, since a substantial growth in European freight transport is envisaged. For instance, long-term modeling studies have shown that between 1995 and 2020, freight transport on Dutch territory, expressed in ton-kilometers, will increase by 80 percent (AVV, 2000: 6). It is likely that this growth in transport will by far outweigh technological advances that reduce the negative effects of transport, such as more fuel-efficient engines.

Both from the policy perspective of public interest and from a theoretical, economic perspective, it is felt that the balance between benefits and costs of transport is not optimal. Moreover, it is considered problematic that a main part of the negative effects of transport are passed on to society, rather than that they are borne by those causing them. It is mainly for this reason that transport policy in Europe has shifted from a demand-led approach, in which infrastructure was expanded in response to increasing traffic volumes, to a more traffic management-based approach (Banister *et al.,* 1999: 21). In many European countries, governments set stricter norms and regulations concerning the environmental performance of transport and strive at a reduction in the growth in traffic, e.g. relative to economic growth (Hafkamp and Geerlings, 2002: 7). In this context, an increased popularity can be observed in Europe to switch to taxation as a means to induce actors that take transport decisions to make a more efficient use of transport resources (Bruinsma *et al.*, 2002: 1). In this way a better balance between the social costs and benefits produced by freight transport is strived for.

Although in the coming years, the introduction of multiple taxes on freight transport are planned, so far little study has been done to systematically explore the effectiveness of taxation as a means to regulate freight transport. This dissertation aims to partly fill in this knowledge gap. The main focus will be on the effects of policy interventions that aim at raising the cost of freight transport on logistical decisions of *shippers* such as manufacturers and wholesalers, who generate freight transport demand.

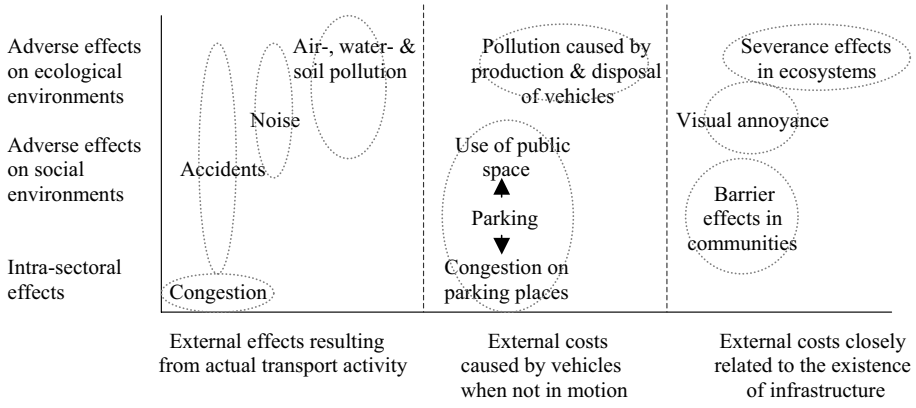
In the following sections the central research problem is elaborated in more detail and the boundaries of the research are set. Section 1.2 describes why the current situation in transport is problematic from a theoretical perspective. In section 1.3 the policy problems related to transport are outlined, as well as the policy response that they have induced. Section 1.4 explores the reasons of the ever increasing transport demand. In section 1.5 the central research problem is reformulated and refined, research questions are formulated, and the overall dissertation outline is presented.

1.2 The economic problem: externalities and allocative inefficiency

The observed problem that transport produces a lot of negative effects, which in addition are not borne by those who cause them but passed on to society, has notably attracted attention from transport economists. For several decades, economists have pleaded for incorporating all costs of transport in transport prices as this would improve efficiency of resource allocation and by that, increase overall social welfare (e.g. Pigou, 1920; Marchand, 1968; Roth, 1996). The argument is that, due to the presence of so-

called negative externalities (i.e. costs that are not incorporated in prices but passed on to others), transport is too cheap and hence consumption is suboptimal (Rietveld, 2001: 46). Shipping firms therefore buy too many transport services compared to the situation in which prices reflect the true cost of transport. In addition, they may use modes of transportation that are undesirable from a societal perspective. This happens if the magnitude of external costs varies for the different modes. Economists emphasize that to firms, the use of freight transport may be efficient, but not to society as a whole. At the level of society, part of the resources currently used in transport (e.g. transport services themselves, fuel or labor used, land, time lost in congestion, but also clean air) could have yielded more welfare if put to another use. Figure 1.2 depicts a typology of external costs of road transport; in fact this typology also applies to the other modes of (freight) transportation[i].

Figure 1.2: Typology of external costs of road transport



Source: Verhoef, 1996: p. 15[ii].

To policy makers, notably emissions of the greenhouse gas CO_2 and the acidifying pollutant NO_x are considered problematic (NEI, 1999: 47). Various estimations have been made regarding the magnitude of external effects produced by freight transport. Considering for instance CO_2 emissions, Bleijenberg (1996: 7) concludes that road haulage is responsible for 6 percent of total emissions in Europe. Transport as a whole (including passenger transport) is estimated to produce 20-25 percent of all CO_2 emissions globally (Olsthoorn, 2001: 127; Nijkamp, 2001: 155). Per unit of transport, usually expressed in ton-kilometers, road transport produces most emissions (for an indication, see Table 1.1). The contribution of freight transport to congestion is limited. Both in the Netherlands and in the United Kingdom freight transport by road is responsible for only some seven percent of all time losses due to congestion (Ministerie van Verkeer en Waterstaat, 1999: 10; NEI, 1999: 50[iii]). An important reason for the limited contribution of road haulage to congestion is that carriers avoid peak hours in order to minimize time losses (CPB, 1998: 28).

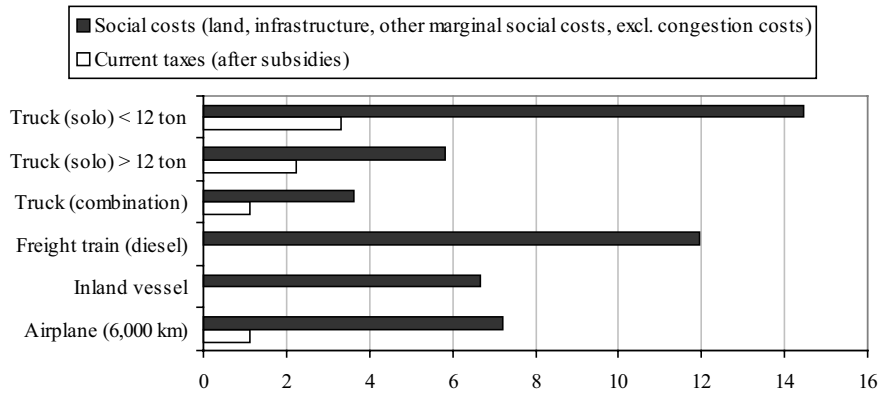
Table 1.1: Environmental pollution by mode of transportation (1995)

	Van	Truck	Train	Inland vessel
Energy MJ/ton-km	10.72	1.41	0.61	0.60
CO_2, gram/ton-km	786	123	44	44
NO_x gram/ton-km	3.8	1.4	0.3	0.4
CO gram/ton-km	6.8	0.35	0.02	0.02
VOS gram/ton-km	1.54	0.24	0.01	0.02
SO_2 gram/ton-km	0.9	0.15	0.02	0.03
Particles gram/ton-km	0.7	0.08	0.01	0.03

Source: Van den Brink and Van Wee, 1997.

Multiple efforts have been made to express external effects of freight transport in financial terms, although in the literature no consensus exists (Geurs and Van Wee, 1997). Disagreement exists among other things on the way in which effects should be valued (e.g. traffic victims); apart from that, knowledge of particular types of external costs is incomplete. Estimations of congestion costs related to freight transport for instance are problematic. Usually, only time losses of drivers multiplied by a certain value-of-time are incorporated; costs that accrue to shippers such as higher pipeline inventory costs or costs in production due to unreliable deliveries are ignored (NEI, 1999: 50)[iv]. Nevertheless scientists agree that in sum transport produces more external costs than what is paid via taxes (see for instance Figure 1.3).

Figure 1.3: External costs and taxes paid in freight transport (in €-cent per ton-km)



Source: Bruinsma *et al.,* 2000, in AVV, 2000: 26.

Thus far much research in transport economics has been conducted on the measurement of external costs, the determination of optimal taxes that incorporate external costs, and implementation issues (e.g. Button, 1998; Johansson and Mattson, 1995; Verhoef, 1996). Only few studies have been conducted on the effects that internalization of external costs may bring about in transport and, related to that, the welfare consequences that may be envisaged. These studies have notably used modeling

techniques, in which freight transport however is seldom incorporated. There are also a few price elasticity studies, which aim to reveal the quantitative effects of changes in carrier rates on the demand for freight services or on the modal split (e.g. Geurs and Van Wee, 1997 and Oum *et al.,* 1990). The few estimates of price elasticity of freight transport demand that are available in the literature however usually do not differentiate between types of cargo or other relevant factors (Beuthe *et al.,* 2001: 253-254). Moreover, price elasticity research commonly provides little insight into the mechanisms that changes in transport costs induce on transport demand. Little is therefore known about inefficiencies in contemporary logistical decision-making and the effects that higher transport costs may have on business logistics.

Only recently have researchers started to systematically examine the relationship between logistical decision-making, freight transport, and transport costs (e.g. McKinnon and Forster, 2000a; Muilerman, 2001; NEI, 1999). The few available studies suggest that logistical cost trade-offs are fairly robust and that very large transport cost increases would be required to induce large changes to logistics structures and practices (e.g. Cooper *et al.,* 1994; McKinnon, 1998; TUB, 2001). An important reason is that transport costs usually represent only a small share in total costs (McKinnon, 1998: 107). Nevertheless, a survey in which manufacturers were asked how they would respond to a hypothetical 50 percent increase in transport costs as a consequence of full internalization of social and environmental costs, revealed that just over half of the respondents envisaged logistical modifications, including (McKinnon and Woodburn, 1996: 156):

- using alternative transport modes instead of road transport;
- restructure logistical operations (unspecified);
- improve efficiency of transport operations;
- contract out a larger proportion of their transport.

In addition, other studies have demonstrated that many unexploited opportunities exist to reduce the amount of kilometers driven, fuel consumption, or emissions, without affecting total costs or deteriorating performance (e.g. Kågeson, 1998; Michon and Hoppenbrouwers, 2000). Notwithstanding these studies, research in this field is still in its infancy and more fundamental research is required to assess which responses to higher transport costs are likely and to explore which types of firms are sensitive to higher transport costs and for what reasons[v].

1.3 The policy problem: negative effects of freight transport

The continuous increase in freight transport and the implications for congestion, noise, air pollution, and traffic victims are not only considered problematic from a theoretical perspective, but also from a policy perspective. The developments namely partly contradict transport policy objectives of EU and most of its Member States, in particular the goals of improved sustainability of economic activities[vi] and improved accessibility of the main transport axes in order to facilitate economic activity (e.g. Ministerie van Verkeer en Waterstaat, 1996, 1999; EC, 1998). Intermediate goals include[vii]:

- a modal shift: stimulate the use of transport modes which cause relatively few negative effects (e.g. rail transport or inland navigation) and discourage use of modes that cause much negative effects (e.g. road haulage and airfreight);
- reduction in the negative effects per vehicle kilometer or ton-kilometer, e.g. by stimulating technological innovations;
- a higher transport efficiency: increase load factors of trucks and reduce empty hauls;
- a reduction in the growth of freight transport relative to economic growth by among other things 'transport conservation': a less transport-intensive organization of logistical processes of shipping firms.

Governments seek to attain the above intermediate goals through a myriad of instruments, including subsidies (e.g. in infrastructure for modes of transportation that could serve as an alternative to road haulage); research and development (e.g. related to cleaner and less noisy engines); information; regulations (e.g. bans or restrictions on weekend driving or transit traffic); et cetera. In addition, an increased popularity can be observed among European governments to regulate developments in transport demand through taxation. Various governments for instance recently announced the introduction of new taxes on road transport (e.g. Austria, Germany, the Netherlands, and the United Kingdom). The European Commission aims at a full internalization of all external costs produced by transport (e.g. EC, 1998; 2001). Next to these new taxes, several governments plan to restructure existing tax regimes by replacing fixed, annual taxes by taxes that are related more to actual transport use. Due to technological advances, more flexible taxation regimes have become possible at low costs (Rietveld *et al.*, 2002: 93). Contrary to the past, most governments have become reluctant to expand road infrastructure networks, among other things due to high costs and the observation that it usually induces more transport and subsequently leads to more negative effects.

The above policy instruments partly are complementary but partly are contra-productive. For instance, measures that are aimed at improving the utilization of trucks may reduce transport demand, but on the other hand reduce a shipping firm's total transport costs, which subsequently may lead to more use of road transport. Other government policy outside the field of transport (e.g. labor regulations) may affect transport decisions by firms as well and with that, affect the effectiveness of transport policy. For instance, the Dutch prohibition to peel shrimps at residences a few years ago, caused a relocation of peeling of Dutch shrimps from the Netherlands to Morocco. This implied a substantial increase in transport flows. These and other examples illustrate the difficulties with which policy makers are faced since general policy goals such as 'a more sustainable economic organization' can be realized and are affected by many different, interacting, and sometimes contradictory instruments. Obviously, this complicates an analysis of the effectiveness of policy.

The brief discussion of transport policy reveals two differences between policy makers and economists:

- they have different objectives: economists focus on resource allocation and welfare only, whereas most governments have a broader perspective (including for instance equity concerns);
- they suggest or employ a different portfolio of instruments: transport policy is not only restricted to taxation, but a wider variety of instruments are used. Taxation plans however are partly based on the welfare economic principles of marginal social cost pricing (see e.g. EC, 1995, 1998, and 2001).

The theoretical and the policy perspectives on freight transport have in common the view that all costs caused by transport should be borne by those causing them and that this will have a positive impact on the use of transport resources.

1.4 Opposite trends in practice: a transport explosion?

The observed and expected continuation in the growth in freight transport is caused by a number of factors. One, freight transport growth reflects economic growth (GDP): the production of more goods simply implies that more goods have to be transported. Yet, economic growth appears to be not the only explanatory factor. For decades, economic growth and transport growth (expressed in ton-kilometers[viii]) were closely related, at least with respect to road freight transport, although a scientific explanation is largely lacking (Bus *et al.,* 1999a: 9; McKinnon and Woodburn, 1996: 142; Voordijk, Vieveen, and Bus, 1999: 113)[ix]. Since 10 or 15 years ago, in some European countries among which the Netherlands, growth rates of GDP and road transport have diverged, due to a faster growth of transport (NEI, 1999: 1). The main reason is that the average distance over which goods are moved has increased significantly (Banister *et al.,* 2000: 52; Bus *et al.,* 1999a: 37-41; Demkes, 1999: 7).

Empirical studies have demonstrated that increased average transport distances have emerged from a restructuring of production and distribution processes, including (Bus *et al.,* 1999a: 37-41; Demkes, 1999: 7; NEI, 1999: 42-45):

- a spatial concentration of production and inventories (i.e. 'centralization');
- vertical disintegration of firms; more activities are outsourced or relocated to low-cost countries;
- a wider geographical sourcing of supplies;
- a wider distribution of finished products.

Apart from that, transport demand has increased due to the application of time-compression principles in manufacturing and retail, leading to more frequent deliveries of smaller shipments (e.g. Muilerman, 2001).

Although there are also trends leading to a lower transport-intensity of the economy, such as de-materialization of products and the use of lighter materials, the dominant trend is that production and distribution as a whole have become more transport-intensive. Many goods are sent over larger distances, but changes in the management of transport operations have provided some compensation for the increased transport

demand. For instance, the use of larger vehicles has increased and empty running has been reduced (NEI, 1999: 15-33).

In practice therefore the de-coupling of freight transport growth from economic growth, as desired by policy makers, has not occurred; rather the trend is in the opposite direction. Modeling studies (e.g. AVV, 2000) as well as surveys among European shippers and carriers (e.g. A.T. Kearney, 1999: 7-16; McKinnon and Forster, 2000a) indicate that the growth in freight transport will only increase in future. An important reason is that the trend toward increasingly transport-intensive production and distribution is expected to continue. In addition, it is expected that the share of road haulage in total transport will only increase further (McKinnon and Forster, 2000a; Ministerie van Verkeer en Waterstaat, 1996). Thus, a reduction in the negative effects of transport by lower transport volumes will not emerge from market forces.

But where does the increased transport-intensity of economic activities originate from? Clearly not from transport in itself; freight transport does not have a utility of its own but creates utility via the activities it enables. Therefore, the demand for transport typically is a derived one (Kanafani, 1983: 14; Nijkamp, 2001: 158; Ruijgrok, 1999: 2). In this context, Kuipers *et al.* (2001) suggest that there are three types of factors that, in mutual interaction, contribute to changes in the transport-intensity of production and distribution activities:

- driving forces: factors that generate transport demand;
- enablers of increased transport use, e.g. the quality and cost of transport systems;
- barriers to transport use, e.g. trade barriers or congestion.

In the literature, several factors are generally listed as key factors that have contributed to the observed increase in transport-intensity. Usually, increased competition (e.g. due to the abolishment of trade barriers or deregulation) is regarded as the main driving force, forcing firms to reduce costs where possible and to broaden product assortments (Christopher, 1993: 21; Van Laarhoven, 1999: 7-8). Cost reductions are for instance achieved by relocating production activities to low cost countries and by outsourcing of non-core activities. The latter has obviously created a transport need that did not exist before. Another effect of increased competition is that firms compete more and more on logistical customer service: the speed and reliability with which they deliver their products (A.T. Kearney, 1999: 4-5). This has created increased time pressure on production and distribution activities, which is regarded to have led to a lower transport efficiency (e.g. Raad voor Verkeer en Waterstaat, 1999: 16).

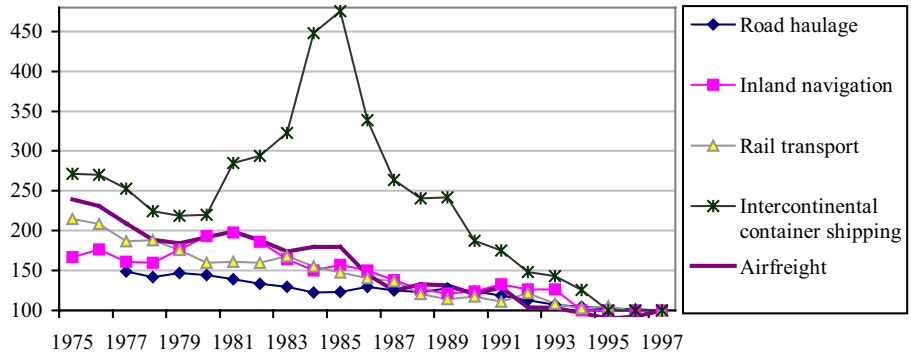
The literature mentions four factors that have enabled more transport-intensive operations[x]:

- lower trade barriers (e.g. due to the European unification in 1993) that have made larger geographical areas accessible for purchase and sales;
- technological innovations; internet and e-commerce have lowered transaction costs and have made larger geographical areas accessible (see above). Apart from that, computerization and automation of planning processes have enabled

further centralization (e.g. Enterprise Resource Planning (ERP) and Advanced Planning Systems (APS));

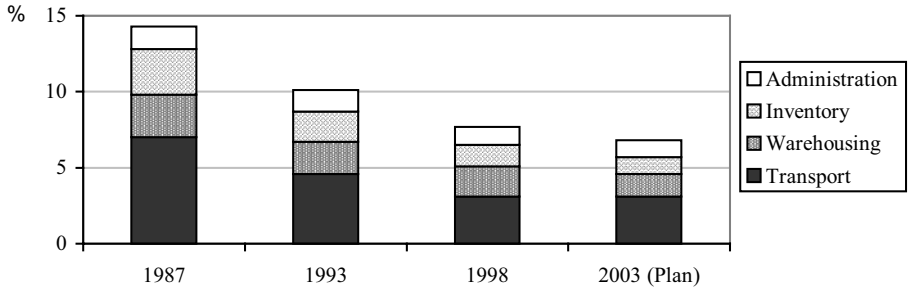
- falling absolute transport costs (i.e. per kilometer or per haul; see Figure 1.4). This is mainly caused by deregulation and technological innovations (e.g. increased containerization of cargo and improved vehicle design);
- falling relative transport costs: despite the increased transport-intensity of many sectors, the share of transport costs in total costs or turnover has fallen (see Figure 1.5). Their share in total logistics costs however has remained fairly constant (40-50 percent). The falling share of transport costs indicates that other production factors have increased in value (e.g. labor and capital costs).

Figure 1.4: Trends in freight rates (in indices; 1997 = 100)(*)(**)



Notes: (*): average rate per ton-kilometer[xi]; (**): peak in deep sea rates was mainly due to a high dollar exchange rate, affecting trade flows and demand for sea transport. Source: Dings, Metz, *et al.,* 1999.

Figure 1.5: Share of logistical costs in turnover



Source: A.T. Kearney, 1999: 16.

Since relatively and absolutely low transport costs have been an important enabler of a more transport-intensive organization of economic activities, policy interventions that aim to *raise* transport costs (such as those that were discussed in section 1.3) may make shipping firms more aware of transport costs. Recent case studies among freight

shipping sectors namely have revealed that at boardroom level, transport costs are hardly recognized when decisions are made that have transport implications (Bus *et al.,* 1999a: 60; McKinnon, 1998: 107). Higher transport costs could change this and could provide incentives for a less transport-intensive organization of production and distribution. Obviously it will not be the intention of policy makers to deteriorate the competitive position of firms by for instance reducing their exports. The main objective of a less intensive and more efficient use of transport resources is to reduce the negative effects produced by transport (cf. Cooper *et al.,* 1994: 283; Cooper *et al.,* 1998: 200; Dings, Metz, *et al.,* 1999: 16-17). The literature however suggests that transport cost increases will have to be rather large in order to provoke logistical adaptations (see section 1.2). Yet, if all external costs of freight transport are to be internalized through taxation, this will probably imply a substantial cost increase (see Figure 1.3).

1.5 Problem statement and research questions

Given the observation that theoretical and empirical knowledge on the potential effects of higher taxation of transport on logistical decision-making and freight transport demand is fairly limited, this topic is chosen as the main theme of this dissertation. Since a main driving force behind the growth in freight transport over the last decades appears to be a restructuring of the organization of production and distribution, this dissertation will focus on how higher transport costs may affect decisions on production and distribution. This implies that notably shippers' responses to an increase in transport cost will be assessed, although carriers' responses will not be ignored. The central research question is formulated as follows:

"How will an increase in transport costs affect
the organization of production and distribution of goods?"

This question is broken down into the following subsidiary research questions:

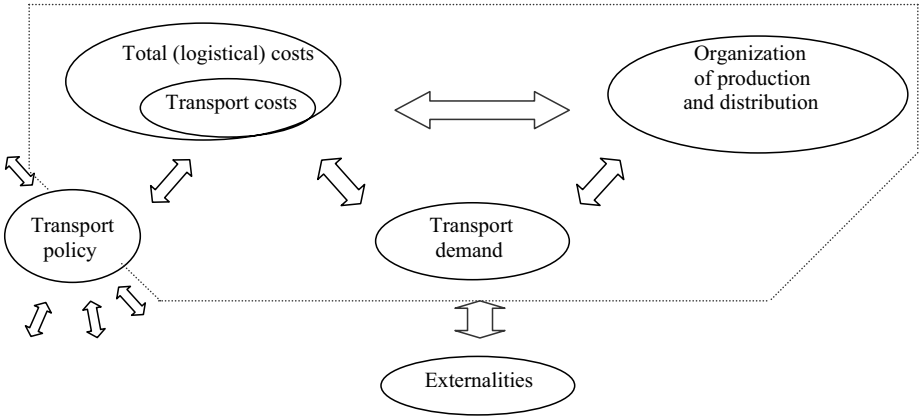
1. what dimensions of the organization of production and distribution affect the amount of transport that is used to deliver a product to its ultimate consumer?
2. what costs do shippers bear when moving their goods?
3. what role do transport costs play in decisions concerning the organization of production and distribution?
4. how can governments affect the costs of freight transport services?
5. what are likely logistical adaptations of shippers in response to higher transport costs, in particular related to the organization of production and distribution?

The product of the study will be a better understanding of the role of transport costs in decisions on the organization of production and distribution by means of empirical analysis. This will not only be a contribution to theory but also to transport policy making, since it can be considered an *ex ante* evaluation of higher taxation of transport.
Obviously, the study will have several limitations. One, no in-depth research will be undertaken into the relationship between logistical decision-making, transport demand, and the magnitude of externalities. The main reasons are that it does not seem necessary for the aim of this study whereas the level of externalities appears to be influenced by a

range of factors besides transport demand (e.g. type of vehicle used, location, and time of day). Two, although alleged allocative inefficiencies due to suboptimally priced transport is one of the theoretical starting points of this research, no in-depth analysis on the appearances of such inefficiencies will be conducted. These inefficiencies may be very difficult to trace (Blok *et al.,* 1992: 54-55) and therefore should be considered in another study. This study aims at achieving a better insight into the main logistical trade-offs involving transport costs, which may help subsequent research in getting an idea of where the allocative inefficiencies can be found. Three, the focus will be on the impact of a discrete set of policy interventions aimed at raising the cost of freight transport; no attempt will be made of evaluating current transport policy as a whole[xii]. Four, the empirical focus will be on Dutch firms that are involved in producing and distributing books and newspapers. Justifications for these and other methodological choices will be given in chapter 4.

The conceptual framework of the study is depicted by Figure 1.6, which also summarizes the scope of the dissertation. It shows that the study will center around three objects of analysis as well as on their interactions: transport costs (in the context of other costs), the organization of production and distribution, and freight transport demand. The dotted lines indicate the limitations of the study. Exogenous factors such as technology are left out of the model in order to reduce its complexity. The conceptual model is not new; in the field of passenger transport studies, Van Wee and Geurs (2002: 52) have proposed a similar model. Furthermore, the relationships between the demand for freight transport, the spatial and logistical organization of economic activities, and transport costs have been recognized before (e.g. Rietveld and Bruinsma, 1998: 48-49).

Figure 1.6: Conceptual framework of the study



The remainder of this dissertation is organized in three parts. Part II describes the theoretical framework of the study. Chapter 2 will elaborate on the relationships between the organization of production and distribution and traffic demand (i.e. research question 1). Chapter 3 will define transport costs, will provide explanations for

contemporary logistical decision-making, and finally will formulate hypotheses on likely adaptations in production and distribution due to higher transport costs (i.e. question 2, 3, and 5). The latter hypotheses will be tested in part III, dealing with the empirical part of this study. Chapter 4 will provide an overview and justification of general methodological choices. In chapter 5, a qualitative and quantitative assessment will be made of how governments may affect transport costs (question 4). In chapter 6, an analysis will be made of the organization of production and distribution of books and newspapers that are produced or sold in the Netherlands. An important element in the analysis will be a preliminary test and refinement of the hypothesized effects of transport cost increases on production and distribution. In chapter 7, the refined hypotheses will be tested by a survey among firms that are active in the production and distribution of books and newspapers, which will answer question 5. Finally, in part IV the findings of the study are synthesized.

[i] The typology only represents 'first-order external costs' that are directly caused by transport. 'Second-order costs', such as increasing emissions per vehicle-kilometer due to congestion, are excluded.

[ii] The Figure originally appeared in Transportation Research, part A: policy and practice (Elsevier Science). Reprinted with permission from Edward Elgar as well as Elsevier Science.

[iii] In the 1999 study by NEI, congestion caused by trucks was measured by the share of trucks in the total traffic on a congested motorway, whereby explicit attention was paid to the fact that the addition of a truck to a road network has a greater impact on speed and hence congestion than a car.

[iv] For a more detailed overview of methodological weaknesses of current estimations of congestion costs, see Hansen (2001).

[v] In this context, stated responses to a hypothesized increase in transport costs in more recent surveys showed significant intra- and inter-sectoral variations (McKinnon, 1998: 104-105; McKinnon and Forster, 2000a: 11).

[vi] The term 'sustainability' refers to policy choices that give priority to ecological objectives (Hey *et al.,* 1999: 173).

[vii] Although the most recent policy document of the Dutch ministry of transport (Ministerie van Verkeer en Waterstaat, 2001a) does not contain specific targets concerning modal shift or the volume of freight transport, guaranteeing the accessibility of economic centers, safety, and sustainability still are important policy goals. Therefore, the intermediate goals will continue to play a role in transport policy, although the emphasis on each of them may change.

[viii] Chapter 2 will discuss indicators of transport (growth) in more detail.

[ix] One reason why (road) transport volumes are not perfectly correlated with GDP is that the nature of the economy is constantly evolving. As a consequence the share of firms that make (heavy) use of transport (e.g. manufacturers) as opposed to those that do not (e.g. services) will not remain the same throughout time (NEI, 1999: 3).

[x] See for instance Bus *et al.,* 1999a: 37-43; Cooper *et al.,* 1998: 192-193; Demkes, 1999: 36; Dings, Metz, *et al.,* 1999: 8; McKinnon, 1998: 107; NEI, 1999: 21-22; Raad voor Verkeer en Waterstaat, 1999: 15-17; Vermunt and Binnekade, 2000: 11; Ruijgrok, 1999: 2-3; The Economist, 1997: 89-90.

[xi] The figures are based on total revenues and are not corrected for changes in turnover per market segment (e.g. general cargo versus more specialized services). Therefore the figures may contain some bias.

[xii] Neither will be examined how governments could or should use tax revenues; for this issue see for instance Verhoef (1996).

PART II: THEORETICAL FRAMEWORK

2 Transport effects of production and distribution activities

2.1 Introduction

This dissertation centers round the interrelations between the organization of production and distribution activities, freight transport demand, and transport costs. For analytical purposes, these interrelations are studied in separate chapters. The aim of this chapter is to operationalize 'the organization of production and distribution' by identifying the key dimensions that generate or affect freight transport demand. The expectation is that higher transport costs will notably have an impact on these dimensions of production and distribution.

The demand for freight transport typically is a derived one, and basically stems from the interaction among economic activities dispersed in space (Kanafani, 1983: 1). Hence the geographical pattern of production and distribution is an important determinant of transport demand. Yet, as was already observed in chapter 1, transport demand is also affected by a number of other factors that will be explored in this chapter.

The chapter is notably based on a review of the theory, but is complemented with findings from empirical research described in the literature. The analytical framework for this chapter is presented in section 2.2. Section 2.3 describes the first part of the analytical framework, which is concerned with transport operations and traffic flows. The impact of production and distribution activities on these two variables is discussed in section 2.4. Finally, in section 2.5 conclusions are drawn.

2.2 Analytical framework

Production, distribution, and transport are often conceptualized as *networks* of nodes and links (e.g. Bowersox *et al.*, 1986; Klapwijk, 1996, Tavasszy, 1996). The nodes are physical locations such as factories, distribution centers, and retail outlets, where goods undergo physical transformation (production), logistical transformation (consolidation, inventory), or transformation of ownership (sales). Nodes are linked by means of transport and communication.

Although this perspective positions freight transport in production and distribution activities, it does not reveal the causal mechanisms according to which freight transport demand is affected by these activities. Various analytical models have been proposed that focus explicitly on these relationships. They will be discussed below.

Layer models are frequently used in transport studies in order to analyze transport processes (e.g. De Wit and Van Gent, 1996: 13-14; Tavasszy, 1996: 10; Van der Heijden, 1997: 382-385). These models usually start from a given demand for transport services, which is derived from production and distribution activities. The focus then is on how this demand for transport services translates into the physical movement of goods. For this purpose, the transport system is subdivided into a number of functionally related layers (e.g. infrastructure services, traffic management, and the management of vehicles). Each layer typically represents a transformation process in which value is added to the next layer. Hence, the output of one layer is the input for the next layer. In-between the layers, often markets exist (Schaafsma *et al.,* 2001: 15)[i]. Although layer models unpack part of the total process in which transport demand is related to transport and traffic flows, no layer models are available that identify the specific factors at the level of production and distribution that determine or affect how much transport is needed to satisfy transport demand.

Another type of models are mathematical ones, in which freight transport is modeled in a rather uniform manner. First, a set of flows of goods within a given production and distribution system is identified. Second, these goods flows are allocated to modes of transportation and routes, resulting in traffic flows. Similar to the above described layer models, traditional models usually assume a given structure of production and a given demand for final products (Vickerman, 1999: 48). Hence, goods flows are not variable or only to a limited extent. This makes mathematical models less appropriate for the purpose of this chapter, since it does not reveal how changes in production and distribution patterns affect transport demand. In this context, more recent mathematical models, specifically designed for logistics and freight transport analysis, are more useful. In the SMILE model for instance, locations of plants, distribution centers, and sales markets are variable. The model distinguishes between a number of processes: transport operations (including route choice, modal choice, vehicle choice, et cetera), goods flow management (inventory management and shipment frequency), locations of distribution centers and factories, and sales of final products (Groothedde and Van Haselen, 1998).

McKinnon and Woodburn (1996) have proposed a more qualitative model. This model is largely based on a survey among shippers and carriers, aimed at exploring the main factors contributing to the recent growth in road freight transport in the UK[ii]. In this model, the amount of (road) freight traffic that is generated by a production and distribution network is affected by three variables: one, total volume of sales; two, the nature of the product (e.g. volume or weight); and three, a number of logistical factors:

- numbers, locations, and capacity of plants and distribution centers;
- locations and numbers of suppliers and customers[iii];

- scheduling of the product flow: e.g. the frequency with which orders are shipped, the required lead time, and delivery reliability;
- transport operations: the process in which individual orders or shipments are consolidated into loads and assigned to vehicles or other transport means.

Similar to mathematical models of freight transport, the first three logistical factors generate goods flows, consisting of individual orders that are sent with a particular frequency between the nodes in a network. The management of transport operations ultimately results in particular traffic flows, i.e. the physical movement of the product flow by trucks or other means of transportation. The model of McKinnon and Woodburn can be considered a sort of layer model, since all the above types of logistical factors are functionally related. The difference however is that not all layers represent transformation processes. The model consists of the same factors that are included in mathematical freight transport models. In contrast to these models, McKinnon and Woodburn state that causal, functional relationships between these factors are probabilistic rather than deterministic.

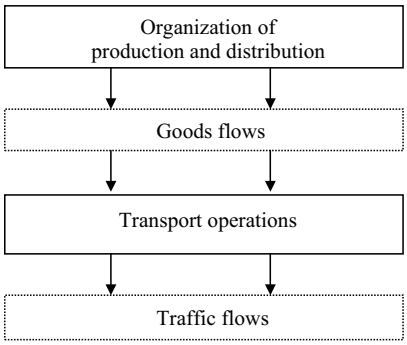
Finally, the logistical literature contains various analytical models that take the management and control of goods flows as the starting point. In this process, transport is only one activity; other activities include inventory-keeping and manufacturing[iv]. Analytical models used by logisticians usually distinguish between two components of the logistical process (Hoekstra and Romme, 1992: 63-71; KPMG, 1993: 15; Ruijgrok *et al.,* 1993: 3; Van Goor *et al.,* 1996: 85-101):

- 'logistical structures', which represent all the nodes in a production and distribution network, as well as their locations;
- 'logistical control concepts', i.e. the management of goods flows within the logistical structure. Relevant aspects are the locations where goods are kept in inventory, when and where value-adding processes are performed, and the frequency with which goods are shipped from one node to another.

The logistical service offered to customers can be regarded as part of the logistical control concept, as it relates to the speed, frequency, and reliability of deliveries. However it may also be regarded a distinct element of the logistical organization of production and distribution, because it is related to customer demand whereas logistical structures and logistical control concepts are supply-oriented.

The above analytical models reveal a repeating number of elements that have an impact on transport demand. Differences between the models are notably related to the classification of elements, which is obviously related to the purpose of the models. In this chapter, a relatively simple analytical framework is used that is based on models that were discussed above (see Figure 2.1).

Figure 2.1: Production, distribution, and transport: an analytical framework



The framework will be used to refine part of the relationships that exist between production, distribution, and freight transport. Distinction is made between the level of production and distribution activities where goods flows are generated, and the level of transport operations, where goods flows are converted into traffic flows. The goods flows, including characteristics such as shipment frequency, basically represent the transport demand; traffic flows are derived from this demand and are affected by the efficiency of transport operations. In line with logistics literature discussed above, three elements of the organization of production and distribution will be distinguished: logistical structures, logistical control concepts, and customer service.

The model has a number of restrictions. One, it only shows relationships in one direction, namely how the organization of production and distribution affects freight transport. Two, it does not include factors that affect the organization of production and distribution; these are examined in chapter 3. Three, the model does not include other factors that may affect the volume of traffic that results from moving a particular amount of goods (e.g. regulations regarding maximum vehicle weight). In this chapter, however, the relationships between the model variables will be illustrated with empirical studies that do take such exogenous factors into account. Four, in practice, production and distribution networks are constantly changing, involving changes that both reduce transport demand and enhance it (McKinnon and Woodburn, 1996: 147; Voordijk, Vieveen, and Bus, 1999: 115). The model therefore is notably suited to study the impact of single changes in production and distribution and is probabilistic rather than deterministic (cf. Muilerman, 2001: 163).

The model relationships will be specified in the following sections. First, the impact of transport operations on traffic flows is examined; subsequently the impact of the production and distribution organization on these variables is explored.

2.3 The impact of transport operations on traffic flows

Transport operations are concerned with (the organization of) the physical movement of shipments of goods. The transport layer models that were discussed in the previous section typically focus on this process and usually distinguish between various activities, including:

- the combination of shipments into loads (i.e. consolidation);
- decisions on which transport units will be used (e.g. containers or pallets);
- the choice for mode(s) of transportation or combinations of them;
- vehicle choice (i.e. type of vehicle and load capacity);
- the assignment of loads to vehicles;
- carrier choice (if part or all of the physical transport is outsourced);
- the acquisition of (return) cargo;
- routing and the organization of transport (e.g. direct haul or multi-drop);
- the scheduling of departure and arrival times.

These activities are usually made on a day-to-day basis; medium- and long-term decisions include for instance investment in new vehicles or investment decisions in new distribution centers. In practice, shipping firms increasingly tend to outsource the management of transport operations to commercial carriers (e.g. McKinnon and Woodburn, 2000a: 13; see also Table 2.1). Often, they still decide on modal choice.

Table 2.1: Commercial and own account road transport in the Netherlands (*)

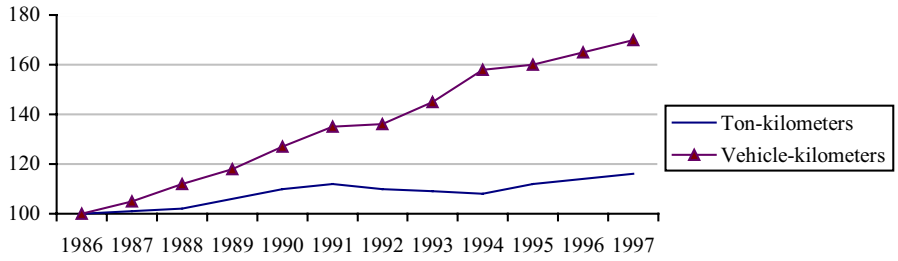
	1983		**1988**		**1993**		**1998**	
	Out-sourced	Own account	Out-sourced	Own account	Out-sourced	Own account	Out-sourced	Own account
Domestic	57%	43%	63%	37%	70%	30%	71%	29%
International	85%	15%	88%	12%	91%	9%	93%	7%

Note: (*): expressed in transported tons of freight. Source: CBS, 1995; 2001.

The output of transport operations are traffic flows. Traffic is usually operationalized as movements of transport means (trucks, vessels, et cetera). An alternative operationalization is the number of vehicle-kilometers produced by particular modes of transportation. Two important constituting elements of vehicle-kilometers are the number of vehicles that are used and the average distance covered[v].

The ratio of goods flows (i.e. ton-kilometers) to traffic performance however depends only in part on the efficiency of transport operations. This can be illustrated by means of trends in international freight transport on Dutch territory, depicted by Figure 2.2. The divergence of ton-kilometers and vehicle-kilometers appears to be mainly caused by an increased share of road transport in total freight transport. Due to lower load capacities of trucks compared to inland vessels or rail wagons, increased road use at the expense of other modes of transportation has raised the number of vehicles used and hence vehicle-kilometers driven (Banister *et al.,* 2000: 49; Muilerman, 2001: 181; Raad voor Verkeer en Waterstaat, 1999: 11).

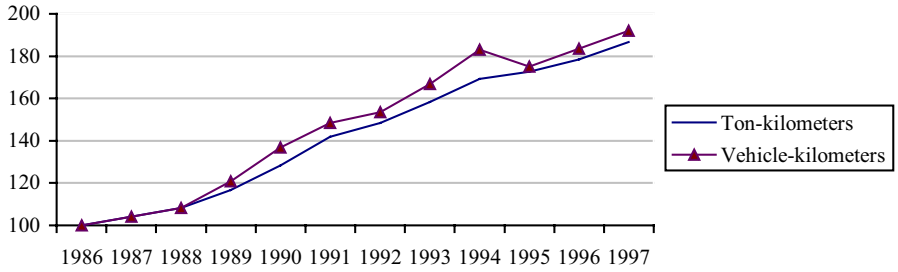
Figure 2.2: Trends in international freight transport on Dutch territory (all modes; 1986=100)



Source: Raad voor Verkeer en Waterstaat, 1999: 11.

A focus on individual modes of transportation reveals a different ratio of ton- to vehicle-kilometers. In international freight transport by road for instance the ratio is relatively stable, indicating that the efficiency of transport operations, expressed in for instance load factors, is not much subject to change (see Figure 2.3). Growth rates of vehicle-kilometers and ton-kilometers in contrast have diverged strongly in domestic freight transport by road (see Figure 2.4). This is largely explained by substitution of large trucks by smaller vans (TNO Inro, 2002). It should be noted that Figures 2.2, 2.3, and 2.4 represent macro-data. At firm-level the ratio of ton- to vehicle-kilometers is less stable, as will appear later in this chapter.

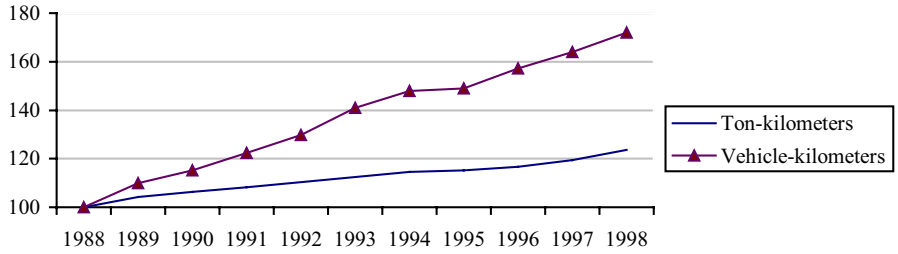
Figure 2.3: Trends in international road haulage on Dutch territory (1986=100)



Source: Raad voor Verkeer en Waterstaat, 1999: 10.

Transport operations affect the eventual 'traffic-intensity' of goods flows in various ways. The number of kilometers driven depends on locations of shipping and receiving firms, but also on routing, which can be influenced by carriers (e.g. by the organization of transport). The number of vehicles that are used, given a certain mode of transportation, depends among other things on the extent to which individual shipments can be consolidated, the ratio of average load size to average vehicle load capacity, the number of loads, and related to that, the number of drops per trip. Consolidation can be affected by various factors, e.g. by increased use of vehicle tracking and information systems (e.g. Anderson *et al.,* 1996) or by cargo exchange between carriers.

Figure 2.4: Trends in domestic road haulage on Dutch territory (1988=100)



Source: TNO Inro, 2002.

2.4 The impact of the organization of production and distribution on transport operations and traffic flows

Within the organization of production and distribution, three distinct areas are the logistical structure, the logistical control concept, and the customer service offered (see section 2.2). They affect transport demand and traffic-intensity of transport operations in many different ways. Below, the above three logistical areas are defined and their main effects on freight transport are discussed. Section 2.4.1 will describe the impact of logistical structures. The transport effects of logistical control concepts and customer service levels are comparable and will be discussed in section 2.4.2.

2.4.1 Impact of the logistical structure on transport and traffic

Theoretical impact

The logistical structure represents all the nodes in a production and distribution network, e.g. suppliers, distribution centers, plants, wholesalers, retailers, and final customers. The primary impact of the logistical structure on transport demand is related to the distances between these nodes, which in turn depends on the number of nodes and their locations. Transport distances may also affect modal choice; on short distances, road transport is usually the cheapest mode but on longer distances, rail transport and inland navigation are often cheaper. The main reason for these cost differences is that although per-kilometer costs of the latter modes are lower than those of road haulage, often additional costs have to be made for pickup and delivery by road and transshipments. Shippers and receivers namely usually have no direct connection to rail or inland waterways. Inland navigation and rail transport are commonly used on distances beyond 250 kilometers (e.g. Ruijgrok, 1999: 26; Van Nieuwenhuis, 2000: 9; Van Schijndel and Dinwoodie, 2000: 233-234)[vi]. Therefore, the availability and costs of alternative modes of transportation may be location-specific.

Transport volumes are affected by changes in the nature of the product flow between the nodes. Usually, the product flow undergoes significantly changes in the trajectory from raw material source to final customer. These changes may relate to the weight and

volume of products or the physical appearance of goods. Firms that desire to minimize the amount of transport therefore may choose to undertake weight and volume reducing activities in an early stage of the production process (e.g. at raw material sources). In addition, they may postpone activities that lead to an increase in product mass until the product arrives at points near the final customer (TUB, 2001: 38; Van de Ven and Ribbers, 1993: 72). The latter issue will be addressed also in section 2.4.2.

Empirical illustrations of the impact of logistical structures on freight transport

Various empirical studies have demonstrated that the configuration of logistical structures in many industries has become more transport-intensive (see chapter 1, section 1.4). International freight transport in Europe for instance has increased due to an increased geographical extension of operations, sourcing, and sales (e.g. Raad voor Verkeer en Waterstaat, 1999: 15-17; Voordijk, Vieveen, and Bus, 1999: 128). Apart from that, the ongoing centralization of factories and distribution centers is often cited as a source of higher transport-intensity (e.g. Kuipers, 2000: 12; NEI, 1999: 42-45; Voordijk, Vieveen, and Bus, 1999: 128). Centralization implies that the geographical area that is served from a single factory or distribution center is increased due to elimination of other factories or distribution centers or by increased specialization of factories ('focused plants'; Christopher, 1993: 123; NEI, 1999: 19). The effects of centralization on transport-intensity are not straightforward. On the one hand, average transport distances between distribution centers or factories and (final) customers increase due to the extended geographical area. Yet, in order to prevent transport operations to become less efficient, centralization is often combined with transshipment of goods on a few decentral locations. In this way, the goods flows between the centralized factory or distribution center and the decentral transshipment facilities can be consolidated and transported by means of large trucks or by alternative modes of transportation. In this way freight movements with small trucks for final distribution are reduced to short distances only (Demkes, 1999: 11; Kuipers *et al.,* 1995: 68-69; McKinnon and Woodburn, 1996: 152; NDL/BCI, 2001; Ruijgrok, 1999: 8; Van Doremalen, 1993: 14).

The example of centralization illustrates that the impact of changes in logistical structures on transport-intensity may be very situation-specific. It also indicates that the ratio of ton-kilometers to vehicle-kilometers may vary heavily between firms.

2.4.2 Impact of the logistical control concept and customer service on transport and traffic

Theoretical impact

The logistical control concept basically refers to the way in which goods flows are managed (cf. McKinnon and Woodburn, 1996: 149-150). With respect to transport operations and its efficiency in terms of the ratio of ton-kilometers to vehicle-kilometers, a number of characteristics of the goods flow are relevant.

One, the frequency with which shipments are shipped and the average shipment size affect opportunities to consolidate individual shipments. For instance, shipments can be shipped in a full-truck-load (FTL) or in multiple less-than-truckloads (LTL), which allows for a higher shipment frequency. In the case of LTL's, consolidation with other shipments may be required in order to maximize the vehicle's load capacity. Switching from FTL to LTL shipments generally increases traffic-intensity of transport operations, since carriers do not always succeed in finding enough other cargo in order to obtain full trucks. Another strategy could be that carriers adapt their vehicles to reduced shipment sizes. In this way the number of vehicle-kilometers still increases, since more vehicles are used to transport a given volume of freight. This strategy also raises total fuel consumption disproportionally, since trucks always need fuel to move their own weight (Cooper *et al.,* 1994: 280; Cooper *et al.,* 1998: 180). Finally, shipment size may affect modal choice; pallets for instance are generally not transported by rail or inland navigation, although experiments are conducted with pallet distribution by inland navigation ('Distrivaart').

Two, the availability of return cargo may improve the load factors of the vehicles that are used. Trucks that deliver goods to retailers for instance often take back packaging or empty pallets. In container transport by sea or rail, large volumes of empty containers are transported on return trips for repositioning purposes.

Three, the speed with which goods have to be transported (or the desired door-to-door lead time) affects the choice for transport modes (NEI/NEA, 1990: ii; Van Goor *et al.,* 1996: 307). In addition required speed may also affect consolidation opportunities; the higher the speed requirements, the less time is available to combine the shipment with other shipments. High time pressure also may reduce opportunities to combine inbound and outbound transport flows, as described above.

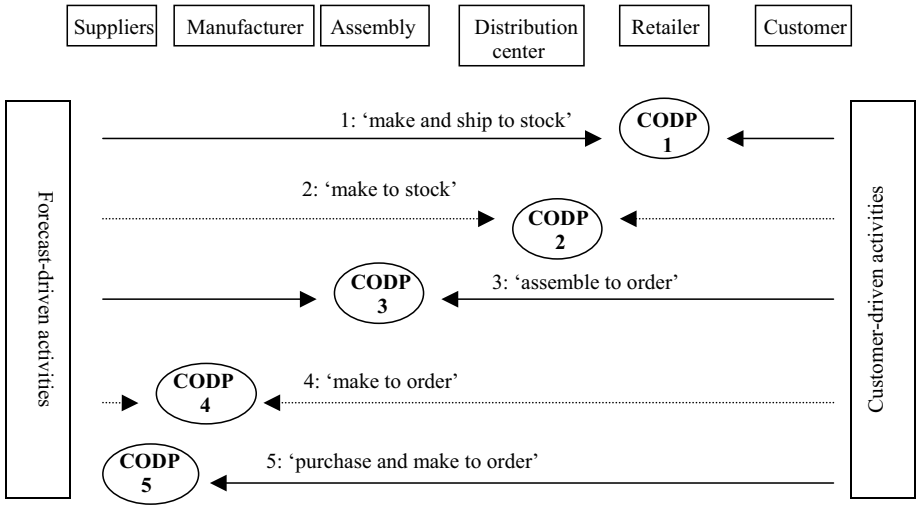
Four, the desired reliability of deliveries (i.e. the extent to which variations in time of delivery are accepted) may affect consolidation opportunities in the same way as the speed requirements. In addition it may affect modal choice, since rail transport in particular is often viewed as an unreliable transport mode (e.g. Demkes, 1999: 64).

Five, several product characteristics may affect the way in which goods have to be transported, including (Gerondeau, 1997: 42-48; Van Goor *et al.,* 1996: 53):

- physical appearance (solid, fluid, or gaseous) as well as the way in which goods are packaged (bulk, pallets, and containerized cargo). This affects the type of vehicles chosen and consolidation opportunities, since some goods can or may not be transported in the same vehicle;
- value density. Expensive goods usually have high opportunity costs and therefore require fast transport. In contrast, low-valued goods, in particular bulk goods such as iron ore, are relatively sensitive to transport costs and therefore are usually transported by slow but cheap modes (e.g. inland navigation);
- perishability of the goods in a physical sense (e.g. food) or commercial sense (e.g. newspapers). These characteristics also affect the required speed.

The above characteristics of goods flows are affected by various components of the logistical control concept. The frequency with which shipments are shipped, the number of shipments, and the average shipment sizes for instance are directly affected by the sizes of inventories held at the various organizations in the supply chain (Ruijgrok, 1991: 13-15; Tweddle *et al.,* 1998: 7). Firms may reduce inventory levels by demanding frequent replenishment deliveries of relatively small shipments instead of less frequent bulk deliveries. Shipment size is also affected by the position of the 'customer order decoupling point', which separates the part of the organization oriented towards customer orders from the part based on forecasts and planning (Hoekstra and Romme, 1992: 4-8; Van de Ven and Ribbers, 1993: 75). Usually five typical positions are distinguished (see Figure 2.5). Switching from production-to-stock to production-to-order generally results in lower shipment sizes.

Figure 2.5: Typical positions of the customer order decoupling point



Note: CODP: customer order decoupling point. Source: Hoekstra and Romme, 1992: 7.

Speed requirements are related to value density (see above), distances that have to be covered, and the logistical customer service that the firm offers (i.e. order lead times). The value of a product is not constant; during the production process value is added to the product in terms of form utility, place utility, time utility, and possession utility through marketing (Coyle *et al.,* 1996: 34-35). How value is added depends on the nature of the production process. Where in the process value is added is largely affected by the customer order decoupling point. For instance, in the case of production-to-order, product customization is postponed until the customer order is received. In this way also product perishability is reduced both in a physical and a commercial sense. As a consequence time pressure is relieved which may allow for more efficient transport operations.

The reliability of deliveries desired is among other things affected by inventory sizes at receiving firms (Kanafani, 1983: 290; Ruijgrok, 1991: 10). Reliable replenishment deliveries for instance are crucial to firms that have no or very low (safety) inventories; unreliable deliveries may otherwise cause distortions in production processes or even lead to lost sales. The required reliability of deliveries also depends on the customer service that the firm offers (Cooper *et al.,* 1998: 180).

Apart from the above characteristics of goods flows, the total volume of goods that are shipped or received has an impact on the efficiency with which transport operations may take place. Shippers of large quantities of goods obviously face more opportunities to combine shipments or to use large vehicles than small firms do.

The responsibility for transport operations can also be considered part of the logistical control concept. Shippers either perform own account transport or outsource transport to commercial carriers. The dominant trend however is that transport is outsourced. It is often claimed that outsourcing affects consolidation positively since carriers or logistical service providers collect shipments of multiple firms (Muilerman, 2001: 181). Table 2.2 confirms that outsourcing improves transport efficiency, although differences in load factors between own account and commercial road haulage are not extremely large.

Table 2.2: Efficiency of transport operations in domestic road haulage (1996)

	Commercial haulage	**Own account haulage**
Load factor – capacity (*)	61.4%	56.5%
Load factor – distance (**)	70.8%	67.3%
Overall utilization factor (***)	43.5%	38.0%

Notes: (*): extent to which load capacity is used during a loaded haul; (**): percentage of kilometers that are driven when loaded; (***): extent to which total capacity is used; calculated by multiplying the previous two factors. Source: AVV, 1998: 115-116.

Finally, the division of responsibilities concerning logistical control concepts may affect transport operations and traffic-intensity. For instance, throughout Europe, many large retailers have taken responsibility for the management of the goods flows from their suppliers to final customers. This has led to more efficient logistical processes, including a higher efficiency of transport operations (NEI, 1999: 21; see also Quarmby, 1989).

Concluding, the logistical control concept affects the characteristics of the goods flow in various ways, which in turn may have various effects on transport operations and traffic-intensity of production and distribution.

Empirical illustrations of the impact of logistical control concepts and customer service levels on freight transport

In practice, the relationships between logistical control concepts and traffic-intensity appear to be not always unambiguous. For instance, it is often claimed that the increased adoption of Just-in-Time (JIT) management has been a major cause of road traffic growth (e.g. KPMG, 1993: 3). A more frequent delivery of smaller orders and reduced

consolidation opportunities due to increased time pressure would have necessitated more vehicle movements. Empirical evidence however shows that over the last 15 years, average load factors rose although the JIT principle has been adopted widely. This may indicate that the transport sector has responded adequately (NEI, 1999: 21-22). Another possible explanation is that part of the additional shipments, created by a higher frequency of deliveries, is absorbed within existing transport operations by using previously unutilized load capacity. Still, it is unclear how load factors would have developed in the absence of increased JIT practices, since part of the observed increase in transport efficiency can be attributed to technological advances that have led to an improved planning of carriers (Bus *et al.,* 1999a: 41). Moreover, in particular industries, such as the Dutch food industry, the JIT principle has led to lower consolidation rates and more traffic (Muilerman, 2001: 180).

Another example is related to the reduction in inventories by shipping firms. One strategy is to demand more frequent replenishment deliveries in smaller quantities. The transport effects of this strategy were treated before. Another strategy, which may be followed simultaneously and which is often observed in practice, is to implement computerized planning and forecasting systems. These systems allow firms to reduce safety inventories, since they provide a better insight into the magnitude of sales compared to traditional planning based on historical sales (Beerens, 2001: 43). The resulting reduction in inventories may also reduce transport demand, since part of the movement of goods for safety considerations becomes redundant.

One of the reasons why the eventual impact of logistical control concepts on traffic-intensity is ambiguous, is that other studies revealed that logistical control concepts tend to develop in ways that have led both to more and to less traffic. In a recent survey among European shippers and carriers for instance, a tightening of customer service requirements was one of the most often mentioned factors generating additional traffic. At the same time however traffic growth was found to be tempered by a reduction in the number of suppliers, resulting in more consolidated goods flows (McKinnon and Forster, 2000a: 9-10).

Even the impact of a single change in the logistical control concept on transport-intensity may be difficult to assess *ex ante*. For instance, a switch to more overnight transport from manufacturers to retailers may affect consolidation rates in two ways (Muilerman, 2001: 181; 283):

- positively if one overnight haul replaces multiple deliveries during the day;
- negatively if distribution is organized in multi-client drops and not all customers are accessible overnight. Apart from that, probably less return cargo will be available at night.

2.5 Analysis and conclusions

The aim of this chapter was to identify the elements of production and distribution that generate or affect transport demand and traffic flows. For this purpose an analytical framework was used that distinguished between goods flows that are generated by production and distribution activities and traffic flows that result from transport operations. By means of a literature review the main factors that affect transport and traffic demand were revealed; they are summarized in Table 2.3. In this way, the variable 'organization of production and distribution' was operationalized for the purpose of this study. In the next chapter an analysis will be made of how transport costs affect the key factors that are summarized in Table 2.3.

Table 2.3: Key factors that affect transport demand and traffic flows generated by production and distribution activities

Logistical structure	Logistical control concept	Customer service
• number of nodes in the production and distribution network • locations of these nodes • nature of product and transformations during production (in terms of value density, volume, etc.)	• number and locations of inventories • inventory levels and frequency/size of replenishment orders • required reliability and lead time of deliveries • position of the customer order decoupling point • availability of return cargo • division of responsibilities for transport and logistics	• order/delivery lead time • frequency of deliveries • delivery reliability

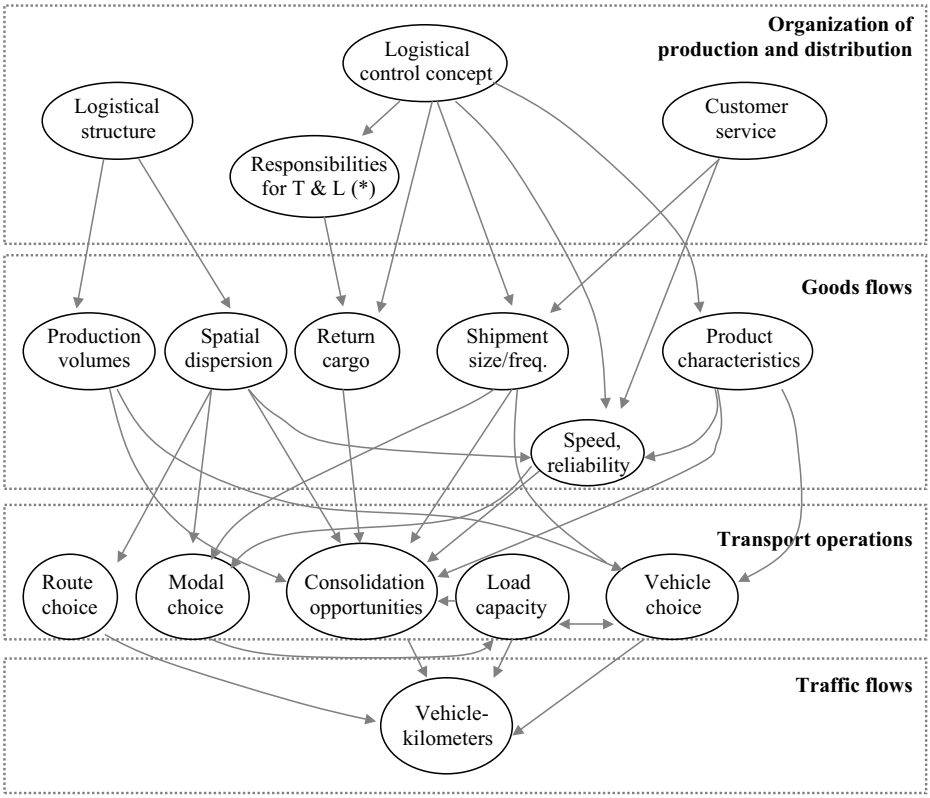
The mechanisms by which production and distribution activities affect transport demand and traffic flows are the following. One, transport distances, total weight/volume transported, and opportunities to consolidate shipments are important determinants of traffic volumes (expressed in vehicle-kilometers). Two, transport distances and total weight/volume transported depend on the structure and spatial configuration of the logistical structure (i.e. number of nodes in a production and distribution network and their locations). Three, consolidation opportunities are affected by a number of factors:

- the extent to which delivery addresses are dispersed in space. This is a characteristic of the logistical structure;
- the number of distribution centers or other nodes where shipments are consolidated, which is also a characteristic of the logistical structure;
- the fragmentation of the goods flow in size and in time, i.e. the number of shipments a goods flow consists of. This characteristic is affected by inventory policy and the position of the customer order decoupling point, as well as the customer service offered (i.e. shipment frequency);
- time pressure, which can be conceptualized as the maximum period in which shipments are allowed to 'wait' at distribution centers or other nodes. Time pressure is narrowly related to the desired speed or door-to-door lead time and delivery reliability of individual shipments, which in turn are related to product value and perishability, inventory policy, the position of the customer order decoupling point, and customer service levels.

Finally, modal choice is affected by the desired speed and reliability of delivery, as well as the spatial configuration of the production and distribution network.

Figure 2.6 depicts the above mechanisms. The Figure can be considered as a specification of both the analytical framework developed in section 2.2 and the overall conceptual framework of this study developed in chapter 1. The Figure only depicts one-way relationships because its goal is to demonstrate how changes at the level of production and distribution eventually might affect the amount of vehicle-kilometers. In practice various two-way relationships will exist between the variables; for instance some firms will try to minimize transport costs by increasing consolidation opportunities, among other things by offering large shipments or return cargo to their carriers. In view of its purpose, the Figure neither includes exogenous factors that have an impact on the organization of production and distribution or on other factors (e.g. customer demands or economic growth).

Figure 2.6: Main mechanisms by which production and distribution activities affect transport demand and traffic flows



Note: (*): T & L: transport and logistics.

In addition it should be noted that the identified mechanisms reflect *ceteris paribus* relationships; in practice changes at the level of production and distribution may reveal different effects on freight transport demand and traffic performance. There are a number of reasons. One, in the organization of production and distribution often many changes occur simultaneously, some of which may increase transport demand whereas others reduce it. Two, changes in production and distribution may be coupled with changes in the management of transport operations, whether or not as a direct consequence. Three, increased transport demand due to for instance a higher frequency of deliveries or longer transport distances does not automatically lead to more vehicle-kilometers. In some situations unutilized load capacity may be used. However if the amount of ton-kilometers increases (due to more freight volumes or longer distances) but total vehicle-kilometers remain constant, negative effects of freight transport may still increase. The reason is that always fuel is needed to move weight and many external effects such as CO_2-emissions are related to fuel consumption. Concluding, the ultimate effect of changes in the organization of production and distribution on the amount of vehicle-kilometers driven will depend on the relative strength of multiple effects, and is likely to be situation-specific.

In the empirical part of this dissertation, the framework depicted by Figure 2.5 will be used to identify the impact of changes in production and distribution on freight transport demand. The framework however will not be formally validated. For more detailed studies into the impact of production and distribution on transport demand, see for instance Muilerman (2001).

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[i] For a recent overview of transport layer models, see Schaafsma *et al.* (2001).

[ii] The model of McKinnon and Woodburn (1996) was also used in the empirical studies referred to in section 1.4.

[iii] Origin-destination relations (e.g. which customer is served from which plant) are implicitly assumed in the first two logistical factors.

[iv] Logistics management focuses explicitly on "that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements" (CLM, 2000).

[v] Regarding external effects, vehicle type, fuel type, et cetera are also relevant characteristics of traffic flows (Rietveld *et al.,* 2002: 94).

[vi] For instance, the break-even point for intercontinental containers is usually at 200 kilometers for rail, 100 kilometers for inland navigation, and 500 for short sea shipping. For continental containers, break-even points are usually found at distances beyond 400, 250, and 650 kilometers respectively. The reason why for intercontinental containers, break-even points are attained at shorter distances is that containers are already at sea terminals, removing the need for additional collection (Ruijgrok, 1999: 26; Van Schijndel and Dinwoodie, 2000: 233-234).

3 Transport costs and the organization of production and distribution

3.1 Introduction

The previous chapter explored the transport effects of production and distribution activities. The way in which these activities typically are organized was largely ignored, although some of the contemporary logistical trends were used in order to illustrate their effects on transport demand. This chapter explores how production and distribution are generally organized and for what reasons, and how (increases in) transport costs affect this organization. In particular attention is paid to those dimensions of the production and distribution organization that have an impact on transport demand, and that were discussed in chapter 2.

Various theoretical frameworks exist that can be used to study the organization of production and distribution. Some focus on specific elements of production and distribution networks (e.g. location theory) whereas logistics theory employs a broader perspective. In this chapter the latter discipline is chosen as theoretical starting point because the focus is on the whole organization of production and distribution, rather than specific elements.

The chapter is organized as follows. In section 3.2, transport costs are defined, providing the foundation for the exploration of their role in contemporary logistical decision-making. Section 3.3 provides a brief overview of the historical developments in logistics management, revealing a number of successive dominant paradigms. The supply chain management paradigm, which has evolved from previous paradigms and that is dominant in contemporary logistics, is discussed in section 3.4. Issues include its implications for the organization of production and distribution and the importance of freight transport and transport costs. In section 3.5, the usefulness of the supply chain management paradigm in light of this study is critically evaluated. In section 3.6 the supply chain management paradigm is enriched with insights from other theories to fill in gaps that are found. In section 3.7, conclusions are drawn and hypotheses are formulated.

3.2 The cost of freight transportation to shipping firms

To shipping firms, overcoming space may cause various types of costs. One type of costs is the price that has to be paid to transport service providers such as carriers (physical movement), forwarders and shipbrokers (transport intermediation, customs, insurance), stevedores (transshipment), and port authorities (pilotage fees, general port fees) (Peeters *et al.,* 1999: 8-11). Carrier rates depend on a variety of factors, including mode of transportation, distance, shipment size, and the availability of return cargo (Bowersox and Closs, 1996: 365-369). Shipment size is important, as prices per ton for e.g. less-than-truckload (LTL) are usually higher than prices for full-truck-loads (FTL) because (Johnson and Wood, 1996: 461):

- trucks have lower load factors and hence the fixed costs of administration, pickup, and delivery are spread over a smaller volume;
- carriers have to consolidate LTL's, which results in additional handling.

Carrier rates are generally based on the operating costs of carriers but also on other considerations. One, prices are sometimes set at perceived shipper value (Bowersox and Closs, 1996: 369; De Wit and Van Gent, 1996: 103-106). Two, in particular in long-term contracts often flat rates are agreed upon (e.g. per pallet or full-truck-load), which are in part independent of distance or weight. This pricing strategy is advantageous to both carriers and shippers, as it lowers administrative costs. Three, back-haul rates are often priced below costs, because the alternative is an empty haul and these costs cannot always be charged to the original shipper[i]. Four, in road haulage and inland navigation, prices often do not cover all operational costs. This is caused by a combination of fierce competition and over-capacity which keeps prices low, inadequate insight into real operating costs of notably small firms, and a tendency of self-employed truckers and bargemen to calculate not all working hours (e.g. Runhaar and Van Reeven, 1997: 9). Five, large shippers often are able to negotiate significantly lower rates than small shippers, which is related to market power and to the fact that large volumes of shipments often allow for more efficient transport operations (see section 2.4.2). Finally, carrier rates often vary heavily in space and time (see also chapter 5).

It should be noted that shippers' perception of transport costs depends also on the division of transport responsibilities between shipping and receiving firms (Tweddle *et al.,* 1998: 1-4). In the case of 'cost, insurance, and freight' deliveries (CIF), suppliers are responsible for the delivery of goods. In this context, often uniform product prices are employed within certain geographical areas, which implies some form of cross-subsidization since actual transport costs may vary depending on the locations of receivers. In the case of 'free on board' delivery (FOB), products are sold without the inclusion of delivery costs and transport has to be organized by the suppliers' customer.

Apart from carrier rates, shippers often face other costs related to freight transportation. The door-to-door lead time of transport for instance affects the interest costs of goods in transit. When these costs are taken into consideration, the mode of transportation with the highest carrier rates may not always be the most expensive mode from a broader logistical cost perspective (see Table 3.1 for an illustration).

Table 3.1: Comparison of carrier rates and costs related to transit times for three alternative modes of transportation (Rotterdam-Milan)

	Road	Rail	Short sea
Carrier rates	€ 1,270	€ 680	€ 1,135
Door-to-door transit time	2 days	4 days	7 days
*Interest costs 0.005%/day**			
• 1 container load with a value of € 25,000	€ 250	€ 500	€ 875
• 1 container load with a value of € 50,000	€ 500	€ 1,000	€ 1,750
• 1 container load with a value of € 100,000	€ 1,000	€ 2,000	€ 3,500
Total cost			
• 1 container load with a value of € 25,000	€ 1,520	€ 1,180	€ 2,010
• 1 container load with a value of € 50,000	€ 1,770	€ 1,680	€ 2,885
• 1 container load with a value of € 100,000	€ 2,270	€ 2,680	€ 4,635

Note: (*): based on an annual interest rate of 6%. Underlined figures indicate the cheapest mode per row. Source: rates and transit times: Kuit, 2000: 43.

Transit times also have an impact on costs in the case of goods with a high 'time and place utility', such as spare parts for machines or computers that only start to earn rentals after they are delivered (Goss, 1991: 182; McKinsey, 1967: 81). Apart from that, transit times are important when shippers aim at reducing order lead times in order to gain advantages, summarized in Table 3.2. To these firms, longer transit times may lead to customer dissatisfaction, which may result in lost sales. In the case of physically or commercially perishable goods, longer transit times may finally lead to a loss in product value or lost sales (Goss, 1991: 182; Gunasekaran *et al.,* 1996: 112). The various types of costs related to transit times are not of equal importance to shippers; interest costs of freight in transit for instance depend on the value density of the product. Therefore it is not possible to identify one general 'value-of-time' for shippers (Tavasszy *et al.,* 2002).

Table 3.2: Advantages of time compression

Time compression feature	Benefit	Financial value
Customer service	• customer loyalty and retention	• gross margin/price protection
Customer responsiveness	• reduce lost sales • conquest sales	• sales growth with existing assets (higher return on assets)
Balance between supply and demand	• lower inventory wastage or write-offs • manufacturing effective	• net margin improvement • lower unit costs
Inventory levels	• less working capital employed in inventory	• improved cash flow

Source: Bumstead, 1998: 159.

A third way in which freight transport may cause costs to shippers is through the reliability of deliveries. Reliability refers to the extent to which actual arrival differs from scheduled arrival time. Unreliable deliveries of raw materials for instance may distort production processes, in particular in the case of JIT production. These so-called scheduling costs depend among other things on congestion levels and the quality of

transport services provided by carriers[ii,iii]. Unreliable transport systems may also lead to forgone sales (see above). Costs due to unreliable transport services will vary heavily in importance among firms. It is likely however that producing firms will notably be confronted with scheduling costs, whereas to retailers, forgone sales are more important.

Regarding both transit times and reliability of deliveries, shippers may avoid or mitigate the negative effects related to structural longer transit times or reduced reliability by compensatory measures, including a higher frequency of shipments (creating more in-transit inventory), higher safety inventories, or adaptations in the organization of production and distribution. Expenditures on these measures could be considered indirect costs of longer transit times of reduced delivery reliability.

Concluding, multiple types of costs may be related to moving goods apart from carrier rates. Since shippers often consider all these costs in transport decisions, in the literature it has become practice to focus on the 'generalized' transport costs in analyses of transport demand (e.g. Goss, 1991: 181; Kanafani, 1983: 13)[iv]. In modal choice for instance, road transport usually is perceived as offering the best price/quality performance (see Table 3.3)[v]. In the remainder of this study, therefore the generalized cost concept is adopted.

Table 3.3: Image comparison of transport modes (*)

Characteristics	**Road**	**Rail**	**Inland navigation**
Reasonable prices	1.9	2.9	1.7
Reliability (**)	1.6	2.7	2.1
Punctuality (**)	1.7	2.5	2.5
Service	1.7	3.1	2.6
Flexibility (***)	1.2	3.7	3.4
Speed	1.3	3.4	4.1
Total	1.6	3.1	2.7

Note: (*): 1 (very good) … 6 (deficient); (**): reliability and punctuality are not defined. Punctuality often refers to actual arrival time compared to the scheduled time (i.e. reliability in this dissertation) whereas reliability means arrival at the correct place, without damage of the goods (Van Schijndel and Dinwoodie, 2000: 234-236); (***): flexibility is not operationalized either, but is often referred to as the number of addresses that can be reached as well as the extent to which transport services have to be planned in advance. Source: EBD *et al.,*1998, in Demkes, 1999: 64.

The role of generalized transport costs can only be understood by a knowledge of leading principles in modern logistics management. In the introduction it was already noted that these principles have not been constant over the last decades. The next section contains a brief overview of paradigms that have been dominant in logistics management. In this perspective the paradigm that is currently dominant can be understood better. In addition, as will appear later in this chapter, the supply chain management paradigm is not able to explain logistics management in every industry. Some industries still seem to be 'stuck' in old logistical paradigms.

3.3 Logistics management: evolution of practice and theory

Logistics as a scientific discipline is relatively young, which is caused by the fact that logistics practice only has emerged in the mid 1950s (e.g. Bowersox *et al.,* 1986: 5). Prior to 1950, the typical firm treated the process of purchasing, inventory, production planning, and final distribution on a fragmentary basis. Firms did not focus on goods flows through the enterprise as a whole but rather on individual activities and processes. Yet, as from the mid 1950s, firms became more aware of the interrelations between the various activities. Reasons are the introduction of computers and quantitative techniques that allowed for more coordinated processes, and increased competition that squeezed profits (Bowersox *et al.,* 1986: 5-6; Sharman, 1984: 71-79). In the 1960s and 1970s firms came to realize that cost reductions could be realized when the scope of attention was shifted from individual activities to the broader process of which these activities were part. Distribution of finished goods to customers for instance appeared to involve more than only the cost of transportation. By spending more on transport, total distribution costs could be reduced, e.g. if the number of warehouses was reduced (Lewis *et al.,* 1965). It took several years before these concepts became accepted, among other things because it was not common to evaluate the full costs of for instance inventories. This obviously weakened the argument for raising transport costs in favor of previously unrecognized costs (Bowersox *et al.,* 1986: 10).

In the 1960s and 1970s, integration of logistical activities started. By the 1980s most US and European firms had organized their logistical activities in a number of more comprehensive processes, including materials management (focused on purchasing and inventories of raw materials) and physical distribution (A.T. Kearney, 1999: 6; TUB, 2001: 7-9). This was also reflected in logistical textbooks that were published in this period (e.g. Tersine, 1988). Logistics became institutionalized within the organizational structures of firms. Factors that stimulated logistical awareness and integration in this period included the fuel crisis, growing ecological concerns, and the economic recession (Bowersox *et al.,* 1986: 11-12).

As from the 1980s, firms started integrating physical distribution, production activities, and materials management, stimulated by an increasing awareness of trade-offs and interrelationships between these processes (A.T. Kearney, 1992: 3)[vi]. Postponement of final product assembly for instance was found to reduce inventory risks and increase overall flexibility. Transport deregulation (lowering transport unit costs), micro computer technologies (enabling optimization of Economic Order Quantities), and the communication revolution (e.g. enabling tracking-and-tracing as well as EDI connections between firms) pushed logistical integration further in this period (Bowersox *et al.,* 1986: 12-14). Another driving force came from the automotive industry, where purchasing and production were integrated in Just-in-Time (JIT) practices (A.T. Kearney, 1999: 6). Many firms in other industries imitated this successful concept (Cooper *et al.,* 1994: 281; Cox, 1999: 167; NEI, 1999: 21-22).

In the 1990s, logistical processes within a large number of firms were integrated with the related functional areas of marketing and production (TUB, 2001: 7-9). In addition,

in this period the idea became widespread that firms could be able to gain competitive advantage by distinguishing themselves by the customer service they offered to their customers. Logistics more and more became considered of strategic importance (Bertrand and Van Harten, 1999: 4-5; Christopher, 1993: 13; NRC, 2000: 1), which led to the representation of logistics at board level in many firms (TUB, 2001: 7-9).

More recently, many firms have begun to realize that logistics management does not stop at the firm's borders. Rather than that competition takes place between individual firms operating in the same market segments, it has become clear that competition takes place between supply chains. The paradigm in contemporary logistics therefore is, not surprisingly, referred to as 'supply chain management' (SCM). The logistical process is viewed as a coherent system in which constituting elements such as the network of facilities (factories, warehouses, and retail stores), forecasting and order management, transport, inventories, and warehousing and packaging, are combined and co-ordinated in order to optimize total logistical performance (cf. Bowersox *et al.,* 1986: 20-21). Typically, modern logistics management centers round individual customer orders; this explains why SCM is sometimes denoted 'demand chain management' (Blackwell and Blackwell, 1999; Kuipers *et al.,* 2001: 13)[vii]. Retailers who started integrating retail, replenishment delivery, and production activities (e.g. materialized in Efficient Consumer Response) initiated SCM.

The brief discussion of the evolution in logistics management reveals an increased professionalization over the last decades, resulting in an increased integration of logistical activities within firms and, more recently, between firms[viii]. This process has been driven by the desire to reduce costs but also by marketing considerations, although inventory minimization is frequently viewed as one of the main drivers (TUB, 2001: 7-9). The developments in communications and transport, imitation of best practices such as JIT, the trends of increasing competition and stronger market positions of customers are regarded as factors that will push logistical integration only further in future (e.g. A.T. Kearney, 1999: 4; Bovet and Sheffi, 1998).

In the next sections, the current paradigm, i.e. SCM, will be elaborated in order to find explanations for the way in which production and distribution are currently organized and for the role of (changes in) transport costs on this organization.

3.4 The supply chain management paradigm

3.4.1 Characteristics of supply chain management

The SCM paradigm starts from the assumption that logistical processes are organized and integrated at the level of supply chains rather than at firm-level. In this context, supply chains can be defined as "the sequential flow of logistical, conversion, and service activities from vendors to final consumers necessary to produce a product or service efficiently and effectively" (Coyle *et al.,* 1996: 9). SCM involves coordination of activities of participants in the supply chain in order to serve customers 'optimally', involving prompt and reliable delivery at minimal costs (Van der Veen, 1998: 1). In

contrast to the past when logistical and production processes of individual firms were optimized, SCM means that the supply chain as a whole is optimized. As a result, total value added through the supply chain is enlarged including profits of each stakeholder.
In the logistics literature, the rise of SCM has notably been explained by three factors (Cox, 1999: 167; Demkes, 1999: 71; Laarhoven, 1999: 7-8; Schipper, 1997: 26; Voordijk, 1994: 34-37):

1. competition has increased in many markets, due to liberalization and deregulation (e.g. the European Single Market). As a result market power has shifted from producers to final consumers, the consequences of which will be discussed below;
2. technological progress in information and communication, production, and transport have allowed further internationalization of firms and the use of new logistical systems and concepts (e.g. enterprise resource planning systems (ERP), simulation-based planning systems, and internet-based shared inventory information systems);
3. replication of Toyota's successful control of its supply chain has contributed to the increased popularity of SCM.

Increased competition in many markets has led to a gradual shift in market power from producers to retailers and final consumers. Many producers as a result have been forced to broaden their product assortment and adapt products more to the needs of individual customers (product differentiation or 'mass-customization') (Voordijk, Vieveen, and Bus, 1999: 121). In addition demands regarding order lead times and delivery reliability have increased (Laarhoven, 1999: 7-8). Many firms have faced decreasing product life cycles (see e.g. Table 3.4) and a demand that has become increasingly difficult to predict (Christopher, 1993: 21). Traditional production techniques of mass production of a few product types, aimed at the realization of economies of scale, have therefore become inadequate. Apart from marketing considerations, this is caused by the fact that large inventories, which are typically related to mass production, increasingly run the risk of obsolescence and simply have become too expensive (Van der Veen, 1998: 4; Voordijk, 1994: 34-37).

Table 3.4: Average product life cycles of several products (in years)

	1960	**1980**	**1990**	**1996**
Televisions	5-10	3-5	1-4	1-3
Stereo equipment	4-6	2-3	< 1	< 1
Video cameras	3-5	1-2	1-1.5	(unknown)

Source: Van Breukelen *et al.,* 1998, in: De Koster, 1998: 10.

Firms have generally responded to the new market conditions in three related ways. One, firms have tried to reduce competition by distinguishing their products from those of their competitors (Cox, 1999: 168). One way is to compete on customer service, e.g. improving speed and reliability of deliveries ('time-based competition'; see for instance Muilerman, 2001). Two, firms have tended to focus on core competencies, i.e. those capabilities that are difficult to imitate and that are expected to offer firms a long-term

competitive position (De Wit *et al.,* 1998: 24-25; Prahalad and Hamel, 1990: 81). The result is an increase in outsourcing and hence an increase in the number of organizations that are involved in the production and distribution network. Three, firms have tried to increase flexibility of production. Rather than predicting demand, firms wait for customer orders and respond fast and efficient (Van der Veen, 1998: 4-5). Customers however are often willing to buy products of competitors if their first choice is not instantly available. Fast response is therefore crucial in order to avoid lost sales. Overall, time has become a critical factor in contemporary logistics (Christopher, 1993: 17-18), which is illustrated by Table 3.5.

Table 3.5: Average order lead times of European manufacturers, wholesalers, and retailers

	1987	**1993**	**1998**	**2003 (plan)**
Number of days	27	18	12	9

Source: A.T. Kearney, 1999: 16.

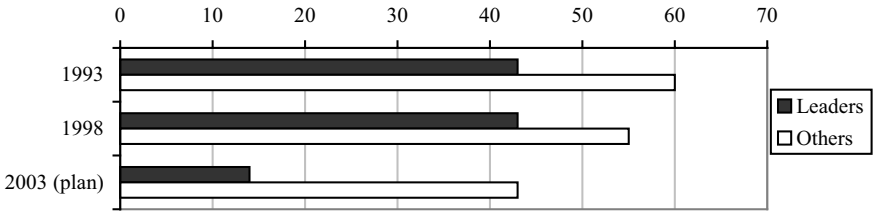
As a result of the above strategies, firms have realized that co-operation with other participants within the supply chain is a prerequisite for responsive action and survival. Rather than between individual firms, competition has begun to take place between supply chains. This has called for an integration of business processes between firms (Christopher, 1993: 14; Cox, 1999: 168). One implication is that relationships between supply chain participants have to be close, collaborative, reciprocal, and trusting rather than competitive. This clearly requires a switch in thinking since traditionally actors assumed that the profit of one goes at the expense of the other (Van der Veen, 1998: 2-4). Co-operation may take many forms, including information exchange about sales forecasts or production planning, and openness in operations and finance (Blackwell and Blackwell, 1999; Van der Veen, 1998: 2-4).

3.4.2 Supply chain management and the organization of production and distribution

In the ideal SCM model, production focuses on individual customer orders, takes place just-in-time, and concentrates only on those actions that create value. Waste in operational processes, such as overproduction and waiting, is eliminated. Inventories are avoided in order to minimize interest costs and maximize capital productivity (see Figure 3.1)[ix]. The latter characteristic of SCM implies a radical change in logistics management, since traditionally inventories are considered an important balancing mechanism: they may prevent lost sales and distortions in (mass) production due to unreliable delivery of inputs. Currently inventories are regarded as a balancing mechanism of last resort (Christopher, 1993: 13). Ideally, goods in transit are the only inventories left (Bhatnagar and Viswanathan, 2000: 32).

The SCM paradigm can be used to describe and explain the main trends vis-à-vis the organization of production and distribution. Below, these trends will be treated in relation to logistical structures, logistical control concepts, and customer service levels.

Figure 3.1: Finished goods inventory (in days)



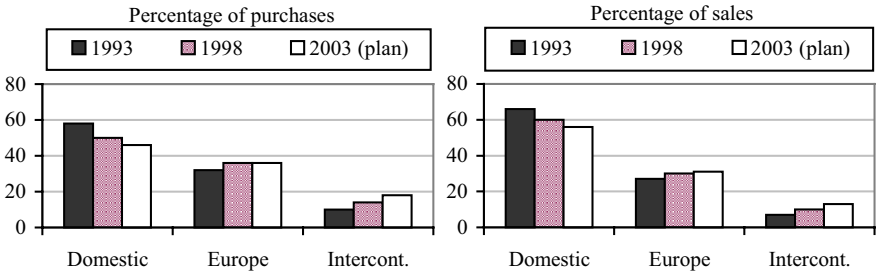
Note: leaders: the 10 percent companies in an industry that are considered to have a leading position regarding SCM. Source: A.T. Kearney, 1999: 28.

SCM and logistical structures

The trend toward centralization of production was already discussed in chapter 2. The main argument for centralization is the desire to increase flexibility, i.e. fast response to changes in demand, without losing economies of scale in production. Centralized production however is gradually being replaced by more decentral production and distribution (NDL/BCI, 2001; Kuipers *et al.,* 2001; Ruijgrok *et al.,* 2002; Vermunt and Binnekade, 2000). This is explained by further flexibilization; plants produce broader product assortments in smaller batches for smaller geographical areas whereas decentral inventories allow for fast supply (Ruijgrok, 1999: 9).

With respect to supplier networks three trends are observed (Demkes *et al.,* 1999: 3; Stabenau, 1996: 12; Van Vliet, 1996: 52). One, increasing outsourcing has led to more suppliers. Two, in order to create 'lean' and demand-driven logistical processes, manufacturers often have chosen to co-operate with a few suppliers and hence have reduced their supplier base (Berry *et al.,* 1994: 20; Cox, 1999: 167-168). Three, there is a trend toward increased sourcing outside Western Europe (see Figure 3.2), which is enabled by a reduction in trade barriers and a fall in transport costs (see chapter 1).

Figure 3.2: Domestic, regional, and intercontinental purchases and sales



Source: A.T. Kearney, 1999: 7.

Geographical markets have become larger and therefore the number of customers served has increased (see Figure 3.2). This is related to centralization of production, saturation in traditional markets, and opportunities to enter foreign markets (Voordijk, 1994: 21-22). It should however be noted that the latest trend of decentralization of production and distribution reduces transport distances (Ruijgrok *et al.,* 2002: 15).

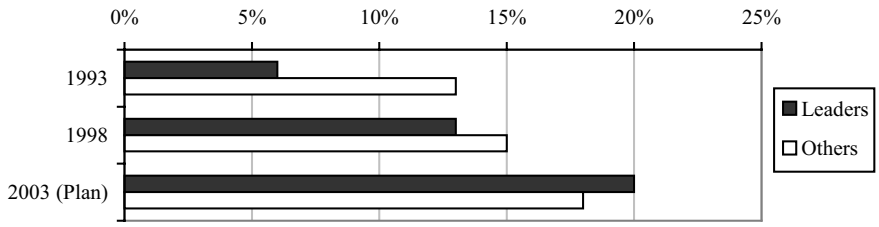
There are two trends regarding locations of production facilities. One, many firms have relocated production activities to low-cost countries, which however is not specifically related to SCM. Two, customization activities (e.g. final assembly) are located close to markets. This allows firms to respond quickly to changing demand, which requires short lead times (Blok *et al.,* 1992: 52; McKinnon and Forster, 2000a: 4). Supply, production, and distribution networks are often still concentrated within the main global trading blocks, partly in order to circumvent trade barriers (Western Europe, Japan, and North America) (Dunning, 1993: 607; Ruigrok and Van Tulder, 1995: 150). Another reason is that order lead times are often not competitive when production and customers are located on different continents[x].

In specific industries, such as the automotive industry, also the trend of co-location or spatial concentration of suppliers and manufacturers is observed. This trend is an imitation of Toyota's business model (Mair, 1992). More specifically, suppliers have moved to sites near car manufacturers, as they are forced to deliver Just-in-Time, often within a few hours after ordering (Kalsaas, 1999: 123; Voordijk, Cornelissen *et al.*, 1999: 12).

The dominant trend regarding distribution centers is centralization in order to minimize inventories (Christopher, 1993: 123; NEI, 1999: 19). Decentral distribution centers are often still employed, but for the purpose of shipment consolidation rather than inventory keeping (see section 2.4.1). This is reflected by the emergence of new logistical concepts such as cross-docking (see Figure 3.3) and merge-in-transit. Cross-docking means that shipments from various suppliers are scheduled in such a way that they arrive at the same time at a distribution center. There, they are sorted and directly shipped for further transport, thus avoiding inventories (Kinnear, 1997: 49-52). Cross-docking requires that suppliers, producers, and carriers narrowly co-ordinate their transport or production schedules since the absence of inventories leaves no buffers in the case of distortions in deliveries (Runhaar, 2001a: 1-3). Merge-in-transit resembles cross-docking; the main difference is that it is applied to product components rather than finished products (Runhaar and Kuipers, 2001). Both cross-docking and merge-in-transit aim to minimize the total cost of carriers, handling, warehousing, and inventory. Compared to traditional distribution however total transport costs may increase.

The disappearance of the storage function of many distribution centers often has been coupled with the emergence of new functions such as customer information, repairs, and the care for returned goods (Van Stijn, 2001: 5). In addition, customization of final products is increasingly postponed until the products reach a regional market. As was mentioned above, such activities increasingly take place at decentral distribution centers in order to reduce lead times.

Figure 3.3: Cross-docking (in percentage of sales)



Note: leaders: the 10 percent companies in an industry that are considered to have a leading position regarding SCM. Source: A.T. Kearney, 1999: 27.

SCM and logistical control concepts

With respect to the management and control of freight flows, the most obvious trend is to eliminate inventories. Inventories have become relatively expensive because of the capital involved and because of the increased risk of obsolescence. Moreover, the trend of increasingly large product assortments and customized products makes it impossible to keep every product in inventory. Inventories are reduced in a number of ways apart from centralization. One, inventories are reduced by more frequent replenishment orders and by JIT deliveries, which have become widespread over the last 15 years. Two, production has become more flexible due to ever smaller production runs, modular design of products (i.e. the use of many standard parts), and postponement of value adding activities (Demkes *et al.,* 1999: 3; Hoekstra, 1998: 508-523; Kuipers, 1999: 52; Voordijk, 1994: 22-23). The logistical organization as a result is to a larger extent oriented toward single customer orders whereas production activities are postponed as much as possible. Yet quick response has required close collaboration between supply chain participants, e.g. by sharing information on planned sales with suppliers.

Another trend regarding inventory policy is that suppliers increasingly take over responsibility for replenishments ('vendor managed inventories'). This allows suppliers to optimize their production planning whereas it relieves the customer from worrying about replenishments (Kuipers *et al.,* 2001: 14; Vermunt and Binnekade, 2000: 25).

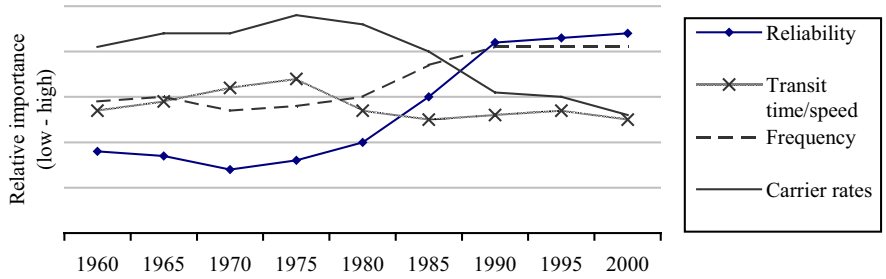
SCM and customer service

Firms continuously aim to improve customer service levels. Table 3.5 already showed that order lead times have become shorter and shorter due to time-based competition. In addition, delivery frequency to customers has increased, because also customers aim to reduce inventories. Finally, delivery reliability (e.g. expressed in the percentage of in-time deliveries) is continuously improved (see for instance A.T. Kearney, 1993).

3.4.3 Implications of supply chain management for freight transport and transport costs

Due to the trends in production and distribution described and explained by the SCM paradigm, firms have become increasingly reliant on freight transport. There are two reasons. One, transport-intensity of production and distribution in general has increased due to for instance longer transport distances and a higher frequency of orders and supplies (Bhatnagar and Viswanathan, 2000: 19; Van der Veen, 1998: 5). Two, the increased time pressure due to for instance postponement of value-adding activities and competition on customer service has led to a structural demand for faster, more frequent, and more reliable supply of goods (e.g. Stank and Goldsby, 2000: 72-73). The latter is reflected in decisions on modal choice where speed, reliability, and flexibility have become more important (Geurs and Van Wee, 1997: p. 36; De Wit and Van Gent, 1996: pp. 47-48; Raad voor Verkeer en Waterstaat, 1999: 16). This is also illustrated by Figure 3.4, which shows that carrier rates (i.e. direct transport costs) have become even less important than speed, reliability, and flexibility. Partly however this is due to falling transport unit costs (see chapter 1)[xi,xii]. Finally the increased time pressure has led to more direct deliveries and the use of express deliveries and airfreight services instead of slower, but more consolidated transport services (Demkes *et al.,* 1999: 3; Kuipers *et al.,* 2001: 19). As a result the market share of modes that are slow but often cheap and less polluting such as rail transport and inland navigation has decreased.

Figure 3.4: Relative importance of several transport characteristics in modal choice and carrier choice



Source: Hodd, 1987, in De Wit and Van Gent, 1996: 372.

The reduced sensitivity of firms to direct transport costs is also caused by the fact that transport costs usually are relatively low, e.g. as a percentage of total costs (e.g. McKinnon, 1998: 107). In contrast, reduction of other costs, in particular inventory costs, appears to be a boardroom issue (Blok *et al.,* 1989, 25; Geurs and Van Wee, 1997: 36; De Wit and Van Gent, 1996: 47-48).

The SCM paradigm appeared to be useful to explain many trends in contemporary logistics management, as well as their implications for the role of transport costs. The theory however also has some weaknesses and limitations, which are discussed below.

3.5 Supply chain management: a critical analysis

The SCM paradigm has become increasingly popular especially in the logistics literature, and many authors have pointed to the need for integral logistics at the level of the supply chain. A recent European survey however concluded that up to now few if any firms have achieved a totally integrated supply chain (Demkes *et al.,* 1999: 4). One explanation may be that SCM is still in its infancy, and that logistical theory is a forerunner to logistics practice. Critical logistics literature and insights from other disciplines however suggest that there are also serious weaknesses in SCM theory, relating to its explanatory and predictive power, assumptions, and its empirical base.

3.5.1 Explanatory and predictive power

SCM literature frequently tends to be normative due to a focus on finding optimal solutions to logistical problems (e.g. Blackwell and Blackwell, 1999; Bovet and Sheffi, 1998; Stank and Goldsby, 2000). Generally, SCM is presented as the only solution (Cox, 1999: 168). Yet with reference to Cooper *et al.* (1998), "there is no reason to suppose that supply chain developments will be the same for all companies, irrespective of industry sector" (op.cit., p. 177). This is in line with other authors who found that logistical behavior often tends to be rather heterogeneous. For example, within the same industries often very different distribution structures are found (e.g. BCI, 1999; NEI, 2001; Ruijgrok *et al.,* 1993; Kuipers *et al.,* 2001). Apart from that, logistical differences are reflected by indicators such as the structure and level of logistical costs, inventory levels, the number of daily JIT-deliveries, and the amount of inter-company traffic (BCI, 2000; Kuipers *et al.,* 1995). There are exceptions; in the chemical industry for instance a strong homogeneity in logistical behavior is found (e.g. Kuipers, 1999), which could be caused by imitation. Vermunt and Binnekade (2000) also found logistical structures that varied between but not within industries. Nevertheless, many examples exist of heterogeneity in the organization of production and distribution within the same industries (Böge, 1993; Demkes *et al.,* 1999), even when targets related to customer service, logistical costs, et cetera are identical (e.g. Kuipers *et al.,* 2001).

Logistics literature does not leave room for logistical heterogeneity and neither specifies which particular form of SCM is a feasible strategy for what type of firm and in which situation. In addition, the theory does not provide insights into how firms might respond to an increase in transport costs, apart from that apparently sensitivity to direct transport costs has reduced in favor of transit times and delivery reliability. With that, the explanatory and predictive power of logistical theory is limited. Some authors explain this by a rather weak theoretical base of logistics literature (Cox, 1999: 171; Croom *et al.,* 2000: 74). Little use is made of insights from other theories (e.g. in economics) to explain observed developments in supply chains, although there are no reasons to conclude that these theories would not apply to SCM or logistical behavior in general. Therefore in the next section, other theories will be consulted in order to fill the gaps that SCM theory leaves.

3.5.2 Assumptions

In the logistics literature in particular two assumptions of the SCM paradigm have been criticized. One, it has been doubted whether supply chain participants will co-operate voluntarily in order to optimize the integral logistical process. Firms rather are expected to try to appropriate value at the expense of suppliers or even customers (Bertrand and De Kok, 1999; Cox, 1999). Empirical evidence shows that many firms perceive information disclosure as a loss of power and therefore provide minimal information to suppliers or customers (Berry *et al.,* 1994: 22). Firms thus will behave opportunistically rather than co-operatively. Then what explains successful observations of SCM?

A second point of critique focuses on the claimed importance of logistical considerations. Several empirical studies have revealed that not all logistical issues that are distinguished in the literature are acknowledged in practice, and that often the relationship between a particular decision and its logistical consequences is not recognized (e.g. Puttman, 1992: 38; Sijbrands, 1993: 236-243). These observations were made early 1990s but at that time already an increased need for integral logistics was felt, at least at firm-level (see also section 3.3). Still, it is plausible that not to all firms logistics management or optimization of logistical processes will be equally important.

3.5.3 Empirical base

Most articles about SCM are based on a few particular industries that successfully have adopted SCM principles, i.e. the automotive industry, consumer electronics, and the food industry (e.g. Cox, 1999; Kinnear, 1997; NRC: 2000; De Vaan, 1998). This does not imply that SCM is not likely to occur in other industries, but it does suggest that there may be differences in the extent to which SCM will be introduced in other sectors.

3.5.4 Summarizing: ‘blind spots’

Concluding, the SCM theory seems suitable for describing contemporary trends in many supply chains in general terms, but provides unsatisfactory explanations or predictions for the following issues:

- heterogeneity in logistical behavior, e.g. related to the impact of SCM on the organization of production and distribution;
- the conditions under which SCM is achieved;
- the impact of higher transport costs on production and distribution.

In the next section complementary theories will be discussed in order to fill these gaps.

3.6 Explanations for supply chain management provided by other theories

Below, the knowledge gaps that were identified above will be filled in by consulting other theories. A broad perspective will be used, including theories that provide alternative explanations for logistical heterogeneity, preconditions for logistical co-operation between firms, and the impact of transport cost increases on logistics.

3.6.1 Explanations for heterogeneity in logistical behavior

Heterogeneous behavior of firms from different industries but also of firms that are in the same industry or sector is addressed by several theories that suggest different, but not necessarily conflicting explanations. Concerning logistical behavior however, up to now no dominant paradigm has been proposed in the literature. Therefore, below some generic theories are discussed as well as their implications for logistical behavior.

Heterogeneity due to a different focus on core competencies

The core competencies approach explains heterogeneous behavior of firms from their tendency to build a competitive advantage by differentiating themselves, either through product differentiation, different production techniques, or a combination (De Wit *et al.,* 1998: 24-25; Prahalad and Hamel, 1990: 81). This is related to the assumption that in the long term, competitiveness depends primarily on firms' ability to respond quickly to changing market opportunities (Prahalad and Hamel, 1990: 81). This ability can be acquired by concentrating on competencies which are likely to play a decisive role in future competition and which are difficult to duplicate by current or potential competitors. Activities that do not yield added value to core competencies are outsourced. Ideally, they are supplied by many firms, which will create a superior position vis-à-vis suppliers (Cox, 1999: 167-173), contrary to the co-operative relationships assumed by SCM theory.

The core competencies approach implies that logistical behavior of firms may vary because firms may build distinct resource mixes and outsource specific types of activities (affecting the pattern of the logistical structure) or may focus on different competencies (e.g. cost leadership or product differentiation, cf. Porter, 1980: 34-41; Porter, 1990: 39). Thus, firms may not be equally sensitive to the various types of costs related to transport. Overall it is not likely that the outsourcing decision is very much affected by transport costs, despite the fact that outsourcing typically induces a transport demand. *Supplier choice* however may be affected by transport costs since prices of alternative suppliers are affected by transport costs, whereas firms that compete primarily on customer service will probably base their supplier choice partly on transport distances and reliability of deliveries.

Heterogeneity and homogeneity due to different product-market characteristics

Some authors argue that although firms within the same industries often make completely different logistical choices, firms with similar product-market characteristics (e.g. value density, perishability, geographical size of the market, and demand frequency) often reveal identical logistical behavior (Ruijgrok *et al.,* 1993: 22-32; Cooper, 1993: 16)[xiii]. These authors therefore consider part of the organization of production and distribution an exogenous factor to logistical behavior. Others suggest that commercial life cycle of products is an important determinant of logistical behavior. To products that have just been introduced in markets, time-to-market is important. In this case, transit times may be more important than carrier rates and delivery reliability in transport or location decisions. When products are in a mature

stage of their life cycle, competition tends to focus on price and customer service. Firms then become more sensitive to direct transport costs and transport reliability (De Vaan, 1998: 19-20).

Nevertheless, despite the theoretical attempts to define 'logistical families', empirical studies have not overcome the problem of identifying generic determinants of logistical behavior (Claus *et al.,* 1995: 41; Tavasszy and Smeenk, 1997: 13). There is however little dispute on the role of product value density on transport demand. High-valued goods bear relatively low direct transport costs, measured in total costs or price, which leads to a low transport cost sensitivity (Bus *et al.,* 1999a: 40; De Dios Ortúzar and Willumsen, 1994: 393-394; Kuipers *et al.,* 1995: 57; Mair *et al.,* 1999: 13; Van de Ven and Ribbers, 1993: 72; Van Goor *et al.,* 1996: 72-73; Voordijk, Vieveen, and Bus, 1999: 116). Machinery or domestic appliances for instance are often transported over larger distances than low-valued bulk goods, because higher transport costs do not result in uncompetitive prices (Cooper *et al.,* 1993: 14).

Yet increased transport costs would not only induce logistical adaptations by shippers of low-valued goods. A survey among manufacturers conducted a few years ago for instance demonstrated no clear correlation between the share of transport costs in total costs and responses to transport cost increases (see Table 3.6). There are two related reasons why shippers of high-valued products or that have otherwise low transport costs may be responsive to an increase in transport costs as well. One, transport costs may be one of the few areas in which firms can realize cost reductions. Two, when profit on turnover is small, an increase in transport costs may have a significant impact on profit margin which could induce firms to adapt transport demand (Bleijenberg, 1998: 27; McCann, 1998: 6; Stefansson and Tilanus, 1998: 44).

Table 3.6: Manufacturers' responses to a hypothetical 50 percent transport cost increase

	Percentage of firms that considers the responses likely, classified according to transport costs as % of sales			
Responses mentioned	0 - 1.9%	2 - 3.9%	4 - 9.9%	≥ 10%
Modify logistical operations	56.5	84.0	53.8	58.3
Pass on cost increases to customers	34.8	48.0	34.6	41.7
Absorb costs/reduce profits	21.7	24.0	15.4	16.7
Would make very little difference	13.0	4.0	0.0	0.0
Possibly/probably go out of business	0.0	0.0	7.7	8.3
Total n^{o} of respondents	23	25	26	12

Source: McKinnon and Woodburn, 1996: 158.

Empirical studies in addition indicate that low-valued goods are not necessarily insensitive to transit times or delivery reliability. In particular where it concerns raw materials, delays may cause significant scheduling costs (see section 3.2). Therefore, shippers of raw materials sometimes have a higher value-of-time than shippers of high-valued, finished products (HCG, 1992; Korver and Mulders, 1992).

Concluding, value density or the share of transport costs in total costs or turnover is not an all-encompassing indicator of the relative sensitivity of firms to transport costs (McKinnon and Woodburn, 1996: 156). Hence it may neither be an exclusive determinant of logistical decision-making.

Heterogeneity due to cognitive limitations or opportunistic behavior

SCM literature largely considers the logistical decision-making process a black box; often it is implicitly assumed that firms will make 'optimal' choices, e.g. so as to minimize total logistical costs. However cognitive limitations or 'bounded rationality' often prevent people from making optimal decisions (Simon, 1976: 33; March and Simon, 1993: 190-191). In addition decisions may be based on wrong assumptions about the future (e.g. Warffemius, 2000: 11). Finally employees within firms or firms within supply chains can be opportunistic and pursue their own goals, which may differ from those of the firm or supply chain (Cox, 1999: 167-173)[xiv]. These theoretical concepts may explain heterogeneity in the extent to which logistics management approaches the ideal SCM model.

Heterogeneity due to path-dependencies

Evolutionary theories explain heterogeneous behavior by investments undertaken in the past in a certain technology, location, or in other assets. Such investments may lead to path-dependency, i.e. the phenomenon that firms may find their options restricted and have to develop along a certain path (Hodgson, 1996: 260). In addition, requirements from the environment in which firms operate may lead to irreversible situations and path-dependency (Saviotti, 1996: 31). Regarding the organization of production and distribution, investments in locations may create 'locked-in' situations (Harrington and Warf, 1995; Warffemius and Kuipers, 2000).

Intrinsic heterogeneity in locational choice and spatial behavior

Recent location theories explicitly assume heterogeneity in the locational behavior of firms, even within the same industry. The main explanation is that firms differ with respect to their dependence on external supply, the degree of market responsiveness desired, abilities to expand on existing sites, and dependence on highly skilled labor. This in turn depends on firms' attempts to gain competitive advantages, discussed above. Locations are specific in terms of resources, labor availability, and markets, and therefore provide different opportunities for competitive advantage (Harrington and Warf, 1995: 66-72; 225-226).

A second source of heterogeneity in locational choice and the importance of location factors is the specific activity in which firms engage (see Table 3.7)[xv]. Transport costs are usually one of the location factors. Their level tends to vary between locations. Locations that attract large freight volumes (e.g. seaports) usually have low direct transport costs because of economies of scale in transport operations (Manners, 1964: 31; Pedersen, 2001). Therefore industries that have high transport costs (e.g. oil), often locate in these areas (Kuipers *et al.,* 1995: 55-73; Van de Ven and Ribbers, 1993: 81).

Table 3.7: Location factors and their relative importance

	European distribution centers	**European head-quarters**	**High-tech production**	**Other production**	**R&D centers**
Economic profile	3	3	3	3	3
Markets	1	3	2	2	4
Taxes	2	1	2	2	2
Regulations	3	4	3	3	3
Labor climate	2	1	1	1	1
Suppliers & know-how	2	3	2	1	1
Utilities	4	3	4	2	4
Incentives	2	3	2	2	2
Quality of life	4	2	3	4	2
Infrastructures & logistics	1	1	2	2	3
Sites & offices	2	2	3	2	2

Note: 1 is highly important. Source: Buck Consultants International in Demkes, 1999: 17-18

Finally spatial behavior varies regarding where firms locate vis-à-vis competitors, suppliers, and customers. Agglomeration benefits tend to promote spatial concentration or clustering of firms. These benefits are location-specific factors that affect production costs, e.g. shared infrastructures, market size, a large and specialized labor market, knowledge spillovers, and local networks of experienced suppliers (Fujita *et al.* 1999: 346; Chevassus-Lozza and Galliano, 2000: 3). In contrast, congestion, immobile production factors, and land rent heterogeneity act as centrifugal forces (Fujita *et al.,* 1999: 346). The importance of centripetal and centrifugal forces is industry-specific. In general however empirical studies show that in many modern industries nearness to sources of raw materials or suppliers of semi-manufactured products is considered increasingly unimportant. Instead, many firms tend to locate near markets as production is often market-oriented, inputs are ubiquitous, and many products are perishable (Cooper, 1993: 13; Harrington and Warf, 1995: 157). This suggests that transit times rather than direct transport costs inhibit locating too far from markets, in line with SCM theory (see section 3.4.2).

Although locational choices may be based on different considerations, recent contributions to economic geography (e.g. McCann, 1998: 49; Ruijgrok *et al.,* 2002) suggest that firms (notably manufacturers) will organize themselves spatially in such a way as to minimize total logistical costs. Typically this is realized at a certain combination of inventory policy, shipment frequency, and transport distance.

3.6.2 Preconditions for supply chain management

Since the assumption of voluntary co-operation between supply chain participants was found to be unrealistic, the question is when and why SCM will occur. Successful observations of SCM (e.g. in the automotive industry and supermarket retail) suggest that the presence of a firm with both an interest in logistical co-operation and enough market power to force his suppliers to co-operate are an important precondition of SCM (Berry *et al.,* 1994: 21; Cox, 1999: 167-173; Muilerman, 2001: 135). In this context,

three observations are relevant. One, in many supply chains power is shifting toward retailers (Demkes *et al.,* 1999: 3; McKinnon and Forster, 2000a: 9). Two, carriers and logistical service providers usually have limited or no market power. Three, in many supply chains where the use of internet has been adopted (e-commerce), market power shifts in favor of purchasing firms, as the internet increases information transparency, enlarges supplier choice, and facilitates combined purchasing (Croom, 2000).

3.6.3 Effects of increased transport costs on the organization of production and distribution

SCM theory does not specify which effects a change in transport costs may have on the organization of production and distribution. It only suggests that overall, firms have become more sensitive to changes in transit times and delivery reliability than to changes in carrier rates. Other theories and studies have elaborated more in detail on this topic. Distinction can be made between literature that specifies which adaptations may occur, and literature that focuses on barriers to adaptation. Below the two bodies of literature are discussed.

Adaptations induced by higher transport costs

In literature mainly originating from economic geography, it has been suggested that in the case of increasing transport costs (notably related to direct costs and costs caused by transit times), markets will be served by local producers or by decentral facilities of foreign firms (e.g. Fujita *et al.,* 1999: 310; Harrington and Warf, 1995: 152). Similar effects are expected in (transport) economic literature. Usually an increase in (notably direct) transport costs is expected to have spatial consequences including relocations of firms, more sourcing from local suppliers, and reduced exports. Ultimately this may lead to more local production for local markets (e.g. Bleijenberg, 1998: 19-29; Blok *et al.,* 1992: 61-62; Boylaud, 2000: 12; Rodrigue *et al.,* 1997: 91; Ruijgrok *et al.,* 2002: 13; The Economist, 1997: 89)[xvi]. These effects of higher transport costs basically are the opposite of what has been observed in logistical practice over the last decades and which has often been attributed to falling transport unit costs (e.g. The Economist, 1997: 89)[xvii]. Spatial effects however are likely to occur in the long term rather than in the short term (Tanja *et al.,* 1989: ii).

In the logistics literature also other effects of higher direct transport costs are identified. One, it may affect decisions regarding frequency of shipments and average shipment size (Blumenfeld *et al.,* 1985; Bowersox and Closs, 1996: 193; Ruijgrok, 1991: 10-11). This may feed back into inventory policy of firms and the use of JIT deliveries. In some situations however transport costs must increase significantly if they are to balance the cost savings in inventory, produced by a higher shipment frequency (Cooper *et al.,* 1994: 283). These are notably short-term responses to higher transport costs, although inventory policy may also affect locations and numbers of production and distribution centers (see section 3.4.2). Two, some authors suggest that only those components of production and distribution that have a direct impact on transport demand, are likely to be affected by higher transport costs. Cooper *et al.* (1998) for instance in an analysis of

six industries found few if any transport effects of customer service, JIT, and reverse logistics and no transport effects of modular products, vertical (dis)integration, and postponement. In contrast, focused production and pan-European sourcing were found to have led to more transport. Hence, they concluded that higher transport costs will notably affect the latter aspects.

Finally the SMILE model that was discussed in section 2.2 also specifies how direct transport costs may affect the organization of production and distribution. The model assumes that an initial rise in costs will be absorbed in five sequential stages. First, at the transport operational level, carriers will try to neutralize the extra costs by for instance adapting route choice or modal choice. If carriers are not able to offset the rise in transport costs, then firms will keep higher inventories and thereby reduce frequency of shipments. If the rise in transport costs is still not absorbed, then the locations of distribution centers are reconsidered. Subsequently production facilities are relocated. The option of last resort is to pass the extra costs on to the customers (see Groothedde and Van Haselen, 1998).

A general weakness of the reviewed literature is that it pays little attention to industry- or situation-specific adaptations, although in section 3.5.1 it was found that logistical behavior is heterogeneous rather than homogenous. This however is not reflected in the adaptations that may be expected in response to higher transport costs[xviii]. In addition, the time frame to which the adaptations relate is not clear, although in general locational choices are considered inert in the short term.

Various empirical studies have provided more specific insight into the effects that an increase in (generalized) transport costs may have on logistical decisions. In section 3.6.1 a survey by McKinnon and Woodburn (1996) was treated. Muilerman (2001) conducted a more detailed and more recent survey. He found that, although there are differences between and within industries, firms are relatively insensitive to an increase in direct transport costs. Most adaptations are related to the management of transport operations whereas only few firms expect to change the organization of production and distribution (see Table 3.8). This is similar to other studies that suggest that in many industries, relatively large increases in transport cost are required to induce changes in production and distribution patterns and practices (e.g. Cooper *et al.,* 1994; McKinnon, 1998; Musso *et al.,* 1999; TUB, 2001). Table 3.8 however shows that an increase in transit times and reduced delivery reliability might affect the organization of production and distribution in part; notably in the parts services industry[xix], firms expect to decentralize their distribution structure. This is in contrast with the results of another, similar survey in which shippers were asked how to respond to delays of at least two hours (Musso *et al.,* 1999). In the latter survey however shippers could choose only among the options ‘reorganize production’, ‘relocate’, or ‘change carrier/frequency/ delivery times’; the possibility to reconfigure distribution structures was not explicitly addressed. In addition, differences may be explained by the fact that shippers from different sectors were interviewed.

Table 3.8: Stated responses of firms in the Dutch food and parts services industries on two road freight transport scenarios

Scenarios→ / **Stated adaptations↓**	**Scenario 1: 25% higher road freight rates due to taxation**		**Scenario 2: Longer transit times and reduced reliability due to congestion**	
	Food	Parts	Food	Parts
Accept scenario consequences/do nothing	70%	57%	15%	57%
Consolidate part shipments via LSP/other producers	60%	21%	50%	21%
Shift to off-peak distribution	30%	29%	45%	93%
Pass on to customers	25%	93%		
Adjust route planning	10%	21%	25%	36%
Consult/inform customer	10%		20%	71%
Stop deliveries to very small customers	10%			
Compensate through cost reductions elsewhere	5%			
Decentralize pattern of DC's		7%	10%	50%
Consider alternative transport modes		7%	5%	21%
Remote diagnosis/repairs				57%

Source: Muilerman, 2001: 183-190.

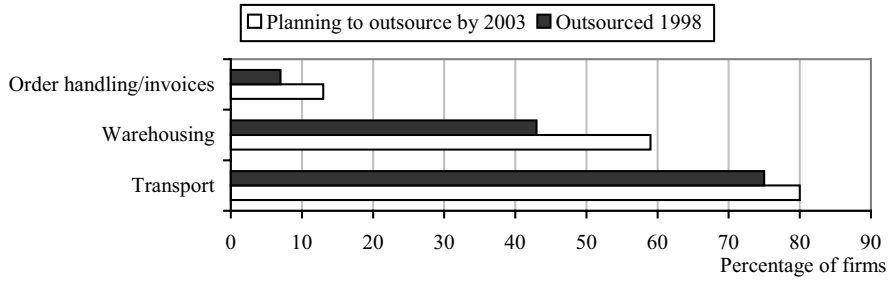
In all of the above surveys it is unclear what time frame the respondents had in mind. The prevalence of short-term adaptations, mainly focused on transport operations, may be due to the fact that such adaptations require lower investments (Musso *et al.,* 1999: 51). Another explanation could be that firms find it difficult to overlook the implications for long-term decisions, due to higher uncertainty. A general outcome however is that direct transport cost increases are less problematic than increases in transit times or delivery reliability, in line with SCM theory.

Barriers to change

Apart from literature in which adaptations to transport cost increases are specified, other literature is concerned with factors that explain rigidity or inertia of production and distribution organizations. The range of options that shipping firms have to adapt their transport demand depends for instance on the extent to which locations of production, inventory, and consolidation are tied to a certain place or region or otherwise fixed (NEI, 1999: 66-67), e.g. due to asset specific investments. In this context, many firms have become more flexible regarding locations and numbers of distribution centers since warehousing is increasingly outsourced (see Figure 3.5).

Firms' flexibility with respect to transport demand are affected by product characteristics as well; not all freight may be combined in transport (see section 2.4.2). In own account transport, shippers may reduce transport costs by outsourcing to commercial carriers since they commonly are able to achieve a higher transport efficiency (see section 2.4.2). The options to switch to other modes of transportation are affected by many factors, including the spatial patterns of freight flows and infrastructure availability. Finally, badly integrated supply chains may provide more options to reduce transport inefficiencies than largely integrated ones (NEI, 1999: 66).

Figure 3.5: Trends in outsourcing of logistical activities



Source: A.T. Kearney, 1999: 24.

The flexibility and inertia of locations has been addressed in location theories. Usually it is assumed that generalized transport costs are important when firms make their locational choices, but that an increase in transport costs seldom is a motive for relocation. This is confirmed by empirical studies (e.g. Hanemaayer and Rekkers, 1998: 12-20; Rietveld and Bruinsma, 1998: 61). One theoretical explanation is that relocation as a consequence of higher transport costs is restricted by the importance of other location factors and the extent to which higher transport costs can be passed on to customers (Harrington and Warf, 1995: 226-227). A second theoretical explanation is that firms tend to make incremental investment in their locations, e.g. by investing in new machinery or additional buildings. Often such investment is in support of the status quo. In combination with prior investments in a particular place (e.g. in the workforce that has been schooled), this often results in immobile production factors and locational inertia. In this context small firms tend to be more inert than large ones (Harrington and Warf, 1995: 148-149; 224). In addition it is sometimes suggested that firms, active in that part of the supply chain which is positioned after the customer order decoupling point, will tend to be less inert in their locational behavior (Cornelissen *et al.,* 1999: 43). An explanation could be that such firms have to be relatively flexible and responsive to changing demand, as they produce to order.

Instead of adapting business processes in order to absorb an increase in transport costs, firms may choose to pass the cost increase on to their customers. Tables 3.6 and 3.8 showed that it is not unlikely that firms will choose this option. The incentive to absorb higher transport costs by adapting the organization of production and distribution as opposed to passing it on to customers, is related to two factors. One, options to absorb or avoid higher costs are important, as was already observed. Two, the competitiveness of markets and market power may explain to what extent firms are inclined to absorb or pass on higher costs. Monopolists are likely to have fewer incentives to absorb higher costs by adapting logistical processes than firms that operate in more competitive markets have. Oligopolists also are more likely to pass on the higher costs in their prices. The reason is that, at least in the case of small numbers of oligopolists, there is a tendency toward joint profit maximization (Lipsey *et al.,* 1987: 282-283). This implies that firms will tend to co-ordinate prices rather than compete on prices, since they know

that the others will have to follow if one drops prices. In the case of a transport cost increase it may be easier to jointly raise prices than to absorb the higher costs, because this may have to be reflected in part by lower (increases in) prices. The efforts that would have to be undertaken to absorb higher transport costs would then only benefit the customers[xx].

The above argument may also apply to the efforts that firms undertake in response to higher costs that occur due to longer transit times or reduced delivery reliability. In particular the efforts that may be undertaken to guarantee a particular level of customer service may be expected to depend on market structure. Monopolists and duopolists again may be expected to have fewer incentives to adapt than firms in more competitive markets, because of a more or less 'captive' demand. In this situation firms might get away with deteriorated customer service levels as it would not lead to a reduction in demand[xxi]. In conclusion, market structure may affect the extent to which firms will be inclined to adapt to changes in transport costs, as opposed to pass on higher costs or inconvenience to their customers.

3.7 Conclusions and hypotheses

Theory and empirical evidence suggest that in transport decisions such as modal choice, the role of direct transport costs has decreased in favor of notably transit times and delivery reliability. This can be explained by falling transport unit costs as well as increased costs related to transit times and delivery reliability. The reduced role of direct transport costs however may also explain the trend toward more transport-intensive organizations of production and distribution, which are typically designed in order to reduce inventory costs and increase flexibility. Transport costs seem to be increasingly traded-off against other logistical costs; centralization of inventory for instance generally leads to higher transport costs, which apparently are offset by savings on the cost of inventory and warehousing. The discussed evolution in logistics indicated that, apart from a reduced importance of direct transport costs, a complementary explanation is that firms have become more aware of the very existence of logistical trade-offs. Yet not all trends in production and distribution can be attributed to changes in logistical trade-offs since exogenous factors (e.g. the European unification) played a role as well.

Based on the preceding, two assumptions are formulated:

A 1: transport costs are one of the factors affecting the organization of production and distribution. The relative importance of direct transport costs has decreased, but that of transit times and reliability has increased;

A 2: the decreased importance of direct transport costs has enabled the trend toward more transport-intensive production and distribution networks.

Central to this study are the effects of an increase in transport costs on the organization of production and distribution. Given the assumption that direct transport costs are increasingly traded-off against other logistical costs, it can be hypothesized that higher direct transport costs may lead to other choices regarding the organization of production and distribution. This hypothesis is supported by the observation that logistical choices

are increasingly made at an integral level (i.e. comprising all relevant cost factors). Empirical studies however show that the increases in transport costs will have to be substantial in order to induce adaptations (see section 1.2). Hence the following hypothesis is formulated:

H 1: if the direct transport (unit) costs increase substantially, firms will reconsider trade-offs involving transport and will be inclined to organize production and distribution in less transport-intensive ways.

The literature reviewed suggests that it is difficult if not impossible to classify firms according to their logistical behavior. This complicates specifying which firms will be sensitive to higher direct transport costs and how they might respond. In more general terms the literature indicates that the following dimensions of production and distribution are susceptible to changes in direct transport costs:

- the market area that is served by a production facility;
- the number of distribution centers and the number of inventory points;
- locations of production and distribution centers;
- supplier choice;
- inventory levels and frequency of shipments.

The increased importance of transit times and delivery reliability is related to increased attention being paid to inventory reduction and flexibilization of production. In turn, this has led to a reorganization of production and distribution. It can be hypothesized that longer transit times and a reduced delivery reliability will be problematic as they conflict with the logistical goals of responsive and reliable supply and lead time reduction. Therefore, longer transit times and less reliable deliveries may lead to more and a wider variety of adaptations in the organization of production and distribution than higher direct transport costs. The survey of Muilerman (2001) among shipping firms in the food and parts services industries supports this hypothesis.

Based on the preceding the following hypotheses are suggested:

H 2: an increase in direct transport costs will notably lead to decentral production or smaller market areas, decentral distribution and inventories, lower transport distances through a relocation of production and distribution centers, more local or regional suppliers, and higher inventories, e.g. due to a reduced frequency of replenishment orders;

H 3: longer transit times and reduced delivery reliability will induce a larger number of adaptations as well as a more diversified set of adaptations, which may relate to all dimensions of production and distribution that affect transport demand.

Finally, it can be expected that to large shippers (in terms of freight volumes), adaptations to transport cost increases are more often lucrative than to small shippers. Large volumes of freight namely may offer more opportunities to improve consolidation factors or to render a modal shift profitable. Therefore, logistical adaptations to higher transport costs are in particular expected from large firms. This hypothesis as well as the others will be tested in the empirical part of this dissertation.

[i] In turn these low rates may attract freight that normally would be transported differently, e.g. in bulk (Pedersen, 2001: 88).

[ii] Scheduling costs however have received little attention in the literature (CPB, 1998: 28; Noland *et al.,* 1998: 561).

[iii] In this context also the frequency of shipments is important (Bruinsma *et al.,* 1999: 6). For instance, in raw material supply for production purposes, the inconvenience of a truck arriving too late (or not at all) may be reduced if the next shipment is scheduled shortly after the delayed one.

[iv] Additional transport characteristics that are sometimes included in the concept of generalized transport costs are the probability of loss and damage (e.g. De Dios Ortúzar and Willumsen, 1994: 393). This characteristic was excluded in this study for a number of reasons:

- it is difficult to quantify whereas empirical data largely lack;
- it can hardly be affected by government interventions, in contrast to other aspects of transport costs;
- direct transport costs and the costs related to transit times and delivery reliability are generally regarded as the most important costs related to transport.

[v] For more specific studies, see for instance NEI/NEA (1990) or Gruppo CLAS (1998).

[vi] As a result, firms achieved the following logistical improvements (A.T. Kearney, 1992: 3):

- a reduction in overall logistical costs of 29 percent between 1987 and 1992;
- a reduction in order cycle times of 35 percent;
- an improvement of service of 31 percent overall (including in-time delivery, order completeness, invoice accuracy, damage-free delivery, and fill rates).

[vii] Demand chain management is sometimes considered a new paradigm, as the emphasis is on responsiveness to customer demand, whereas SCM focuses both on responsiveness and overall logistical costs (Kuipers *et al.,* 2001: 13). Other authors however argue that SCM involves both supply chains that primarily are focused on cost reduction (e.g. for products with low variety and life cycles beyond two years) and responsive ones for innovative products that demand flexibility (e.g. Laarhoven, 1999: 7-8).

[viii] For a more detailed description, see for instance Bowersox *et al.* (1996) or Stabenau (1996).

[ix] Capital productivity depends among other things on rotation of inventories, i.e. the periods of time in which capital is invested in inventories.

[x] In the automotive industry for instance, order lead times would be too long because of long distances and the fact that cars are produced to order (Kalsaas, 1999: 48).

[xi] The Figure also shows that transit times have become less important than reliability. This is confirmed by other studies that focused on the impact of congestion (e.g. Korver and Mulders, 1992: 37-38). Costs related to uncertainties in delivery times caused by road congestion were found to be larger than direct delay costs (e.g. interest costs). If congestion is known, it is less of a problem since unreliability can be planned. This indicates that the effect of longer transit times is less problematic.

[xii] Apart from that, the Figure is partly based on forecasts, making it indicative rather than representative; yet more recent time series were not found in the literature.

[xiii] For instance physical or commercial product perishability affects the location of production and distribution facilities. Highly perishable products often demand short transport lead times, which may be realized by fast transport modes or short transport distances (e.g. Van de Ven and Ribbers, 1993: 72). Therefore perishability may explain part of the logistical heterogeneity.

[xiv] In addition, firms are often engaged in multiple supply chains. Optimization of processes within one supply chain may very well be hampered because of the negative consequences for other supply chains (Bertrand and De Kok, 1999: 16). Few firms for instance will employ specific warehouses for each of the products that they sell. Therefore within firms concessions may have to be made regarding the design of logistical processes.

[xv] For a more detailed description of the importance of location factors to various types of firms, see NEI (2001).

[xvi] The latter in turn may lead to less competition in markets, which may lead to higher prices and higher profits (Rietveld and Bruinsma, 1998: 65; Tweddle *et al.,* 1998: iii).

[xvii] In addition, Manners (1964) for instance shows that transport costs have a crucial impact on the geographical pattern of energy production and distribution (op.cit., 85-92):

- they affect the costs of exploiting energy resources;
- by influencing the cost of energy at its markets, they affect the competitive position of various energy sources available there;
- they strongly affect the mode of transportation that is used for moving particular energy;
- they affect the location of gas and electricity manufacturing.

[xviii] In this context, Ruijgrok *et al.* (2000) state that "[although] reactions of logistics structures to changes in transport costs are well known in theory (…) in practice, however, these responses – and their impact on regional development – will vary by sector due to the large variety in logistical needs and boundary conditions" (op.cit., p. 16).

[xix] The parts services industry consists of a wide range of firms that provide after-sales repair and maintenance service for industrial systems as well as for consumer products. The study of Muilerman however was confined to firms that perform activities that require physical transport of spare parts, i.e. repair and maintenance services (Muilerman, 2001: 131).

[xx] In the case of an asymmetric oligopoly where one firm has a dominant position, usually the dominant firm will determine what happens: absorbing the higher costs or raising prices. In both cases the other firms are obliged to adopt the prices set by the dominant firm (Mamuth, 1992: 288-289).

[xxi] It should be noted that under particular circumstances this phenomenon might also occur in more competitive environments. Hirschman (1970) for instance claims that a uniform quality decline that hits all firms in a sector or industry may leave total demand for each firm unchanged (op.cit., pp. 26-27). This will happen when demand is captive and when customers perceive quality differences between firms that in reality do not exist. In this situation, customers will switch from one producer to the other in search of superior products, leaving total demand per firm largely unchanged.

PART III: EMPIRICAL ANALYSIS

4 Research design

4.1 Introduction

The theoretical framework of this dissertation was developed in the previous two chapters. Chapter 2 resulted in a model for analyzing the impact of production and distribution on freight transport demand. Several key aspects were identified that have a potential impact on transport demand, although the actual impact is often situation-specific. In chapter 3 two issues were addressed. One, transport costs were defined. Two, explanations were explored for the way in which production and distribution are organized. In this context the potential impact of higher transport cost was examined as well. Two main conclusions were that logistical behavior tends to be heterogeneous, and that firms may have different perceptions of transport costs. These conclusions imply that the responses of firms to an increase in transport costs may vary as well. The theory however only yielded general hypotheses about firms' responses to higher transport costs and did not allow for a clear differentiation between firms.

The above implies that additional empirical research is required for more complete answers to three out of five research questions of this study, namely:

- what costs do shippers bear when moving their goods?
- what role do transport costs play in decisions concerning the organization of production and distribution?
- what are likely logistical adaptations of shippers in response to higher transport costs, in particular related to the organization of production and distribution?

In addition, the fourth research question of this study has only been addressed superficially, i.e. how governments can affect the costs of freight transport services. A specification of the possible effects of policy interventions on transport costs requires more in-depth research. Therefore in this chapter the methodological approach is outlined for filling the remaining knowledge gaps. The chapter is structured as follows. Section 4.2 will describe the organization of the empirical analysis. Section 4.3 will set the boundaries of the study, e.g. concerning time frame and level of analysis. Research strategies will be selected in section 4.4 and will be elaborated in section 4.4 through 4.7. Representativeness of the study will be discussed in section 4.8. Finally in section 4.9 the main methodological choices are summarized.

4.2 Organization of the empirical analysis

In chapter 2 the various factors that affect transport demand were analytically distinguished. At the level of production and distribution, goods flows between firms are generated. The nodes in a network for instance determine origins and destinations of goods. At the level of transport operations, goods flows are converted into traffic flows in a process of shipment consolidation, routing, et cetera.

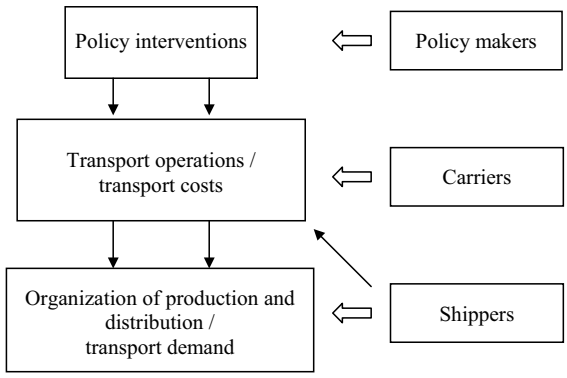
Central to the study is the question how an increase in transport costs, induced by policy interventions such as taxation, may affect the organization of production and distribution. Chapter 2 however taught that policy interventions may affect the management of transport operations as well. These effects have to be isolated or at least distinguished from other effects of an increase in transport costs on the organization of production and distribution. This task is complicated by a number of factors:

- the flexibility with which logistical decisions can be changed varies. Decisions on the logistical structure (e.g. locational choice) for instance usually are long-term decisions, whereas many decisions related to transport operations are made much more frequently (e.g. Tavasszy, 1996: 9-12). It is therefore likely that increases in transport costs in first instance will be absorbed by adapting transport operations (cf. Guglielmineti, 1998a: 5; Stefansson and Tilanus, 1998: 5). Depending on how successful these adaptations are, this may reduce or even remove the need to adapt long-term decisions[i];
- various actors are responsible for making logistical decisions. Shippers usually decide how production and distribution are organized whereas most activities related to actual transport are outsourced to carriers. Yet carriers do not operate in complete isolation as shippers determine some of the conditions under which transport has to take place (e.g. regarding arrival times or risk of damaging);
- much depends on the specific design of policy interventions. A fixed levy on vehicle possession may provide carriers fewer options to adapt than a levy that varies with the amount of kilometers driven. The design of the policy intervention therefore in part determines carriers' flexibility in absorbing cost increases and the cost increase that will be passed on to shippers.

Various analytical approaches are available in order to distinguish the effects of transport policy on transport operations from those on the organization of production and distribution. One, both carriers and shippers can be asked after the responses to specific policy interventions that they expect in various time horizons (short term, medium term, long term), both from themselves and from the other parties. The advantage is that this enables a rich assessment of how policy interventions may affect transport operations. A disadvantage however is that the analysis may be blurred because shippers and carriers may have different perceptions of what the other parties may do, for instance due to wishful thinking. Such biases are probably difficult if not impossible to assess. Alternatively, the impact of policy interventions on carriers' transport operations can be examined in isolation of shippers' responses. Transport operations are namely predominantly the responsibility of carriers, because most shippers have outsourced transport. In addition, decisions in the field of transport

operations usually are short-term decisions, whereas many decisions related to the organization of production and distribution are medium- or long-term decisions. In view of this it is likely that shippers will wait to what extent carriers can absorb the effects of policy interventions before they will adapt their organization of production and distribution. Thus, it seems plausible to examine first the extent to which carriers may absorb the effects of policy interventions, and then construct scenarios that describe a particular development in transport costs, due to the implementation of certain policy interventions as well as the responses that they induce by carriers. Subsequently, shippers can be confronted with these scenarios in order to explore likely adaptations in the organization of production and distribution. A disadvantage of this approach may be that simultaneous adaptations related to transport operations by shippers and carriers are ignored. Anticipating on the introduction of new taxes, shippers may for instance adapt their logistical processes prior to actual implementation and therefore not base their decisions on the actual changes in transport costs. Opposite effects for instance have appeared in the chemical industry where shippers centralized production facilities anticipating among other things a further fall in direct transport costs (Kuipers, 1999: 247-248). Yet despite this disadvantage, this approach was considered to yield a more accurate assessment of the eventual impact of policy interventions on the organization of production and distribution than the first one. In addition, the above disadvantage was minimized by leaving shippers enough room to reflect on the impact of policy interventions on transport operations. This structure of the empirical analysis is depicted by Figure 4.1.

Figure 4.1: Structure of the empirical analysis



4.3 Boundaries of the research

In this section several boundaries of the research are set, namely the time frame, level of analysis, geographical scope, and research objects.

4.3.1 Time frame

The effects of higher transport costs may be studied from a retrospective, a contemporary, or a prospective view. In this study a contemporary and prospective approach was chosen for the following reasons:

- chapter 1 revealed that over the last 15 years production and distribution have become more transport-intensive. The supply chain management (SCM) theory suggests that this is due to an intrinsic change in logistics. This reduces the validity of extrapolation of past events and produces results that are of limited value to policy makers that are interested in an *ex ante* evaluation of some of their transport policies;
- a prospective approach based on future plans allows for accurate assessments of the effects of different kinds of (hypothetical) transport cost increases. A retrospective approach based on revealed behavior is problematic since up to now transport costs have shown a continuous fall (see chapter 1, Figure 1.4) and problems may occur if the effects of changes in transport costs can not be isolated from other factors (e.g. the European unification). A prospective analysis however may yield validity problems, in particular if interviews are a major source of information. This issue was explicitly addressed in this study (see section 4.5 through 4.7).

A second choice related to the time frame involves the time horizon that was examined. It was already observed that logistical structures usually involve long-term decisions. To explore the effects of a change in transport costs on the whole organization of production and distribution, ideally the time frame should cover the period in which all logistical choices become variable again. On the other hand, extending the time horizon too far in the future runs the risk of yielding only unrealistic speculations. Therefore a period of a maximum of ten years was examined (i.e. 2001-2010).

As will be discussed later, interviews and two surveys were the main data sources. In both, the above time horizon was explicitly mentioned in order to prevent respondents from considering short-term adaptations only. Similar studies that were not explicit in their time horizon namely yielded notably short-term adaptations (e.g. Korver and Mulders, 1992; Muilerman, 2001; McKinnon and Woodburn, 1996). Other studies however showed that shippers, when specifically asked for, also expected to restructure production and distribution if (direct) transport costs increase significantly (McKinnon, 1998: 104-105; McKinnon and Forster, 2000a: 11). This suggests that firms tend to focus on adaptations within the existing organization of production and distribution, e.g. because of short-term choice inertia.

The third choice related to the time frame of the study involves the duration of the changes in transport costs examined[ii]. The focus was on structural cost increases for it is likely that a temporary increase in transport costs will not play a significant role in typically long-term decisions on production and distribution.

4.3.2 Level of analysis

Logistical decision-making is typically a multi-actor activity including for instance manufacturers, suppliers, carriers, wholesalers, and final customers. In this study logistics management was studied from the perspective of a supply chain, i.e. all the firms that are involved in the production and distribution of a particular product. Reasons for this choice were:

- it allowed an assessment of the extent to which logistical decisions are made at the level of supply chains rather than individual firms, similar to what SCM theory suggested;
- the theory reviewed in chapter 3 identified certain background variables, which affect logistical choices (e.g. product value density). These variables will probably have different values in the various sectors involved in a supply chain, which provides a basis to examine the impact of these variables on the sensitivity of firms to increased transport costs;
- many logistical studies have employed a supply chain perspective; hence this study would be complementary to the existing literature.

The supply chain perspective is not employed in a dogmatic way because firms are often involved in a network of supply chains; production and distribution therefore will be organized in a way that optimizes the whole of activities rather than those that are performed for one particular customer.

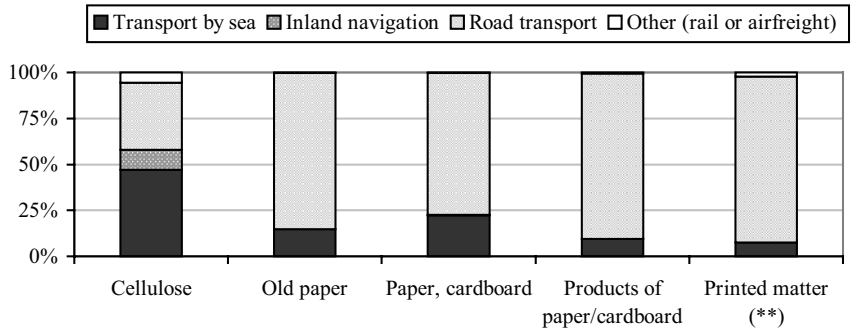
Supply chains within one single industry were preferred in order to enable an in-depth analysis. The alternative would be to examine multiple industries in order to yield a richer overview. Yet by selecting an industry that consists of different sectors, this problem may in part be resolved.

The industry chosen is the printed media industry, more in particular supply chains for books and newspapers[iii]. They include the following sectors: old paper collection and wholesale, paper production, paper wholesale, newspaper production and distribution, book publishing, printing, binding, and book distribution (including retail). The printed media industry was selected for the following reasons:

- the above sectors show a wide variety in the organization of production and distribution and in transport-intensity. Paper producers for instance serve much larger geographical customer areas than paper wholesalers;
- there is at least a potential for reducing transport demand by changing production and distribution (see Bus *et al.,* 1999b: 151-159);
- recent technological changes in production and distribution are also present in the printed media industry (e.g. e-commerce). Hence the study may reveal insights for both ‘traditional’ and modern supply chains;
- the industry produces substantial transport flows, although it has a modest share in total transport volumes (e.g. 2.6 percent in total Dutch imports and exports; CBS, 1996). Various modes of transportation are used throughout the industry, although road transport and sea transport dominate (see Figure 4.2);

- the outputs of the sectors differ with respect to product characteristics that according to the theory affect sensitivity to transport costs (see Table 4.1);
- the industry has not yet been subject to many logistical studies.

Figure 4.2: Modal split of transport on behalf of the printed media (1995)(*)



Notes: (*): only imports and exports, in tons; more recent statistics or data in ton- or vehicle-kilometers were not available; (**): books, magazines, et cetera. Source: CBS, 1996: 56-99.

Table 4.1: Logistical characteristics of products of the printed media industry (*)

	Value density	**Packaging density**	**Physical perishability**	**Commercial perishability**
Old paper	low	low (bulk)	low	low
Pulp	low	low (bulk)	low	low
Paper	low	low	low	low
Books	high	high	low	low
Newspapers	low	high	low	high (1 day)

Notes: (*): classification based on a two-point scale (high-low), cf. Ruijgrok *et al.,* 1993: 25, and Kuipers, 1999: 102, using the following standards: value density: € 1,360 per m^3; packaging density: 20 units per m^3; physical or commercial perishability: 1 week.

4.3.3 Geographical limitation

The focus was on firms located in the Netherlands for two related reasons. One, trends in traffic-intensity of firms (i.e. the ratio of ton-kilometers to vehicle-kilometers) differ heavily between countries (see Table 4.2). These differences probably reflect country-specific factors such as policy and regulations (e.g. bans on lorries in weekends or environmental regulations). As a consequence however firms in different countries probably face different levels of transport costs. Two and related to the first reason, the costs of input factors differ significantly between countries as Table 4.3 illustrates. Both may for instance affect locational choice and total logistical costs. Although the Table does not show input unit costs in the Netherlands (these were not included in the study on which the Table is based), a few years ago it was found that within Europe, firms located in the Netherlands had relatively the lowest logistical costs (Van den Bossche *et al.,* 1995: 52-53). Substantive research is required to produce general results for e.g. the European printed media industry, which however is beyond the scope of this study.

Table 4.2: Trends in road transport in Europe (1985-1995)

	France	Germany	NL	Sweden	UK
Road share in modal split	+10%	+20%	0%	+11%	+1%
Average haul length	+36%	+4%	+29%	+37%	+24%
Ton-kilometers	+57%	+33%	+60%	+48%	+46%
Vehicle-kilometers	+28%	n.a.	+30%	+18%	+37%
Ratio growth vehicle-kilometers to ton-kilometers	0.49	n.a.	0.50	0.38	0.80

Notes: n.a.: not available. Source: NEI, 1999: 16.

Table 4.3: Differences in input unit costs in Europe (1998) in indices (Austria = 100)

	Austria	France	Germany	Italy	UK
Transport costs [a]					
• Road transport	100	167	178	178	111
• Sea transport	100	86	86	71	71
• Air freight	100	83	80	83	80
Electricity costs[a]	100	57	102	114	72
Telecom costs [a]	100	57	84	95	73
Property taxes [b]	100	2,140	1,305	5	2,647
Corporate income tax [b]	100	120	199	148	97

Notes: [a]: electronics, food processing, medical devices, metal fabrication, pharmaceuticals, plastic products, telecom equipment, packaged software, and advanced software industry; [b]: same industries, except for packaged/advanced software. Source: Mair *et al.,* 1999: 27-30.

4.3.4 Research objects

Objects of analysis in this study are production and distribution networks in the printed media industry, involving the entire supply chain from raw material up to the final customer. These networks consist of individual firms that each are responsible for part of the total network. Firms will therefore be the major sources of information.

4.4 Selection of research strategies

In the introduction it appeared that four out of five research questions of this study have not yet been completely answered and therefore require additional research. Below adequate research strategies are selected. A research strategy can be defined as "a distinct way of collecting and analyzing empirical evidence" and is a "logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions" (Yin, 1994: 3; 19). Typical research strategies used in social science include experiments, surveys, analyses of archival information, histories, and case studies. Although most research problems can be addressed by all of these strategies, circumstances may make a particular research strategy preferable (see Table 4.4).

Based on the guidelines from Table 4.4 as well as additional considerations three strategies were selected: a case study, a Delphi survey, and a stated adaptation survey (see Table 4.5). The latter two strategies are both specific forms of a survey. In the following sections the research strategies chosen will be discussed in more detail.

Table 4.4: Relevant situations for different research strategies

Strategy	Form of research question	Requires control over behavioral events?	Focuses on contemporary events?
Experiment	how, why	yes	yes
Survey	who, what, where, how many, how much	no	yes
Archival analysis	who, what, where, how many, how much	no	yes/no
History	how, why	no	no
Case study	how, why	no	yes

Source: Yin, 1994: 4-6.

Table 4.5: Research strategies chosen in this research

Research question	Research strategy
• *What costs do shippers bear when moving their goods?* • *What role do transport costs play in decisions concerning the organization of production and distribution?*	case study
• *How can governments affect the costs of freight transport services?*	Delphi survey
• *What are likely logistical adaptations of shipping firms in response to higher transport costs, in particular related to the organization of production and distribution?*	case study / stated adaptation survey

4.5 Exploring contemporary logistics and the role of transport costs: a case study approach

The main reason to select the case study method for answering three out of five research questions was the predominantly exploratory nature of the questions. Rather than to obtain results that are statistically representative of a number of industries or supply chains, the questions aim at in-depth understanding of how production and distribution are organized and for what reasons, and aim at a more specific and differentiated set of hypotheses of what changes an increase in transport costs might induce. Below potential strengths and weaknesses of case studies are discussed. Based on this, the approach followed in the execution of the case studies is outlined.

4.5.1 Strengths and weaknesses of case studies

Generally case studies are considered an adequate strategy for in-depth descriptions, interpretations, and explanations of real-life phenomena e.g. for the sake of theory-building (Eisenhardt, 1995: 65-90). Their broad scope makes case studies in particular appropriate in situations where there is no sharp distinction between the phenomenon and its context (Yin, 1994: 13). This might be the case regarding the concept of logistics management: although the supply chain management theory treated in chapter 3 suggests that firms are increasingly aware of logistical processes and trade-offs, this may not be the case in the printed media industry. Case studies are frequently used to examine situations in which the intervention being evaluated has no clear, single set of outcomes (Yin, 1994: 15). This corresponds to the identification of the specific effects of an increase in transport costs: although it is likely that higher transport costs may

affect the key factors of production and distribution that affect transport demand, actual effects are probably heterogeneous. Finally, in contrast to surveys, case studies allow for adjustments of the questionnaire during the research.

Case studies also have drawbacks (Ellram, 1996: 97-105; Muilerman, 2001: 107-109; Yin, 1994: 63-74). One, there are no standard analysis techniques for data obtained in case studies. Hence, case study protocols (e.g. interview guides) and analysis procedures should be made as explicit as possible, in order to enable verification. Two, case studies seldom yield statistically representative results, which inhibits generalizing of findings. This however is no problem when the goal is building or refining theories or sets of hypotheses. Generalization can be achieved when case studies are followed by more large-scale research (e.g. surveys). Three, case studies often use interviews as a data source, which run the risk of yielding biased information. Three main potential pitfalls are (Foddy, 1996: 2):

- failure of respondents to understand the questions as intended;
- a lack of effort, or interest, on the part of the respondents;
- unwillingness to admit to certain attitudes or behavior.

The latter can be caused by various biases (Muilerman, 2001: 122-123):

- affirmation bias: answers are conformed to what is expected to be the 'right' answer in the eyes of the researcher;
- unconstrained response bias: unreliable answers because the respondent does not understand the task or because the study's topic does not appeal to him or her;
- rationalization bias: respondents want to cast existing (or future) behavior in a better light;
- policy response bias: respondents want to influence the outcome of the study by deliberately manipulating answers, thus trying to affect policy decisions that might be taken as a consequence of the study.

In the next subsection, measures that were undertaken to avoid these pitfalls in this study will be addressed.

4.5.2 Organization of the case studies

Since an important conclusion from chapter 3 was that logistical behavior tends to be rather heterogeneous, a so-called multiple-case study was conducted. This means that the same set of questions were used within several cases, with the aim of developing a rich picture of both the ways in which production and distribution are organized and how firms might respond to an increase in transport costs. The cases consisted of particular sub-supply chains within the printed media industry, i.e. supplier-buyer relationships in the various sectors.

Multiple sources of evidence were used where possible, such as professional literature, previous studies, statistics, interviews with interest groups and firms, and observations. The data collection started with an examination of secondary sources, and was in some

cases supplemented with interviews in order to validate and complement findings. Since the goal was primarily to describe current and future situations, the potential of the biases that were discussed in the previous section was not considered large. A pre-structured case outline was used to organize and analyze the data in order to facilitate verification (cf. Ellram, 1996: 107). This is reflected in the structure of chapter 6.

4.6 Assessing the flexibility of carriers: a Delphi survey

4.6.1 Introduction

The fourth research question of this study aims at exploring how and to what extent transport costs can be affected by governments. The focus is on transport costs that are perceived by shippers, i.e. carrier rates, costs related to transit times, and costs related to reliability of deliveries (see chapter 3, section 3.2). An important element in the analysis was how carriers might behave when confronted with policy interventions. For instance, will they simply pass on a cost increase to shippers or will they try to absorb increases in costs by adapting their operations?

In the literature the above types of questions have been analyzed by means of various techniques, which, for practical reasons, can be distinguished as follows:

- price elasticities research;
- mathematical modeling;
- empirical and theoretical studies of the impact of exogenous factors (such as government policies) on transport decisions.

Price elasticities research

Price elasticities studies focus on the quantitative effects of changes in the price of transport services on the demand for these or substitute services (e.g. Geurs and Van Wee, 1997 and Oum *et al.,* 1990). Price elasticity research may focus on revealed behavior or on stated behavior. In the literature however few estimates of price elasticity of freight transport demand are available. Moreover available elasticities usually do not differentiate between types of cargo or other relevant factors (Beuthe *et al.,* 2001: 253-254). In addition they commonly provide little insight into the mechanisms by which changes in transport demand are produced.

Mathematical modeling

Another research technique is mathematical modeling, also discussed in chapter 2 (section 2.2). Models contain a given set of variables and relationships between them. The aim is to reconstruct decision-making and its outcomes, and to make predictions about the effects of certain changes in decision-making. In logistical and transport research, modeling is frequently employed (see e.g. De Dios Ortúzar and Willumsen, 1994; Groothedde and Van Haselen, 1998; Tavasszy, 1996). There are however only a few models in which freight transport is incorporated. In addition often the process of transport operations is not modeled, but use is made of certain price elasticities. An exception is the SMILE model developed by TNO Inro. It enables simulation of the

effects of policy interventions such as taxation on transport operations (e.g. routing or modal choice) as well as calculations of the eventual effects on transport demand. A disadvantage is that the model necessarily is based on a large number of assumptions e.g. about likely and unlikely responses of carriers and the estimated effects of such responses (see for instance AVV *et al.,* 1998). This is not unique for the SMILE model but for mathematical modeling of logistics and transport in general. Main reasons are a lack of quantitative data on past trends or on statistical relationships between model variables (McKinnon and Forster, 2000a: 3). In addition little empirical research has been undertaken in order to validate model outcomes, despite the fact that the following characteristics may seriously reduce validity of models:

- the frequent use of controversial assumptions such as utility maximizing behavior of actors and 'rational' decision-making (i.e. structured, consistent, and purposeful action)[iv,v];
- path-dependencies are usually not modeled, although they may reduce flexibility of firms (see chapter 3, section 3.6.3);
- often, an exhaustive set of possible actions (or adaptations) is available, from which a decision-maker can choose although it is likely that not all actions available in theory will be recognized in practice. In this context, Witlox (1998) for instance states that "due to bounded rationality and limited knowledge of the satisfier, a decision-maker's choice set in evaluation consists only of those alternatives that are*, at that time,* both feasible to the decision-maker *and known* during the decision-making process" (op.cit., p. 68). Moreover, in this study a main goal is to explore the set of actions rather than assuming a particular set.

Empirical and theoretical studies

Various empirical and theoretical analyses the impact of policy interventions on transport decisions and the management of transport resources have been conducted, although most of them have not distinguished between the various levels of decision-making affecting transport demand that were discussed in chapter 2. Dings, Leurs, *et al.* (1999), Kågeson and Dings (1999), and Voordijk, Vieveen, and Bus (1999) for instance have studied the effects of increases in kilometer operating costs on the operations of carriers. In addition Korver and Mulders (1992) and Van Schijndel and Dinwoodie (2000) have described and analyzed the stated logistical responses of Dutch shippers and carriers to increased congestion on motorways.

Comparison of alternative research techniques

A disadvantage of all of the above research techniques is that they typically either focus on a (qualitative) description of the responses of carriers to policy interventions or aim to ascertain the (quantitative) effects of policy interventions on the outcomes of this process (i.e. transport demand or vehicle-kilometers driven). A combined approach would be more interesting, e.g. if an analysis is made of the relative importance of a large number of imaginary responses of carriers.

There are several ways in which the qualitative approach and the quantitative approach can be combined. One option is to examine the effects of policy interventions that have

been implemented in the past or events that resemble policy interventions. In light of this study, this option however is not available in the absence of events that have led to a substantial increase in transport costs and that have lasted for ten years or so. Apart from that, a disadvantage would be that the changes in behavior of carriers can only be compared with past behavior. Unknown is usually how behavior would have developed otherwise (i.e. in the absence of the policy intervention). The latter situation would however probably provide a better basis to ascertain the extent to which for instance cost increases can be absorbed by carriers. Extrapolation of past trends is not always adequate. The main reason is that in open systems such as the transport system, uncertainty will always exist as "the system cannot be fully controlled but is subject to impacts of many factors. Therefore it is difficult to predict which developments in these systems are likely in the future" (Ubbels *et al.,* 2001: 11).

An alternative to observations of past behavior is to rely on the expertise, opinions, and estimations of experts. In this way the research questions can be addressed more specifically since the impact of certain policy interventions can be isolated. Experts can be consulted in a number of ways:

- individual expert consultations, e.g. via interviews or surveys;
- group consultations, i.e. expert meetings or Delphi surveys.

For the purpose of this study a Delphi survey was chosen. Delphi surveys consist of "a series of repeated interrogations of a group of experts, focusing on reaching a consensus among them" (Marchau and Van der Heijden, 1998: 250). Experts are generally asked for their anonymous reaction on a set of questions. The responses are fed back to the experts in order to encourage a 'virtual' debate. Experts are given the opportunity to change their original opinion using the group information, after which a new interrogation round starts (Van Houten, 1988: 5; Woudenberg, 1991: 133).

A Delphi survey was preferred to other ways of expert consultation for several reasons. One, the (indirect) exchange of opinions occurs was expected to accentuate opinions or make them more complete. Two, compared to expert meetings there is no influence of dominant persons, no (or less) influence of social desirable behavior or majority thinking, and time for the experts to develop or adjust opinions (Daniëls and Duijzer, 1988: 89). Three, Delphi surveys are used frequently in studies in the field of transport and logistics (see for instance Marchau, 2000 or McKinnon and Forster, 2000a for an overview). Therefore the methodological knowledge that has been built could be used.

4.6.2 Strengths and weaknesses of Delphi surveys

In the previous section, three characteristics of Delphi surveys were discussed that represent their strengths vis-à-vis alternative methods. Delphi surveys however also face several potential methodological pitfalls. One, as the number of experts involved is usually small, they do not (and are not intended to) produce statistically representative results. They represent the synthesis of opinion of a particular group, no more, no less (Gordon, 1994: 4). Two, by seeking consensus they tend to promote a conservative view of the future and reinforce existing paradigms[vi]. Three, Delphi surveys generally

offer little insight into the reasoning behind responses. Therefore Delphi surveys are often considered as "a last resort where no other, more scientific method can be deployed to investigate a particular subject given its complexity and uncertainty" (McKinnon and Forster, 2000a: 3). Finally a number of biases may occur when questionnaires are inadequately constructed (see section 4.5.1). Measures to deal with these disadvantages will be discussed below.

4.6.3 Organization of the Delphi survey

The Delphi survey was organized in two stages. First several scenarios were developed that each describe the implementation of policy interventions that have an impact on transport costs. For this purpose, a literature study was conducted in order to explore how governments can affect transport costs. Second, a Delphi panel was consulted in order to assess (a) the likely responses of carriers to these scenarios and (b) the eventual impact on carrier rates, transit times, and delivery reliability. Below the two stages of the Delphi survey are elaborated.

Policy scenarios used

Scenarios are "plausible narrative descriptions of the future that focus attention on causal processes and decision points" (Futures Group, 1994: 5). Usually they involve a characterization of the environment of the subject under study, in particular "that part of the environment which has important repercussions for the organization but in which it has limited influence" (Van der Heijden, 1996: 6; 292). Scenarios are often used to show the consequences of specific actions in situations where large uncertainty exists (Banister *et al.,* 2000: 112; Ubbels *et al.,* 2001: 11). Extrapolations are often not possible in such cases. Scenarios are frequently used to explore future developments in the transport sector, which due to its open character is subject to a multiplicity of factors (for an example, see Ministerie van Verkeer en Waterstaat, 1998)[vii].

By means of scenario analysis the impact of policy interventions on the transport sector and on transport costs could be isolated from the impact of other factors. For this purpose first the autonomously expected trends in the behavior of carriers as well as in transport costs were assessed (i.e. the 'autonomous scenario'). Subsequently these trends were compared with the expected effects of the policy scenarios under study in order to reveal their impact. The autonomous scenario and the policy scenarios had a time horizon of 2001-2010 (cf. section 4.3.1). Policy interventions were selected that were plausible in order to avoid unconstrained response bias on the part of Delphi participants (see section 4.5.1).

Delphi survey set-up

The Delphi panel was asked to give estimations of expected trends in the behavior of carriers related to the management of transport resources (e.g. modal choice, consolidation activities, et cetera) as well as expected development in carrier rates, transit times, and delivery reliability. Below three specific aspects in the survey design will be discussed in more detail.

(a) Selection of experts

The specific type of expertise desired in this Delphi survey involved knowledge of the following issues:

- pricing strategies of transport firms;
- options available to absorb an initial deterioration in costs, transit times, and reliability caused by certain policy interventions (e.g. more use of ICT in order to improve load factors);
- options likely to be chosen in response to certain policy interventions;
- other effects of policy interventions on the transport market, affecting rates, transit times, and reliability (e.g. entry of low-cost foreign transport firms).

The experts were provided with estimations of current rates, transit times, reliability, and cost structures of the transport modes under study, as well as an overview of possible options to respond to policy interventions (which could be supplemented by the panel). In this way it was hoped to address a broader pool of experts whereas the Delphi panel at the same time were stimulated to employ a more or less similar starting point with respect to these variables. The experts were identified through contacts of myself and my supervisors, (professional) literature, and through 'snowballing' (i.e. asking experts that were invited to provide names of additional experts).

Relying exclusively on experts working at transport firms was expected to yield biased data, notably due to the risk of policy response biases. This is motivated by the observation in another Delphi survey that shippers and carriers had completely different expectations with respect to future carrier rates (Cooper *et al.,* 1994: 251). This may partly be caused by wishful thinking. Therefore, it was decided to include other experts as well, namely persons who are narrowly involved in the transport market, such as interest groups and shippers, or experts who act as 'observers' (e.g. scientists, researchers, or policy makers from the Ministry of Transport). Obviously, each of these experts will have their own bias, which however could be revealed *ex post* by comparing opinions of groups of experts sharing the same professional background. Another potential advantage of a broad Delphi panel was that it may enrich the variety of responses from carriers that policy interventions may induce. In this way experts were stimulated to reason not only from existing paradigms, which is a potential pitfall of Delphi surveys (see section 4.6.1)[viii].

(b) Questionnaire

The questionnaire that was used in the Delphi survey addressed two types of questions. One, experts were asked which responses of carriers they expect in each policy scenario. For instance in response to an additional tax per kilometer, carriers could be expected to become more active in acquiring return cargo in order to reduce empty running. This part was of interest in order to reconstruct the rationale of the answers to the second part of the questionnaire, i.e. an estimation of how rates, transit times, and reliability will be affected. In this way one of the weaknesses of Delphi surveys was reduced, i.e. that they provide little insight into the respondents' reasoning.

Pre-specified answers were used for two reasons:

- to simplify analysis of the intermediate and final results;
- to reduce the efforts demanded from respondents, which may increase response rates and reduce dropout.

A disadvantage was that biases could occur because answers are suggested instead of spontaneously given by respondents (Foddy, 1996: 128). The risk however was expected to be low since the empirical and theoretical literature described above revealed many of the options that carriers have to respond to policy interventions. Yet unclear is which options are feasible and will be chosen. Experts were given the possibility to add other responses, which could be included in subsequent interrogation rounds (cf. Marchau, 2000: 62).

(c) Stopping criterion

Delphi surveys aim to achieve some form of consensus among the Delphi participants. In this context, consensus should be considered a means, not an end. Continuing interrogating a Delphi panel in order to achieve consensus may produce new insights or a refinement of earlier opinions. Ideally the interrogation ends when complete consensus is achieved. Given the fact that this rarely occurs in practice, interrogation rounds are often stopped if a certain degree of stability in answers is obtained (Daniëls and Duijzer, 1988: 89-90; Marchau, 2000: 59-60). The literature however does not provide unambiguous stopping criteria, which therefore had to be developed (see chapter 5).

4.7 Assessing shippers' responses to increased transport costs: a stated adaptation survey

4.7.1 Introduction

A stated adaptation survey was selected in order to explore the changes in the organization of production and distribution due to increased transport costs. Alternative research strategies, i.e. mathematical modeling and experiments, are discussed below.

Mathematical models

Mathematical modeling was treated in detail in section 4.6. The main reason why models were disregarded in this study was that they contain a limited set of possible actions or adaptations firms are assumed to choose from, whereas it is not certain whether or not this set is exhaustive. Moreover, based on the conclusions from chapter 3 a certain heterogeneity in firm responses to higher transport costs may be expected, which is probably difficult to include in models because not all explanatory variables are known (see chapter 3, section 3.6.1). Finally there are practical reasons to disregard models: modeling is very time-consuming and there may be data collection problems (e.g. with respect to price elasticities; see chapter 1, section 1.2).

Experiments

Experiments typically focus on decision-making processes. Persons are grouped in a laboratory setting and are confronted with a particular event, leaving all other variables in the subject's context constant. By observing subsequent changes in behavior, very accurate assessments of the impacts of that experimental variable can be made. Furthermore, replication of the experiment is easy due to limited time and costs. A weakness of many experiments however is that social processes that occur in a laboratory setting may differ from those that occur in a more natural setting (Babbie, 1998: 251).

For the purposes of this research, an experiment could be designed in which logistics managers are asked to redesign a fictitious logistical system in response to a particular change in transport costs. This approach was for instance employed by Van den Bossche *et al.* (1995). Although the advantage compared to modeling is that fewer assumptions are needed since observation is possible, the need for simplifying assumptions is not reduced to zero. Hence, still some of the problems that were identified above may occur. Moreover, many biases on the part of the respondent could occur that are difficult to control for (e.g. unconstrained response biases; see section 4.5.1). Finally additional research activities would be necessary to reveal the rationales behind the observed behavior.

In view of the above disadvantages of modeling and experiments, the so-called stated adaptation technique was chosen. In the next sections this approach will be discussed and subsequently the organization of the survey will be outlined.

4.7.2 Strengths and weaknesses of stated adaptation surveys

Surveys in general are often regarded as adequate strategies to test specific hypotheses on a large scale, with the aim to obtain statistically representative findings. The predominant use of quantitative and pre-defined answers facilitates data processing and statistical analysis. However, surveys have several potential disadvantages, including:

- statistically significant relationships between variables do not always represent causality; e.g. intervening variables may be overlooked (Muilerman, 2001: 106);
- low response rates, in particular when postal surveys are used. This can be reduced however by focusing on industries that are not frequently subject to survey research, by limiting the amount of work required to fill in the survey, and by employing a clear and unambiguous questionnaire;
- biases caused by inadequate formulated questions (see section 4.5.1);
- the validity of the survey outcomes depend on the efforts made by respondents to provide realistic answers, which cannot completely be controlled by the researcher.

Stated adaptation surveys are specific surveys that aim to explore (changes in) attitudes and behavior of target groups in hypothetical situations. They can address any possible event, whereas their experimental character allows for very accurate assessments (e.g.

by comparing the effects of a number of different scenarios). In this respect they resemble experiments. In transport research the technique has been used notably in passenger transport studies, for instance to assess the impact of road pricing on travel behavior. Stated adaptation surveys usually start with an inventory of current transport activities, from which constraints faced by the respondents can be deduced (e.g. availability of transport alternatives). These constraints are used to control for unrealistic responses (e.g. unconstrained response biases). Stated adaptation research shares many characteristics with stated preferences research, but a distinguishing feature is that stated adaptation surveys usually leave respondents free in their responses (Faivre d'Arcier *et al.,* 1998: 170-171).

Stated adaptation surveys may yield incomplete data, e.g. when respondents are unwilling to give exhaustive information (Swanborn, 1987: 267). By confronting respondents with other sources of evidence (e.g. the literature), this bias may be reduced but not avoided. Apart from that, stated adaptation surveys may face potential biases due to inadequate formulation of questions or interpretation errors, or by biases on the part of the respondent (notably unconstrained response biases, non-commitment biases, and policy response biases).

4.7.3 Organization of the stated adaptation survey

Below several specific elements of the stated adaptation survey will be discussed, namely the data collection technique, the questionnaire set-up, the interviewees, and the scenarios that will be examined.

Data collection

Face-to-face interviews were held because important advantages as opposed to a postal survey are the possibilities to ask follow-up questions, to clarify the purpose of the research, explain questions (the need for which may be observed by non-verbal communication), and to respond to unrealistic answers. Additionally, experiences from other studies (e.g. Muilerman, 2001) suggest that interviews may yield a higher response than postal surveys.

Questionnaire

The questionnaire that was used in the stated adaptation survey consisted of three parts. The first part of the interview concentrated on an inventory of the existing organization of production and distribution. In addition, information was gathered about some background variables, which according to chapter 3, are important in logistical decision-making and hence may explain variance in the survey outcomes.

In the second part of the interview, firms were asked to express their logistical plans for the next 10 years. For instance, do they foresee a reduction in the number of distribution centers, or the adoption of other production techniques? And what are the main reasons for these changes? In particular, they were asked how they expected that carrier rates, transit times, and reliability will develop and whether or not this had affected their

plans. This is relevant information, since firms may have different expectations with respect to these variables. The rationale of identifying the autonomous plans was twofold. One, it allowed for an assessment of the impact of a change in transport costs. Two, it could reveal unrealistic responses (e.g. when a stated adaptation differs strongly from the current situation or the autonomous trend). Alternative questions like "suppose you are to reconsider production and distribution, what would you do if carrier rates increase by 25%?" were expected to leave less room for such control.

The third part of the interview focused on the stated adaptations. Respondents were asked how their plans would be altered if they know that transport costs develop in a particular way, and what the main reasons for that behavioral changes were. The emphasis was on the most likely adaptations (cf. HCG, 1992, in a similar study). When the responses differed from what was found to be plausible from the case studies (e.g. if an expected adaptation is not mentioned), respondents were asked for clarification[ix]. Logically, there are four answers:

- there was no (perceived) relation between the expected adaptation and transport demand or transport costs;
- the change in transport cost was absorbed by other adaptations (e.g. at the level of transport operations);
- the change in transport costs was not radical enough to render such an adaptation profitable;
- the adaptation was not possible for one reason or another (e.g. sunk investments).

Respondents were given the possibility to answer freely. The reason was that the case study that preceded the stated adaptation survey might not have revealed all plausible adaptations to higher transport costs: only part of the firms in the printed media industry was examined in the case studies and firms often tend to be more creative than originally foreseen. Respondents were confronted with a set of key indicators of production and distribution, identified in chapter 2, in order to yield specific answers. McKinnon and Woodburn (1996), in a study exploring British manufacturers' responses to a 50 percent increase in road transport costs, namely recorded notably responses such as "consider alternative distribution methods" and "improve efficiency of current operations". For the purpose of this research, such answers were not considered specific enough. In addition it was expected that my approach would yield answers that are more comparable across firms and sectors. In line with section 4.2, respondents were allowed to express logistical adaptations that could be outside the scope of production and distribution, e.g. transport operations.

In the preceding section it was recognized that stated adaptation surveys may yield invalid data due to biases caused by inadequate formulation of questions or due to biases on the part of the respondent. Table 4.6 describes the measures that were undertaken in order to avoid or reduce such biases. Although these measures were no absolute guarantee that biases were avoided, they seemed to be sufficient for their purpose.

Table 4.6: Overview of measures, aimed at reducing or avoiding interview biases

Potential bias	Measure
Failure to understand questions as intended	• use technical terms (source: case study results (chapter 6)) • relate questions to respondent's situation
Lack of effort or interest of respondent	• give something in return (e.g. copy of final thesis) • explain background and guarantee confidentiality • use of plausible questions and scenarios • open answers
Unwillingness to give exhaustive information	• confront with data from case studies • confront with (anonymous) data obtained from previous interviews in the same sector • observation on site or information from annual reports
Affirmation bias	• do not pose suggestive questions
Rationalization bias (e.g. by suggesting that decisions will be based on extensive calculations rather than on intuition)	• control questions (relate answers to current practices; source: case study results)
Policy response bias	• control questions (source: case study results)
Unconstrained response bias (i.e. answers that do not seem plausible)	• control questions (source: case study results) • relate adaptations to current situation or autonomous plans • limit the time horizon that is examined • triangulation: interview both suppliers and customers • use of plausible questions and scenarios • ask for reasons behind answers (four logical answers)
Interpretation bias interviewer	• send respondents interview report for correction

Interviewees

The analysis of two supply chains enabled a comparison of the stated adaptations of firms that are in a supplier-buyer relationship. For instance will suppliers adapt their distribution patterns or will buyers be forced to adapt their ordering behavior? It was expected that an important explanatory variable in this context would be the distribution of power between the firms (see chapter 3, section 3.6.2). In theory, inconsistencies in responses of suppliers and customers enabled control questions and could reveal possible biases. Few if any inconsistencies were found, however (see chapter 7).

Within firms, logistics managers were interviewed since logistics is their profession and hence they usually are acquainted with all aspects of production and distribution (cf. Kuipers, 1999: 107)[x]. Therefore they were expected to have a good feeling of how decision-makers other than themselves would respond to higher transport costs. Finally, logistics managers were easier to approach than decision-makers at board level.

Scenarios

A few scenarios were constructed that each describe a particular change in transport costs caused by policy interventions. These scenarios were largely based on the results of the Delphi survey in order to guarantee a certain level of plausibility. The number of scenarios was restricted in order to avoid fatigue effects on the part of the respondent: due to its character it was expected that the survey would take quite some time.

4.8 Generalizability of research outcomes

An important issue that has not yet been addressed concerns the generalizability of the results of the case studies, the Delphi survey, and the stated adaptation survey. Below the generalizability issue will be elaborated in more detail.

4.8.1 Generalizability of the case study findings

The case studies aimed at getting a better insight into production, distribution, and transport activities in the printed media industry, as well as the likely impact of higher transport costs. Thus the issue that will be addressed below is whether or not the findings are representative of the printed media industry as a whole.

In section 4.5.1 it was already concluded that case studies seldom yield results that are generic for the whole population that is under study, because samples are rarely representative. In the case studies that were conducted in this study, this problem only applied in part since the focus was not on individual firms but on the typical organization(s) of production and distribution in the various sectors. For this purpose notably data sources were employed that have a sector perspective rather than a firm perspective (e.g. sector studies or interviews with sector or industry interest groups). The exploration of likely and unlikely responses to higher transport costs however is not necessarily representative because of two reasons:

- chapter 3 concluded that responses to higher transport costs will probably be heterogeneous rather than homogenous, both at industry level and at sector level. The case studies however have not addressed this issue in detail but rather focused on likely dominant responses per sector;
- part of the expected responses were based on deduction rather than empirical evidence.

The fact that the cases were not completely representative regarding the likely effects of higher transport costs was not problematic, however. The goal of the case studies was building theory rather than obtaining generic results. The latter was the aim of the stated adaptation survey, in which representative samples of firms were interviewed.

4.8.2 Generalizability of the Delphi survey results

The Delphi survey aimed to assess the effects of policy interventions on the behavior of carriers and the eventual implications for carrier rates, transit times, and delivery reliability. A time frame of 10 years was employed whereas the focus was on the Netherlands (see section 4.3).

There are several aspects of the Delphi survey that make its conclusions indicative but not necessarily representative of the transport sector as a whole:

- only a few policy scenarios were used. It is however plausible that different policy interventions will have different effects;

- within the time horizon employed it is possible that some of the options that carriers have to adapt to a changing environment have not yet become variable (e.g. investment in transport means). In addition a longer time horizon could have provided new opportunities to restructure transport operations (e.g. by switching to future technologies such as underground transport systems);
- the transport market can be subdivided into many different market segments related to transport modes, types of cargo, or quality characteristics (e.g. reliability or speed). Time and budget constraints inhibited a full analysis of all market segments, which reduces generalizability of the Delphi findings;
- the findings are not necessarily representative of carriers operating in other countries than the Netherlands, among other things because chapter 5 will demonstrate that cost structures of foreign carriers are not equal to those of Dutch carriers. This may lead to differences in flexibility.

In chapter 5 therefore the limitations of the Delphi survey results will be discussed in more detail.

4.8.3 Generalizability of the stated adaptation survey outcomes

Regarding the outcomes of the stated adaptation survey, three issues are relevant:

1. representativeness of the interview samples to the whole industry;
2. generalizability of conclusions to other industries;
3. generalizability of the policy interventions that were examined.

The obvious way to safeguard generalizability of the survey outcomes to the entire industry is to select a representative sample of firms that are interviewed. This however was not obvious in the light of the conclusion from chapter 3 that logistical behavior tends to be heterogeneous whereas there is no consensus in the literature about which factors are decisive in logistical decision-making. Nevertheless the survey yielded insight into the dominant adaptations to higher transport costs.

Generalizability to other industries is complicated because of the difficulties that appear to exist in clustering firms into 'logistical families' (see chapter 3, section 3.6.1). However in the recent past, various similar studies have been undertaken, the results of which were compared with the outcomes of this study (e.g. McKinnon and Woodburn, 1996 or Muilerman, 2001). This at least enabled an analysis of commonalities in stated adaptations. In addition, this and other studies revealed factors that can explain why certain types of firms expect to reveal a particular type of adaptation (e.g. product value density)[xi]. Based on this, new hypotheses can be formulated about how other industries might respond. Testing of these hypotheses however is beyond the scope of this study.

A final issue is the generalizability of the effects of policy interventions. Only two policy scenarios were examined and hence no conclusions can be drawn about the effects of transport policy in general. The stated adaptation survey did however reveal the main trade-offs that involve transport costs, which can be used to analyze the effects of other policy interventions (e.g. by estimating threshold values).

4.9 Conclusions

An important conclusion from the preceding chapters was that additional empirical research is needed to answer the following research questions:

- what costs do shippers bear when moving their goods?
- how can governments affect the costs of freight transport services?
- what role do transport costs play in decisions concerning the organization of production and distribution?
- what are likely logistical adaptations of shippers in response to higher transport costs, in particular related to the organization of production and distribution?

In this chapter the methodological approach that was used to answer the above questions was outlined.

First the overall organization of the remainder of the study was discussed. It was decided to analyze the impact of policy interventions on carrier rates, transit times, and delivery reliability in isolation from the effects of changes in these variables on the organization of production and distribution.

Second the research field was defined. The most important choices included:

- the study focused on contemporary and future events, with an emphasis on the long term (i.e. 2001-2010);
- only structural increases in transport costs were considered;
- the effects of higher transport costs were explored by examining supply chains within the printed media industry;
- only firms located in the Netherlands were examined;
- a small number of transport cost scenarios were examined.

Third, research strategies were selected. A case study approach was chosen to examine how production and distribution are organized in practice, to explore the main types of costs related to freight transport as well as their role in logistical decision-making, and to explore the likely effects of increases in transport costs on production an distribution systems. The case study approach was considered adequate because of the exploratory nature of the questions, the fact that no *ex ante* exclusion of potentially relevant factors is required, and its flexibility with respect to the questionnaire.

The exploration of how policy interventions may affect transport costs was conducted by means of a Delphi survey. There were two reasons for this choice. One, given the complexity of the issue it was felt that consultation of a broad pool of experts was appropriate. Two, the iterative nature of a Delphi survey was expected to have additional benefits over alternative ways of expert consultation.

Finally, to assess the responses of shippers within the printed media industry to a change in transport costs, a stated adaptation survey was chosen. This approach requires far less assumptions than alternative research strategies such as modeling or

experiments. However, specific attention was paid to avoid or reduce a number of biases, which may occur in conducting the interviews.

In chapters 5 through 7 the results of the above three research strategies will be described and analyzed. Specific methodological issues related to data collection, analysis techniques, operationalizations, and questionnaires, will be discussed in these chapters as well.

One implication of the methodological choices made is that the empirical study is more qualitative than quantitative of nature. The main reason was that theory as well as empirical studies have demonstrated that due to its heterogeneity and openness to many factors, logistical behavior can only be modeled under strict assumptions. Thus the outcomes of this study will lead to a better understanding of the role of transport costs in contemporary logistical decision-making rather than to a quantified overview of the various responses that an increase in transport costs may induce. The generalizability and the limitations of the study outcomes were already discussed in this chapter, but will be re-addressed in the final chapters of this dissertation.

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[i] Note that this logic and sequence of adaptations is similar to the SMILE model discussed in chapter 3, section 3.6.3.

[ii] Duration refers to the length of time that an event lasts (Monge, 1995: 273).

[iii] Magazines were excluded due to time constraints. In addition, it was expected that books and newspapers were more different in a logistical perspective than books and magazines or magazines and newspapers. The reason is that concerning the logistical characteristics from Table 4.1, many magazines have a value in-between those of books and newspapers.

[iv] Consistency for instance means that it is assumed that if alternative A is preferred to B, and alternative B is preferred to C, then A is preferred to C (i.e. the neoclassical transitivity theorem). This assumption has proven to be invalid in several situations, however.

[v] Models based on decision tables or decision plan nets often employ these assumptions (see for instance Witlox, 1998).

[vi] Note that this may also be due to the fact that many experts appear to assume a lack of surprises, which however is not specific to Delphi surveys (Marchau, 2000: 59-60).

[vii] For a more detailed analysis of the use of scenarios, see for instance Van der Heijden (1996).

[viii] Only Dutch experts were invited for two reasons. One, the focus was on freight transport from and to the Netherlands by notably Dutch carriers, with which the experts were expected to be most acquainted. Dutch carriers were chosen because of differences in costs structures of carriers between countries (see chapter 5), which might affect the extent to which they can absorb cost increases due to policy interventions. Two, there were practical reasons to choose Dutch experts only (e.g. identification).

[ix] In this way, part of the case study material was used to triangulate by posing control questions, which was expected to raise validity of the stated adaptation survey.

[x] In most cases, the names of the managers responsible of logistics were identified by means of telephone calls with secretaries. The logistics managers were sent a letter in which they were asked for an interview. The purpose of which was explained in the letter as well. In a few cases, the letter was handed on to a person within the same firm who had more experience or knowledge.

[xi] Note that this was one of the reasons to select the printed media industry, because the industry consists of sectors that show a large variety in product characteristics and other background variables (see section 4.3.2).

5 Policy interventions and the flexibility of freight carriers

5.1 Introduction

The central issue that will be explored in this chapter is how and to what extent governments can affect the costs of freight transport services. The focus is on those dimensions of freight transport that may affect shippers' costs, i.e. carrier rates, transit times, and delivery reliability (see chapter 3, section 3.2).

In the previous chapter it was concluded that carriers may to some extent offset the effects of policy interventions that (directly or indirectly) aim at raising the cost of freight transport or that negatively affect transit times and delivery reliability. Carriers may for instance offset higher fuel taxes by reducing the amount of kilometers driven or by investing in more fuel efficient engines. Adapting the management of their transport operations thus provides them some flexibility to respond to policy interventions. This flexibility will be assessed in this chapter for two reasons:

- to assess the extent to which policy interventions work through the various levels of logistical decision-making that appeared to affect transport demand (see chapter 2). Policy interventions that are completely absorbed by carriers will probably not induce (large) adaptations by shipping firms;
- to develop plausible transport cost scenarios for the stated adaptation survey (treated in chapter 7). The main rationale for this is that (highly) unrealistic scenarios may run the risk of yielding unrealistic and hence invalid results (e.g. due to unconstrained response biases; see chapter 4, section 4.5.1).

This chapter is structured as follows. Section 5.2 describes various ways in which policy interventions may affect transport costs. Subsequently in section 5.3 the focus is on how carriers may respond to such policy interventions. In section 5.4 the organization of the Delphi survey is outlined, which aimed to assess the specific impact of particular policy interventions on transport costs. The Delphi survey examined three scenarios, the results of which are described and analyzed in section 5.5 through 5.7. Conclusions are drawn in section 5.8.

5.2 Policy interventions and transport costs

There are many ways in which governmental action may affect carrier rates, transit times, or delivery reliability. Distinction can be made between policy measures that deliberately are aimed at these variables and measures of which changes in these variables are a side effect. An example of the first type of policy are new or higher levies on freight transport, whereas the second type of policies for instance includes labor regulations on resting times of truck drivers. Stricter regulations in this area may reduce overall productivity of carriers and hence inflate total costs, which subsequently may result in higher carrier rates.

An exhaustive exploration of the whole range of policy interventions that have an impact on transport costs is beyond the scope of this chapter. Instead, an overview will be given of some of the main policy interventions that have an impact on transport costs[i].

5.2.1 Policy interventions and carrier rates

Policy interventions may affect carrier rates in various ways. One, governments may set minimum or maximum levels of carrier rates. Although such price regulation is common in passenger transport (i.e. public transport), it has become less common in the context of freight transport. Two, governments may affect prices of transport services via taxes such as VAT. Three, transport prices can be affected indirectly if governments succeed in affecting scarcity of freight transport, e.g. by restricting the amount of traffic that is allowed on its territory (which is the case in for instance Austria and Switzerland). Finally, policy may affect carrier rates through interventions that affect operating costs of carriers (e.g. labor regulations). Since most of the policy interventions that affect transport costs work through the latter mechanism, this section will focus on such interventions.

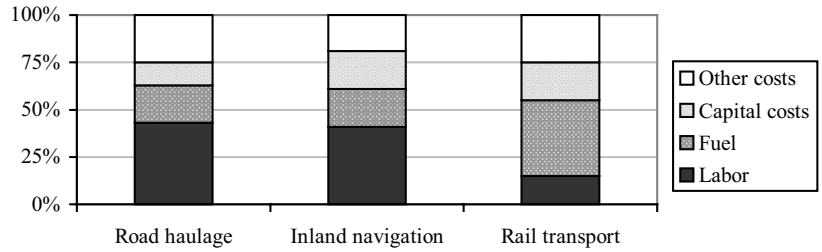
Taxes are an important instrument for policy makers who want to affect transport costs. In Europe various governments have announced plans to introduce new taxes of notably road transport haulage, mainly with the aim of slowing down the expected growth in freight transport. Examples include:

- the German, Austrian, English, and Dutch governments have plans to introduce levies that vary with the amount of kilometers driven (Nieuwsblad Transport, December issues 2001). These taxes could be relatively high; for instance the German kilometer tax will mount to 15 €-cents per kilometer whereas the average current rate per kilometer is about € 1;
- the European Commission envisages a phased introduction of taxes that aim at full internalization of external social costs of (freight) transport (EC, 1998; 2001);
- tax restructuring. In the Netherlands for instance the aim is to replace fixed annual taxes by taxes that are more directly related to actual transport behavior or pollution (i.e. ‘variabilization’) (ministerie van Verkeer en Waterstaat, 1999).

These planned taxes supplement existing taxes such as excise duties on fuel, which are not only meant as a source of state revenues but also aim at providing an incentive for an efficient use of this resource.

The initial consequences of taxes on operating costs and eventually on carrier rates will depend on the level of the tax as well as the level and structure of total operating costs. In this context, the impact of higher fuel taxes will be different for the various modes of transportation (see Figure 5.1).

Figure 5.1: Cost structures in inland navigation and road haulage (*)



Note: (*): data 2000, concerning international transport by Dutch carriers. Sources: inland navigation: NEA, 2001; road haulage: TLN, 2001: 83; rail transport: confidential.

Apart from taxation, governments may affect operating costs and carrier rates in more indirect ways, including:

- environmental regulations, e.g. concerning maximum noise levels of airplanes or emissions of trucks. These regulations may for instance require additional investments;
- technical regulations, e.g. on the maximum load capacity of trucks. Raising the maximum weight of trucks to 60 tons may allow carriers to transport larger volumes of freight per haul, raising productivity of drivers and trucks;
- investment in new infrastructure. Additional lanes on motorways may increase average driving speed, which affects productivity (i.e. the number of hauls per day or the number of drops per haul). As a consequence unit costs and rates may fall[ii]. In rail transport, the new safety system BB21 may increase capacity of the rail network, which in turn may lead to lower unit costs for infrastructure use[iii]. Finally in inland navigation, deepening of canals may enable the use of larger vessels or more freight on existing vessels;
- market regulations. Liberalization and deregulation of transport markets are often cited as factors that have led to a fall in operating costs and carrier rates, because they enable and stimulate carriers to raise efficiency of operations (e.g. Cooper *et al.,* 1994: 251-259; Dutz *et al.,* 2000);
- fiscal policy. For instance, in the Netherlands several years ago fiscal arrangements for sea carriers were relaxed, because many shipowners had relocated to other countries (i.e. 'flagging-out'; Nieuwsblad Transport, October-December 1995).

5.2.2 Policy interventions affecting transit times and delivery reliability

The door-to-door transit time of freight transport can be considered a function of average speed and total distance that has to be overcome. They may be affected by many factors that are exogenous to carriers but that are within the sphere of influence of governments, such as:

- available infrastructure and new investment, which affect both speed and distances (a dense network will for instance provide relatively many options to avoid detours);
- congestion on roads or in sea ports, decreasing average speed[iv];
- customs procedures at borders that may cause delays;
- delivery windows for city distribution that limit the period during which trucks are allowed to enter city centers for pickup and delivery.

Delivery reliability refers to the extent to which planned arrival times coincide with actual arrival times. Delivery reliability may deteriorate when freight movements take longer due to delays. In particular congestion is a main cause of unreliable deliveries. Although for instance part of the queues on motorways have become regular (e.g. during peak hours when commuters travel between work and their homes), part of the queues remain unpredictable and hence complicate an accurate planning of arrivals. In turn this may lead to lower delivery reliability. Yet the use of ICT may improve planning. For instance with the aid of telecommunications, drivers easily can notify shippers or receiving firms about delays. In this way actual arrival still may differ from the planned arrival, but scheduling costs may be reduced because receiving firms are able to reschedule their planning.

Governments may affect delivery reliability via the factors that were mentioned in relation to transit times. An additional policy instrument that is currently considered in the EU is the investment in a pan-European satellite navigation system, Galileo. This system may enable carriers to improve their planning because it enables tracking-and-tracing of vehicles, containers, or other transport means, and because it facilitates telecommunications.

5.3 Flexibility of freight carriers[v]

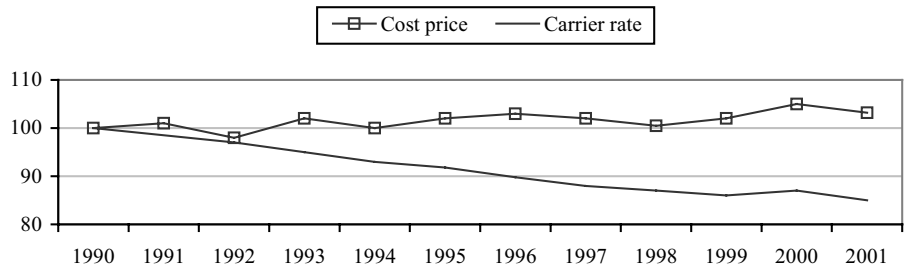
5.3.1 Flexibility in the context of higher costs due to policy interventions

In chapter 2, section 2.3, various activities were identified that are related to the management of transport operations. By adapting these activities carriers may avoid or absorb cost increases due to policy interventions. There are four distinct ways in which carriers can absorb policy interventions that have an impact on carrier costs and rates[vi]:

- reducing input use if the policy intervention affects a particular input (e.g. in the case of fuel taxes);
- compensating by cost reductions in other areas (e.g. less overhead);
- accepting lower profits;
- raising overall productivity or efficiency of operations.

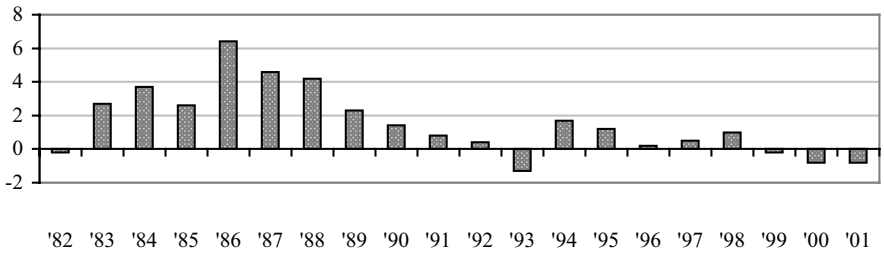
Another option is to pass on (part of the) cost increase to shippers. In particular in road haulage this is not always possible due to fierce competition. As Figure 5.2 shows in the last years costs have increased more than rates, which is partly caused by cost absorptions and partly by lower profit margins (see Figure 5.3)[vii]. In contrast, deep sea carriers regularly introduce surcharges due to higher bunker and currency costs (so-called BAF's and CAF's; bunker or currency adjustment factors), indicating that they have fewer problems with passing on cost increases to their customers.

Figure 5.2: Trends in carrier rates and operating costs in international road haulage by Dutch carriers in real terms (1990=100)



Source: TLN, 2001: 95.

Figure 5.3: Trends in profit margins in international road haulage (*)



Note: (*): in % of net turnover; Dutch carriers only; 2001 estimate. Source: TLN, 2001: 97.

5.3.2 Flexibility in the case of longer transit times or reduced reliability

Investment in infrastructure or the absence of investment, leading to increased congestion, is among the main ways in which governments may affect transit times and delivery reliability. In addition they may affect costs that vary with transit times, such as labor costs (Van Schijndel and Dinwoodie, 2000: 235). Congestion may occur at various stages of a transport chain, e.g. at the point of transshipment or en-route. Again carriers have various options at their disposal to avoid or reduce delays, including:

- rescheduling arrivals or departures (e.g. more overnight transport);
- re-routing (i.e. using alternative, less congested routes);

- improved planning of hauls and routing, e.g. due to more investment in and use of advanced planning systems;
- improving productivity by raising load factors, which may reduce the total number of hauls and hence make carriers less sensitive to delays.

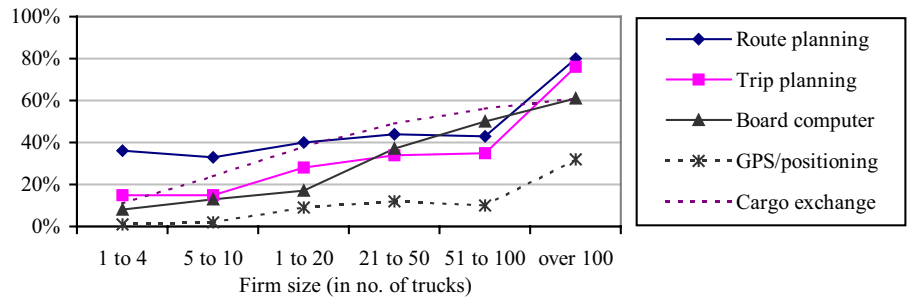
5.3.3 Short-term versus long-term flexibility

In chapter 2, section 2.3, it appeared that transport operations notably consist of day-to-day activities such as consolidation, routing, and vehicle choice. Given the short-term flexibility of these activities, it was concluded in chapter 4 (section 4.2) that policy interventions will in first instance notably induce adaptations in the management of these transport activities. Yet carriers' flexibility is probably even larger in the long term, where more options to respond to changing circumstances may be available (e.g. fleet renewal). Thus, the time frame is important when assessing flexibility to change.

5.3.4 Other effects of policy interventions

Apart from the above effects, policy interventions may also affect the organization of the transport sector. If for instance due to a particular intervention carriers are forced to improve productivity in terms of load factors, large firms may appear to be more successful than small ones. Reasons may be that they have larger staffs for cargo acquisition or can more easily finance investment in advanced planning systems (see Figure 5.4). Hence in the long term policy interventions may lead to a shake-out of small firms and thus to an upscaling in average firm size. This may have second-order effects on carrier rates: if market power of carriers improves due to more concentration, carriers can more easily pass on higher costs.

Figure 5.4: Use of ICT applications by Dutch road hauliers (2001)

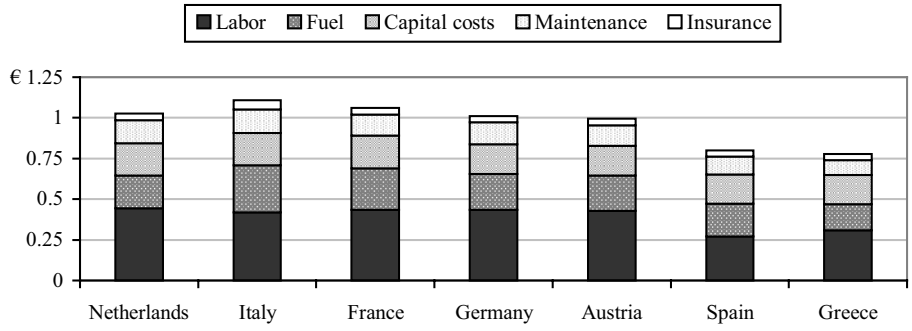


Source: TLN, 2001: 103.

A second possible effect of policy interventions is that the relative attractiveness of the various modes of transportation alters. Internalizing the external costs of freight transport for instance will lead to different taxes for each mode (see Figure 1.3 in chapter 1), thus affecting relative prices.

Finally a third potential effect of policy interventions may be the inflow of carriers from low-cost countries, since operating costs and carrier rates appear to differ significantly between countries, even within Western Europe (see Figure 5.5 or Table 4.3 from chapter 4).

Figure 5.5: Comparison cost price per vehicle-kilometer in road haulage in Europe (1999)



Source: TLN, 2001: 89.

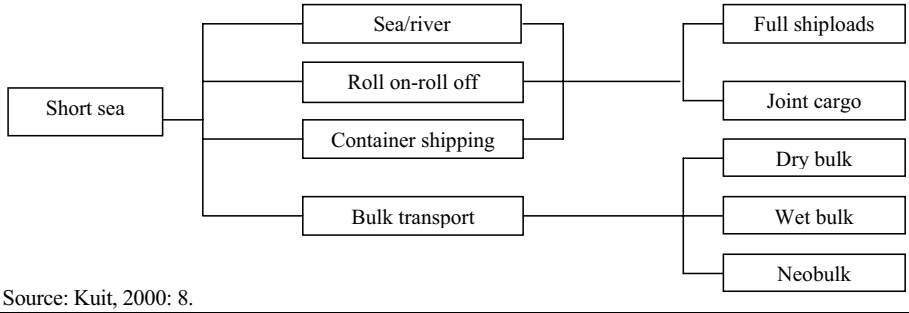
5.4 Organization of the Delphi survey

The goal of the Delphi survey was to assess the extent to which policy interventions may affect carrier rates, transit times, and delivery reliability, considering the observation that such effects may depend heavily on the type of intervention. Two aspects were assessed: one, the flexibility of carriers (i.e. the mechanisms by which they can absorb or avoid the effects of a policy intervention), and two, the eventual impact of policy interventions on rates, transit times, and delivery reliability. In this section the organization of the survey is outlined; more general methodological choices have been made and described in chapter 4, section 4.6. The Delphi survey outcomes are described elsewhere in more detail (Runhaar *et al.,* 2001).

5.4.1 Empirical focus of the Delphi survey

A first step was to select the types of carriers that are examined. A common way to stratify the transport sector is to distinguish between the different types of transport modes (e.g. De Wit and Van Gent, 1996: 231; Geerlings, 1997: 15). However each mode is characterized by a high degree of heterogeneity for a number of reasons. One, various market segments are served (see Figure 5.6 for an example). Two, cost conditions, and hence rates often vary per transport relation. Imbalances in transport flows for instance may lead to different rates in reverse directions (see for instance Table 5.1). Three, large cost differences exist between countries (see Figure 5.5)[viii]. Four, total costs as well as the relative importance of the various cost components fluctuate in time, as Figure 5.7 illustrates. Five and finally, costs and rates vary between firms; it is for instance well known that self-employed drivers often do not calculate all (labor) costs.

Figure 5.6: Sub markets served by short sea shipping



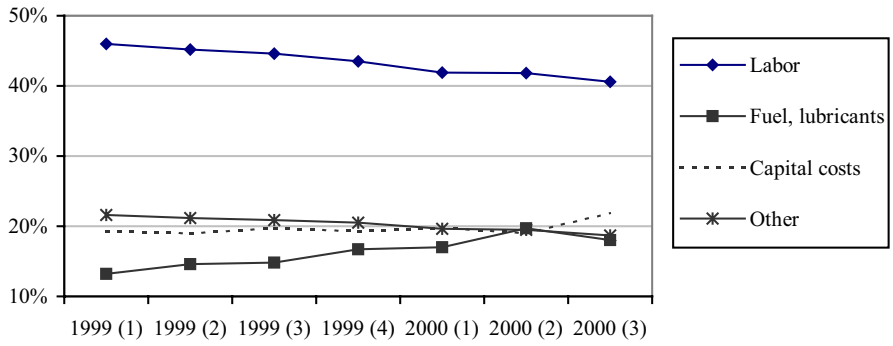
Source: Kuit, 2000: 8.

Table 5.1: Road haulage rates on various connections (1993/1994)

Route	FTL rate from UK (in £)	FTL rate to UK (in £)
London-Milan	800	1.400
London-Paris	350	700
London-Frankfurt	500	800
London-Amsterdam	400	700
London-Antwerp	250	400

Source: Cooper *et al.,* 1994: 262.

Figure 5.7: Trends in average cost structure in container shipping on the Rhine (*)



Note (*): quarterly data; relate to Dutch shipowners. Source: NEA, 2001.

Due to the observed heterogeneity, generic statements about 'the road haulage sector' or 'the inland navigation sector' are barely possible. Thus, the focus should be on particular segments within the transport market, in which case there are two options. One, the focus could be on transport flows in the printed media industry. A disadvantage could be that transport operations and costs in this industry may have specific characteristics. This would make this market segment less representative of the transport sector as a whole. A specific market segment might also reduce the pool of experts that could participate in the survey. Two, the focus could be on the major types of transport, in terms of volume, transport mode, cargo type (container, general cargo,

bulk), and distance (domestic, intra-European, intercontinental). For such types of transport, possibly more experts are available. Moreover the survey results would relate to a larger market segment and may be more representative of other market segments than the first option.

In this study the latter approach was employed. For six modes of transportation, statistics were used to select the main transport flows from and to the Netherlands[ix]. Excluded were modes that are not or barely used in the printed media industry, such as pipelines. Table 5.2 shows the transport flows that were eventually selected. The approach obviously runs the risk of ending up with expert estimations that, for the printed media industry, could be too optimistic or pessimistic.

Table 5.2: Transport flows examined in the Delphi survey

Transport mode	**Transport flow**
Road haulage	container haulage from Rotterdam to Duisburg (Germany)
Inland navigation	container shipping from Rotterdam to Mannheim (Germany)
Rail transport	container rail transport from Rotterdam to Milan (by shuttle)
Short sea	transport of wood and forest products from Sweden to the Netherlands
Airfreight	general cargo transport from Amsterdam to Tokyo
Deep sea	container shipping from Rotterdam to Singapore

5.4.2 Policy scenarios

The number of scenarios was restricted in order to minimize the efforts that were demanded of the experts. Based on an analysis of current, planned, and potential policy interventions that could affect transport costs, eventually two scenarios were developed:

- "fair and efficient pricing": it was assumed that all external social costs of transport would be passed on to freight carriers that operate in Europe;
- "insufficient infrastructure provision": in this scenario, infrastructure policy was assumed to be insufficiently effective in accommodating the future growth in (freight) traffic demand. The result would be a strong increase in congestion on infrastructure networks that are used in the transport flows under study.

These policy scenarios were chosen because governments can affect carrier costs and rates through taxation, whereas transit times and reliability of freight transport depend in part on the degree of congestion, which in turn can be affected through the level of investments in infrastructure. An additional argument is that the scenarios chosen are plausible for all six transport modes examined in this research, which enables some comparisons between the transport sectors. The scenarios namely describe plausible directions in which transport policy may develop; a full internalization of all costs of freight transport has been advocated for years (e.g. EC, 1995; 1998; 2001), whereas the forecasted dramatic growth in (freight) transport has not (yet) induced large-scale investment in new infrastructure (at least in the Netherlands).

The policy scenarios were operationalized and quantified in the following way. As regards the "fair and efficient pricing" scenario, a hypothetical implementation of ton-

kilometer taxes was assumed. Although actual implementation of such taxes may be problematic[x], they were used for the following reasons:

- it was expected that such a tax would also be felt by shippers since it is directly related to transport demand;
- since full internalization of external costs would imply a substantial cost increase, *ex ante* it was expected that carriers were not able to absorb the entire tax; hence the scenario would lead to higher carrier rates;
- the source that was used for the quantification of the taxes (i.e. Dings, Janse, *et al.,* 1999) expressed external costs per ton-kilometer[xi].

The "insufficient infrastructure provision" scenario was operationalized and quantified for each of the transport modes by asking policy makers, representatives of freight carriers, and sector specialists about the main potential causes of increased congestion as well as an estimation of the delays that these factors could cause. Annex II contains descriptions of the scenarios per transport mode.

The effects of the above scenarios were compared with the experts' estimations of how carrier rates, transit times, and delivery reliability would develop autonomously (i.e. the base case scenario). Therefore in sum three scenarios were explored.

5.4.3 The Delphi panel

About 130 persons were selected that were expected to have relevant expertise (see chapter 4, section 4.6.2.2). A broad pool of experts was approached within the transport sector, shipping firms, interest groups, academia, research institutes, the Ministry of Transport, and the environmental movement. By doing so, possible biases on the part of the experts could be explored (again see chapter 4, section 4.6.2.2).

The level of expertise was assessed prior to the Delphi survey so that non-experts could be excluded and the selection of the others could be justified (cf. Gordon, 1994: 12; Marchau, 2000: 171). Table 5.3 provides an impression of the expertise of the panel.

Table 5.3: Indication of the expertise of the Delphi panel

	Number of years of experience			**Expertise with respect to more than one mode** (N = 64)	**Expertise obtained in more than one position** (N = 64)
	> 5 years	2-5 years	< 2 years		
Number of experts	58	6	0	46	32
In % of total panel	91%	9%	0%	72%	50%

5.4.4 Design of the questionnaire

The questionnaire consisted of two parts. The first part contained a number of propositions concerning the behavior of carriers that may affect rates, transit times, and reliability. One proposition for instance was "carriers will intensify the use of route

planning systems". The propositions were derived from the literature (see section 5.3.1) and were largely identical for each of the six transport modes that were examined in the survey. The experts were asked to indicate the plausibility of each of the propositions in each of the three scenarios[xii]. Similar to McKinnon and Forster (2000a), who conducted a Delphi survey to explore future transport costs and logistical trends, four options were chosen to assess the likelihood of various responses, ranging from very likely to very unlikely. Apart from that, a 'do not know' option was added, as well as the option 'differs between firms'[xiii]. An illustration of the questionnaire is depicted by Figure 5.8; see annex II for the full survey.

Figure 5.8: Illustration of the first part of the questionnaire

[Part research on road haulage]	**No scenario** How likely do you consider these developments between now and 2010, if neither scenario eventuates?						**Scenario 1** How likely d development 2010 should s		
Question 1: Which developments until 2010 do you expect in container haulage from Rotterdam to Duisburg? *Possible developments:*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know	Very likely	Likely	
1. The use of trip and route planning systems will increase									
2. Carriers will acquire more return cargo									
(...)									

The first part of the questionnaire provided a basis to analyze and interpret the estimations of developments in rates, transit times, and delivery reliability that were asked in the second part of the questionnaire[xiv]. In this way the criticism was avoided that the Delphi survey would give little insight into the respondent's reasoning. Although experts were given the opportunity to add propositions to the questionnaire, this was done only very incidentally. Consequently, it seems right to assume that the questionnaire addressed most relevant possible developments[xv].

5.4.5 Response rates and the number of interrogation rounds

During Spring 2001 186 surveys were sent to the 130 experts; some experts received multiple surveys. 68 Experts responded by returning one or more questionnaires (52.3 percent of the experts; 46.8 percent of the number of questionnaires that were sent out). For more detailed information, see Table 5.4.

Table 5.4: Response rates of the Delphi survey

Partial research (by transport mode)	Questionnaires sent out	Response first response round		Response second response round	
		Percentage	*N*	*Percentage*	*N*
Road haulage	58	44.8%	26	31.0%	18
Inland navigation	41	46.3%	19	34.1%	14
Rail transport	33	57.6%	19	42.4%	14
Airfreight	15	46.7%	7	33.3%	5
Deep sea shipping	19	26.3%	5	21.1%	4
Short sea shipping	20	55.0%	11	30.0%	6
Total	186	46.8%	87	32.8%	61

The Delphi survey consisted of six partial researches, one for each of the transport modes under study. In the surveys on road haulage, inland navigation, rail transport, and short sea shipping, a relatively high response rate was realized. Also, a relatively large number of experts were involved in these surveys, which makes the outcomes less sensitive to (deviant) opinions of individual experts. In contrast, the surveys on airfreight and deep sea shipping yielded a lower response; their results should be considered with more caution.

Table 5.5: Response by professional background of the experts

Professional background respondent	Questionnaires sent out	Response first round		Response second round	
		Percentage	*N*	*Percentage*	*N*
Transport sector (*)	53	49.1%	26	35.8%	19
Interest groups (**)	19	47.4%	9	21.1%	4
Consultancy/ research institute	36	61.1%	22	38.9%	14
University	18	55.6%	10	44.4%	8
Shipping firms	42	33.3%	14	31.0%	13
Government	16	25.0%	4	18.8%	3
Environmental group	2	100%	2	0.0%	0
Total	186	46.8%	87	32.8%	61

Notes (*): includes transport companies, forwarders, and terminal operators; (**): interest groups on behalf of the transport sector.

Table 5.5 describes the response rates by the professional background of the respondents. The relatively low response among shippers appeared to be caused primarily by a certain 'survey fatigue'. A lack of time or expertise probably caused the low response among governmental experts.

After the first response round, group opinions were fed back by showing the scores for each of the questions in the questionnaire (in percentages), marked on a form similar to the original questionnaire. Experts were invited to reconsider in particular questions that had not yielded 'sufficient' consensus, which, due to a lack of unambiguous criteria in the Delphi literature, was defined as follows:

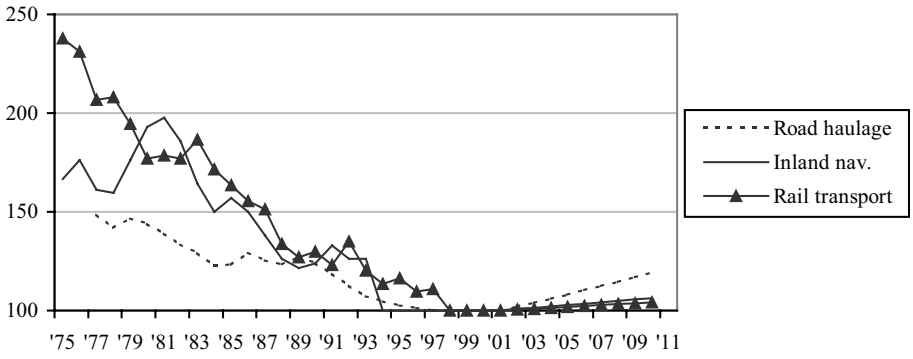
- regarding the first part of the questionnaire, at least 60 percent of the panel considered a proposition likely or very likely (or unlikely or very unlikely);
- regarding the estimations of carrier rates, transit times, and delivery reliability, at least 50 percent of the panel selected the same predefined interval[xvi].

Eventually, for all subsidiary surveys, two reaction rounds were held for three reasons. One, a relatively high degree of consensus was reached after two rounds. Overall, consensus was attained for 68.6 percent regarding the propositions and 56.5 percent regarding the estimations of rates, transit times, and reliability. Two, 41.3 percent of the experts had not changed his or her original opinion in the second reaction round whereas the remaining 58.7 percent reported mainly minor changes. Three, the drop-out rate after the second reaction round was relatively high (see Table 5.5) even though non-responding experts were contacted several times by telephone in order to persuade them to respond. Hence a third round would most likely yield an incomplete overview of changes in the degree of consensus and the 'persistence' of non-responding experts, although there is obviously no guarantee that a third round would not yield a further convergence of opinions.

5.5 Autonomous expectations

The first step was an inventory of expectations regarding autonomous trends in carrier rates, transit times, and delivery reliability between 2001 and 2010. Figures 5.9 and 5.10 show that for all modes a real increase in rates was expected, which means a discontinuation in the trend over the last decades[xvii]. Except for road haulage however the expected rate increase was relatively small.

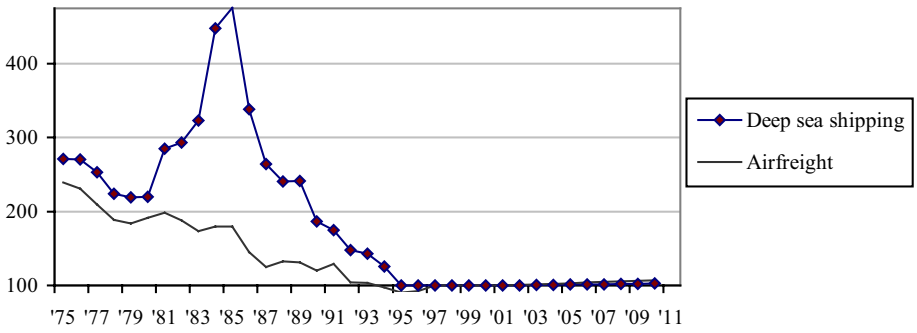
Figure 5.9: Historical and expected trends in real freight rates (continental transport) in indices (2001 = 100)(*).



Note (*): excluding short sea shipping, due to a lack of historical rate data. Source: Dings, Metz, *et al.,* 1999, supplemented with Delphi survey outcomes.

For road haulage, airfreight, and deep sea shipping, the expected trends in rates more or less coincided with the results of a similar Delphi survey, conducted in 1999 (McKinnon and Forster, 2000a; b). For inland navigation, rail transport, and short sea shipping, the Delphi results were not in line with that survey. This may have three causes. One, the Delphi survey focused on specific transport flows, whereas the 1999 survey focused on transport modes in general. Two, between the two surveys, 1.5 years elapsed in which diesel prices rose considerably. This may not have been anticipated in the 1999 survey; in similar surveys that were conducted a few years before the 1999 survey for instance many respondents did not even expect any increase in road rates (McKinnon and Woodburn, 1996: 155). Three and finally, McKinnon and Forster did not distinguish between inland navigation and short sea shipping.

Figure 5.10: Historical and expected trends in real freight rates (intercontinental transport) in indices (2001 = 100)



Source: Dings, Metz, *et al.,* 1999, supplemented with Delphi survey outcomes.

Various causes underlie the expected real increase in carrier rates. From a literature review and interviews conducted prior to the Delphi survey it appeared that cost increases were envisaged due to higher taxation (see section 5.2.1). E.g. the Dutch kilometer tax for all road transport, the German kilometer tax for heavy freight vehicles, and the infrastructure levy in Dutch rail transport. But also rising wages and productivity losses due to increased congestion were expected to contribute to cost increases. Yet, at the same time the Delphi participants expected that between 2001 and 2010, carriers will improve productivity, for instance by an increased use of planning systems and advanced information technology, reduced fuel consumption, and by increased efforts to acquire return cargo.

Regarding transit times, for all modes of transportation with the exception of road haulage, a reduction was expected between now and 2010. For road transport, this would be contrary to the trend from the 1970s onwards (e.g. MuConsult, 2001: 54). The reliability of freight transport, expressed in the number of overdue arrivals, was

expected to remain the same or even improve, except for airfreight and road haulage (see Table 5.6). Apparently, for the latter modes, increased congestion was foreseen.

Table 5.6: Average expectations regarding transit times and reliability in 2010, compared to 2001

	Road haulage	**Inland navigation**	**Rail transport**	**Airfreight**	**Deep sea shipping**	**Short sea shipping**
Transit time	+ 9.6%	- 6.9%	- 4.8%	- 4.2%	- 7.5%	- 1.25%
Delivery reliability	Same/ worse	Better/ same	Better	Same/ worse	Same/ better	Better/ same

Concluding, the panel expected that road transport will face most difficulties in the near future, resulting in higher rates, longer transit times, and possibly a reduced delivery reliability. This may deteriorate its competitive position vis-à-vis intermodal transport.

5.6 The "fair and efficient pricing" scenario

5.6.1 The scenario

In the first policy scenario that was examined, it was assumed that within the European Union, full social cost pricing will be introduced at the end of 2001 (see section 5.4.2). Hence, all external costs of freight transport would be passed on to carriers, including the cost of infrastructure maintenance, traffic control, emissions, traffic fatalities, and injuries. Passenger transport was assumed not to be levied for the moment. The external social costs would be passed on as a surcharge per ton-kilometer, imposed on all transport companies that carry freight to, from, or within the EU. Table 5.7 shows the initial levies in €-cents per ton-kilometer, both absolute and relative to current rates.

Table 5.7: Taxes in scenario 1 and current rates in €-cent per ton-kilometer[xviii]

	Road haulage	**Inland navigation**	**Rail transport**	**Airfreight**	**Deep sea shipping**	**Short sea shipping**
Tax/tonkm	5.54 ct.	2 ct.	2.43 ct.	5.94 ct.	0.67 ct.	0.67 ct.
Current rate/tonkm	18.02 ct.	3.58 ct.	3.27 ct.	21.15 ct.	0.91 ct.	0.91 ct.
Tax in % of rate	30.7%	55.9%	74.3%	28.1%	73.6%	73.6%

Sources: external costs: (*): Dings, Janse, *et al.,* 1999; (**): T&E, 1993. Current rates are average rates early 2001 and include loading and discharge. Data were collected from anonymous carriers, shipowners, forwarders, and interest groups on behalf of transport operators. Average load of containers: Deelen *et al.,* 1999.

5.6.2 Hypothesized effects, based on the literature

Due to the ton-kilometer tax, unit costs per ton and per ton-kilometer would be raised. It was anticipated that carriers might respond to this in two ways. First, they might try to

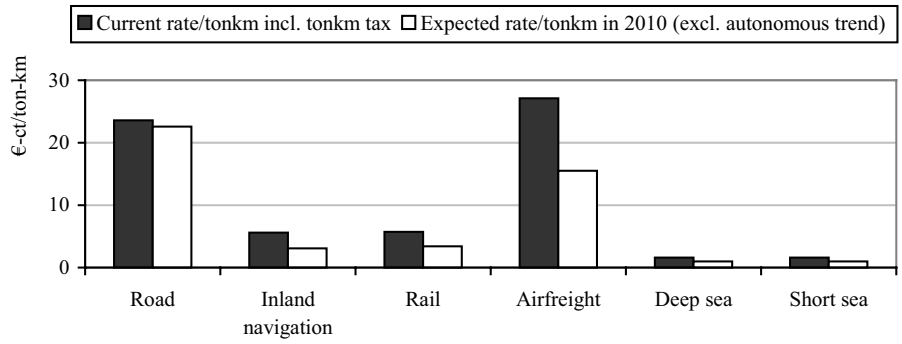
raise load factors by a higher level of consolidation of less-than-truck or -container loads or by a more active acquisition of return cargoes. Although the ton-kilometer tax would remain the same irrespective of a raise in load factors, a higher load factor might enable carriers to spread operating costs (e.g. writing-off, fuel, and administrative costs) over a larger volume of cargo. In this way operational unit costs are lowered (cf. Johnson and Wood, 1996: 461). By doing so, carriers might succeed in reducing part of the cost increase caused by the ton-kilometer tax. Second, carriers might try to offset part of the initial cost increase by economizing on other costs, e.g. fuel use. Due to the competitive environments in which most carriers operate, it was not considered likely that shippers will accept a simple raise in rates without compensatory measures undertaken by carriers.

5.6.3 Delphi results

In order to assess the extent to which carriers can offset the initial cost increase, the following method was employed. First current rates per ton-kilometer were raised with the ton-kilometer tax that was assumed to be introduced by the end of 2001, which indicates the initial impact of the ton-kilometer tax. This figure however can not be compared with the expected rates in 2010 in scenario 1 for an assessment of the eventual price effect of the ton-kilometer tax (and by that, the absorptive capacity of carriers). The reason is that 2010 rates are also affected by factors that are partly exogenous to the scenario: they are considered as autonomous developments. For instance for road haulage an autonomous price increase of nearly 20 percent was expected. This is caused by increased congestion, growing fuel scarcity on the global market as well as by increased taxation, perhaps in part based on the idea of "fair and efficient pricing". Therefore the scenario formulation might have led to some overlap in both scenarios. Nevertheless, rate increases in case of the ton-kilometer tax would be much higher than in the autonomous scenario, indicating certainly no *complete* overlap. Since the exact size of the overlap could not be assessed, a comparison was made between the initial price effect of the ton-kilometer tax and the price effect in 2010 *on top of* autonomous price increases (see Figure 5.11). In this way the absorptive capacity of carriers was assessed, although due to the scenario overlap the initial price increase in scenario 1 and hence absorptive capacity might be overestimated.

The Delphi panel expected that road carriers will absorb about one quarter of the ton-kilometer tax; the rest will be passed on to shippers or will lead to lower profits of carriers (which is another type of absorption[xix])[xx]. The other transport sectors are expected to absorb a larger share of the tax; hence their rates will be raised less. Apart from the relatively high ton-kilometer tax that is assumed to be imposed on road transport, will the competitive position of road transport in this scenario also be deteriorated by the relatively low absorptive capacity. In inland navigation and airfreight, carriers were expected to adapt operations in such a way that cost savings will even *exceed* the initial cost increase due to the ton-kilometer tax[xxi]. Apparently experts expect the ton-kilometer tax to act as a catalyst for new investments or another organization of transport operations that will raise overall efficiency in these modes.

Figure 5.11: Comparison of freight rates in 2001, including ton-kilometer tax, and expected freight rates in 2010



The ways in which the ton-kilometer tax is expected to be absorbed differs per transport sector (for a complete overview, see annex II). The ton-kilometer tax will reinforce the autonomously expected increased acquisition of return cargo, except in the case of short sea shipping. Currently, however, usually low rates exist for return cargo. Therefore, carriers often do not wait for return cargo but turn back to deliver the next shipment (Voordijk, Vieveen, and Bus, 1999: 129). Raising load factors by cargo exchange between carriers is considered likely in inland navigation, rail transport, airfreight, and in short sea shipping. Additionally, in all waterborne transport a reduction in fuel use by slowing sailing speed is expected (without affecting reliability of arrivals). The Delphi panel was not asked about the reasons for the expected reduction in fuel use but possible explanations are: (a) since the ton-kilometer tax would be related to emissions a reduction in emissions might lead to lower surcharges; (b) the cost increase would in part be compensated by cost reductions elsewhere (i.e. fuel costs). The latter strategy might in particular be effective in deep sea container shipping because of a high share of fuel costs in total costs (De Wit and Van Gent, 1996: 269; Prince, 2001: 63-67). The expected reduction in average sailing speed indicates that the experts expect that shippers using waterborne transport will be more sensitive to transport costs than to transit times, similar to what was found in other studies (e.g. HCG (1992)). A scaling-up of average firm size due to the ton-kilometer tax is expected in rail transport and all sea borne transport. Adaptations in transport equipment, such as vessels or trucks, are expected in all sectors except for road haulage and deep sea container shipping. Finally, it is expected that road carriers, airlines, and deep sea container carriers will more often refuse small or unprofitable shipments. In conclusion, the logistical organization of carriers is expected to be quite flexible to adapt to the new cost conditions.

In waterborne transport, transit times are expected to increase as compared to the autonomous scenario, which is mainly explained by the above-mentioned efforts to reduce fuel use by slowing sailing speed. Regarding the other modes, transit times are expected not to change or only marginally as compared to the autonomous scenario. A

positive effect of the ton-kilometer tax on reliability is expected in road haulage, rail transport, and aviation. In road transport, this may be explained by improvements in truck capacity utilization (reducing the amount of trucks on road networks) and a better spread of freight traffic over networks and in time. In rail transport and airfreight, however, congestion is notably caused by increasing passenger traffic; hence, the above explanation will probably not apply. An alternative explanation is that air and rail carriers will try to compensate for the higher transport costs by an improved quality of service. In inland navigation and deep sea container shipping, the ton-kilometer tax is expected to affect reliability negatively. In inland navigation, this may be explained by increased efforts to improve load factors. In deep sea shipping, an explanation may be that in contrast to the autonomous scenario, it is expected that carriers will not call at other ports; apparently, the experts expect that in the current ports of call, congestion will increase in future. Finally, no changes in reliability are expected in short sea shipping. This may be explained by the fact that in the transport flow under study (i.e. wood and forest product transport from Sweden to the Netherlands), arrival dates are known only a few days before actual arrival.

5.7 The "insufficient infrastructure provision" scenario

5.7.1 The scenario

The second policy scenario that was examined, assumed that investment in new infrastructure or in better infrastructure capacity management, would not be sufficient to accommodate the expected growth in (freight) transport. Consequently, between 2001 and 2010 congestion was assumed to increase. It should be noted however that the nature of congestion varies for each mode of transportation. For instance, queuing is only to a limited extent possible in rail transport and airfreight, in contrast to the other modes. This is mainly caused by the relatively rigid infrastructure capacity allocation systems employed in these transport sectors. Once 'slots' are deployed, queuing is only to a limited extent possible. Although delays often occur in rail transport and in airfreight, experts considered scenarios in which transit times initially increase by ten percent or more due to congestion unrealistic regarding the transport flows under study. Hence, the congestion scenario was disregarded for rail transport, whereas an adapted scenario was constructed for airfreight[xxii]. For the remaining transport modes, the scenario described a substantial increase in congestion by the end of 2001. Even for these modes, the nature of congestion differed. In road transport, congestion was assumed to occur on transport links, whereas in the other modes congestion was notably assumed to exist in ports and terminals[xxiii]. The questionnaires contained quantitative indications of the assumed increases in transit times, which were considered plausible if carriers would not adapt their operations (see annex II).

5.7.2 Hypothesized effects, based on the literature

The congestion scenario initially would lead to longer transit times and reduced delivery reliability, but also to higher costs due to productivity losses (see section 5.3.2). This might provoke various responses, which probably will depend on the shippers'

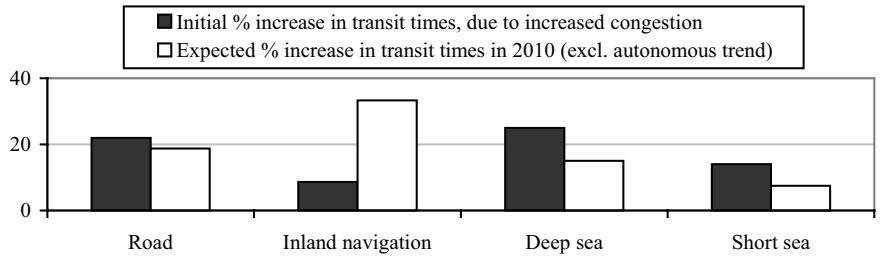
demands. Often shippers make a choice for road transport, in particular because of the high level of reliability (see chapter 3, section 3.2). Therefore, it was expected that carriers would try to reduce as much as possible the negative effects of congestion on this service quality even if this would lead to higher rates. In contrast, in short sea shipping, usually relatively low-valued bulk is transported, which is more sensitive to transport costs than to changes in transit times or delivery reliability. In that sector, operating costs and lead times are to a large extent related since manning costs, making up some 30 percent of total costs, vary with sailing time. Hence, in short sea efforts were expected that aim at reducing costs and lead times, rather than measures to maintain a reliable arrival.

5.7.3 Delphi results

In order to assess the absorptive capacity of carriers regarding delays, the same method was employed as in the previous section. As Figure 5.12 shows, the respondents expected that the extent to which the initial delays assumed in the scenario affect transit times in 2010 varies significantly between the modes. Remarkably, for inland navigation a disproportional increase in transit times is expected. This is only in part explained by the fact that in the transport flow in inland navigation under study (i.e. container shipping from Rotterdam to Mannheim) multiple ports are visited; in short sea shipping this is also the case. The experts did not explain the reasons of the disproportional increase in transit times. It might be speculated that the planning of terminal operators that are called at by inland shipowners is less flexible than de planning of terminal operators visited by short sea shipowners (e.g. due to relatively small capacity for transshipment). Another possible explanation is that short sea carriers have more options to cope with delays in ports by increasing sailing speed. The panel namely expected that in this scenario, fuel use would decrease at a lower rate than in the autonomous scenario, which could be due to a higher average speed and hence less economic fuel consumption (see section 5.6.3). Apart from that the transport flow in short sea transport involved a much larger distance than the flow in inland navigation (i.e. an average of 1,800 kilometer versus 590 kilometer), which obviously offers more opportunities to cope with delays in ports.

Another remarkable result is that for all modes of transportation, a deterioration in reliability is expected, despite the increasing importance shippers attach to this transport quality. Apparently, this is unavoidable, which can be explained by the fact that the occurrence of and delays caused by congestion vary and can not be predicted completely. Finally, for all modes of transportation it is expected that carrier rates will increase more than in the autonomous scenario. Main reasons include lower productivity due to congestion and the efforts that have to be made to reduce the negative effects of congestion (such as more efficient logistics planning or the use of advanced information technology).

Figure 5.12: Comparison of assumed delay due to the congestion scenario and expected delay in transit times in 2010



Similar to the ton-kilometer tax scenario, different responses of transport companies are expected (for a complete overview, see annex II). The strong increase in congestion will provide an additional stimulus to carriers in road haulage, inland navigation, and short sea shipping to intensify the use of planning systems, whereas more in advance planning of departures with shippers is considered likely in all modes except for airfreight. The use of larger transport means is expected in all sectors but inland navigation. Changes in departure times, including more overnight transport, are only expected in road haulage, short sea shipping, and deep sea shipping. In the other modes, flexibility in scheduling apparently is low. This is partly explained by the rigid infrastructure allocation systems in air transport, and partly by the fact that inland shipowners depend on arrivals of deep sea container vessels as well as on terminal operators. In short sea shipping, and road haulage, load factors may be raised due to intensified cargo exchange between carriers. This enables the expected use of larger transport means in these sectors. In deep sea shipping it is expected that shipowners will more often postpone departure until a higher load factor or more return cargo is acquired. Consequently, fewer sailings may be necessary to carry a given amount of cargo. Finally, in road haulage it is expected that carriers may avoid part of the delays by adapting route choice, whereas in airfreight, deep sea shipping, and in short sea shipping, other (air)ports will be called at.

Operators of sea transport prove to possess the largest absorptive capacity, which can be explained by the fact that "maritime transportation (...) has a very flexible network structure, *including* the nodes (ports)" (Rodrigue *et al.,* 1997: 88). Ports are no fixed and obligatory points of transshipment. Consequently, deep sea and short sea carriers have the choice of using several different infrastructures in an efficient manner. In other modes of transportation, infrastructure networks can be used in a less flexible way.

Only a few studies are available that addressed similar questions and that can therefore serve as a benchmark for the Delphi survey. Van Schijndel and Dinwoodie (2000) for instance, in a survey, addressed how effective carriers and shippers located in the Netherlands consider particular measures to deal with congestion. Attractive responsive measures included more overnight driving, the use of larger trucks, and less frequent

deliveries (e.g. by postponing departure) (Van Schijndel and Dinwoodie, 2000: 237). These results coincide with the findings of the Delphi survey, although the Delphi survey yielded a wider variety of adaptations (e.g. more cargo exchange between carriers).

5.8 Conclusions and discussion

5.8.1 General conclusions

The topic of this chapter was how and to what extent governments can affect the cost of freight transport services. Distinction was made between three characteristics of freight transport that affect shippers' costs: carrier rates, transit times, and delivery reliability.

Governments appeared to be able to affect these variables in many different ways. Yet taxation was considered one of the main instruments for governments that actively seek to affect carrier rates. Transit times and delivery reliability in contrast may be primarily influenced via infrastructure policy.

The ways in which the level and structure of carrier operating costs and carrier rates could be affected by policy interventions appeared to be manifold. Much depends on the design of the intervention: taxes on particular inputs such as fuel may have different cost effects than fixed levies on for instance vehicle possession. The results of the Delphi survey illustrated that the impact of infrastructure policy on transit times and delivery reliability also may be different. Delays in ports or other nodes that are called at in a transport chain can often be avoided less easily by carriers than delays en-route, mainly due to a lack of alternatives in the first area. An exception was (deep) sea carriers that in general employ a very flexible infrastructure network.

The Delphi survey was conducted in order to examine in more detail to what extent carriers may avoid or absorb the effects of policy interventions and to assess the eventual impact of particular interventions on carrier rates, transit times, an delivery reliability. Two policy scenarios were examined. In the first scenario all external social costs produced by freight transport are passed on to freight carriers by means of a ton-kilometer tax. In the second scenario investment in infrastructure will not meet the expected future increase in demand for infrastructure capacity.

The expected effects of the two policy scenarios on future carrier rates, transit times, and delivery reliability were assessed by comparing them with the autonomously expected trends up to 2010. Most experts envisaged that real rates would slightly increase, which would mean a discontinuation of the historical, downward trend in rates. For road transport, however, a relatively high rate increase of almost 20 percent was expected. Regarding transit times, for all modes of transportation with the exception of road haulage, a reduction is expected between now and 2010. The reliability of freight transport, expressed in the number of overdue arrivals, is expected to remain the same or even improve, except for airfreight and road haulage. Apparently, the latter modes will face increased congestion.

The expectations of the Delphi participants regarding the effects of the two policy scenarios that were examined, indicated that the absorptive capacity of road haulage is the lowest of all modes. Hence, if the scenarios would become reality, road transport would face a deterioration of its competitive position vis-à-vis rail transport, inland navigation, and short sea shipping. This effect would be on top of the autonomously expected reduction in attractiveness of road transport due to higher rates, longer transit times, and possibly a lower level of delivery reliability. The Delphi survey however did not address the possible impact of the three scenarios on modal choice. Partly this is due to the fact that the transport flows that were considered are not completely comparable across modes. In addition modal choice also depends on shippers' demands vis-à-vis speed and reliability requirements and the (financial) valuation of these variables (see chapter 3, section 3.2.). For these reasons, the effects of the two scenarios on modal choice will be addressed in chapter 7.

5.8.2 Discussion

The results of the Delphi survey should be interpreted with caution, because a number of methodological limitations of the Delphi method restrict the extent to which the findings that were discussed can be generalized.

One, no complete consensus was achieved. Yet, it was decided to stop after the second reaction round since non-response would otherwise give a biased picture (and lead to complete consensus, neither).

Two, the focus was on one important transport flow per mode of transportation; hence the outcomes can not be generalized to other transport flows without additional research. However for the purpose of this chapter (i.e. to understand how carriers may absorb policy interventions) the outcomes are sufficient. In addition they provide a basis to develop plausible scenarios for the stated adaptation survey in the remainder of the study. Using the same methodology and questionnaire for other transport flows will probably notably yield different outcomes vis-à-vis the level of absorptive capacity of carriers. The extent to which for instance delays in loading in ports can be compensated by a higher sailing or driving speed will probably be related to transport distances. However it is plausible that the identified responses of carriers to the scenarios are more generic. The questionnaire namely included very general adaptations that were found in the literature (e.g. increased use of route planning systems); they are probably not specific to the transport flows examined.

Three, it appeared that responses varied with the experts' professional background (cf. Cooper *et al.,* 1994: 251). The direction of this deviation is not unambiguous, however: there was no systematic bias of for instance experts originating from transport firms to give more pessimistic estimations of the effects of the policy scenarios (see Table 5.8). Since it could not be assessed to what extent the expert panel is a representative sample of the total population of experts, the Delphi results could be biased.

Table 5.8: Differences in experts' expectations regarding the impact of the two policy scenarios on rates, according to professional background

	Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
Transport sector						
• Scenario 1	+	- -	≈	-	+	++
• Scenario 2	+	- -	*n.a.*	-	-	++
Shippers						
• Scenario 1	-	- -	≈	*n.a.*	*n.a.*	*n.a.*
• Scenario 2	-	+	*n.a.*	*n.a.*	*n.a.*	*n.a.*
Other						
• Scenario 1	-	++	≈	+	-	- -
• Scenario 2	-	+	*n.a.*	+	+	- -

Note: + : higher rate increase expected; - : lower rate increase expected; ≈: almost equal increases expected; ++ : substantially higher rate increase expected; - - : substantially lower rate increase expected; *n.a.:* no data, either because the scenario does not apply or because no such experts had responded.

Four, in order to reduce complexity and to maintain a level of comparison of the responses, a fixed load unit was assumed and load characteristics, such as value density, were disregarded[xxiv]. It is recognized that these characteristics may be of influence on future developments in generalized transport costs, as well as on the effects of the two scenarios.

Five, the Delphi results reflect estimations by a broad pool of experts, which provide an overall sense of the magnitude of the absorptive capacity of freight transport operators, rather than absolute predictions. For more precise estimations of carriers' responses to policy scenarios or the impact on rates, transit times, and reliability, additional research is requested. Such research might be based on an analysis of the past and hence suffer less from uncertainties that existed in the Delphi survey due to its prospective approach. On the other hand, one has to recognize that in open systems, such as the transport system, uncertainty will always exist (see chapter 4, section 4.6). The differences in expectations in autonomous trends in carrier rates between the Delphi survey and similar studies that are held a few years ago, may stem from unforeseen developments, such as the fuel crisis in 2000. At the same time, the validity of the Delphi results may have been reduced by for instance the consequences of the terrorist attacks on September 11, 2001. Although part of the uncertainty can be coped with in scenarios, uncertainties remain with respect to the behavior of carriers.

Six, the Delphi survey encompassed a time period of nearly 10 years. A longer time horizon could have revealed a larger absorptive capacity of the freight transport sector. Most responses that the Delphi panel envisaged, were short-term actions, e.g. the acquisition of more return cargo. Only a few long-term responses were mentioned, such as expected changes in vehicle size (requiring in part investments in fleet renewal) and changes in average firm size. In a time horizon of more than 10 years, increased congestion may for instance accelerate the development of underground transport

systems. Nevertheless a longer time horizon would have raised the complexity of the questionnaire, and subsequently might have led to less valid outcomes. To study longer time horizons, the research design should be more exploratory, e.g. use open answers instead of closed answers as in this survey.

Seven and finally, the congestion scenario was not examined in the case of rail transport. Nevertheless some hypothesis can be formulated. Similar to airfreight, infrastructure allocation is relatively rigid. Hence it is barely possible to reschedule departures. Among the main responses of airfreight carriers to increased congestion were therefore the use of larger airplanes (reducing the ratio of freight volumes to airport 'slots') and a switch to other airports. Given the similarities in infrastructure allocation, it is plausible that rail carriers will reveal similar responses in case of congestion, although they may have fewer options to call at other terminals.

[i] The policy interventions were identified by means of a literature review (e.g. De Wit and Van Gent, 1996; Guglielminetti, 1998a; Hillestad *et al.,* 1996; Muilerman, 2001; and Tweddle *et al.,* 1998), policy documents (ministerie van Verkeer en Waterstaat, 1996; 1999; 2000; 2001a), professional journals (e.g. Nieuwsblad Transport, Logistiek.nl, the LogistiekKrant, and Cargoweb newsletter), discussions with employees from the Dutch Transport Research Center, the Dutch ministry of Transport, and carriers, and finally pre-existing knowledge of my own.

[ii] Congestion in contrast may inflate operating costs. In this context for instance TLN, a Dutch interest group on behalf of road freight carriers, claimed recently that the costs of congestion in domestic freight transport had increased from 2.7 percent of total costs in 1997 up to 5.8 percent in 2002, involving € 184 million (Nieuwsblad Transport, April 19, 2002). In addition, TLN claims that the productivity losses of all Dutch road hauliers (involved in both domestic and international transport) are worth € 1.2 billion (TLN website, viewed July 2002).

[iii] Dedicated rail infrastructure for freight transport such as the Betuwe route has the same effects.

[iv] According to Van Schijndel and Dinwoodie (2000) congestion occurs when "demand for road space exceeds the available supply, and the flow rate of vehicles wising to travel on a given section of highway exceeds its capacity or ability to provide acceptable travelling conditions" (op.cit., p. 231). A consequence is queuing. In ports flow rates may drop and queuing may occur because demand for loading or unloading exceeds supply.

[v] Options to adapt transport operations were identified by means of a literature review (including for instance Bleijenberg, 1998; Bus *et al.,* 1999b; Busscher, 2000; Cooper *et al.,* 1994; Coyle *et al.,* 1996; Crowley, 1998; Ginkel *et al.,* 1995; Guglielminetti, 1998a; Kågeson and Dings, 1999; McKinnon and Woodburn, 1996; Michon and Hoppenbrouwers, 2000; Muilerman, 2001; ministerie van Verkeer en Waterstaat, 2001b; Regan and Golob, 2000; and Ruijgrok, 2000) as well as pre-existing knowledge of my own.

[vi] A specific type of adaptation to higher costs are illegal operations such as exceeding legal regulations concerning driving time or maximum vehicle loads (Guglielminetti, 1998a: 6). Such adaptations however are difficult to assess.

[vii] The gap between cost prices and rates in Figure 5.2 is not completely reflected by the trends in profit margins, depicted by Figure 5.3. The reason is that the cost price figures are not corrected for a higher efficiency of inputs and therefore only reflect trends in unit costs (source: TLN).

[viii] Another example originates from Hensher and Brever (2001: 138) who compare cost structures of short sea shipowners in a number of countries. They found large differences between countries; in 1994 the average share of manning costs in total costs in the VS was for instance 58 percent against only 28 percent in the UK.

[ix] The focus was on modes of transportation rather than on intermodal transport, in which multiple modes of transportation are combined to move freight. The main reason was that otherwise the analysis would become too complicated. This implies that pickup and delivery by road transport in intermodal transport was left out of consideration.

[x] A ton-kilometer tax might have various disadvantages in practical use, e.g. because transport demand also depends on other cargo characteristics such as volume and physical characteristics (e.g. Beuthe *et al.,* 2001). In addition, a ton-kilometer tax may not completely be related to the causes of external effects (e.g. emissions). Apart from that there might be practical difficulties in measuring ton-kilometers (e.g. Dings, Leurs, *et al.,* 1999). Finally a ton-kilometer tax might notably induce responses from shippers of bulky and low-valued goods but less from shippers of high-valued goods (Van den Brink and Van Wee, 1997), although the latter shippers may generate more transport (in average distance of hauls as well as average shipment size). This would undermine the effectiveness of the tax as an instrument to reduce overall freight transport. Yet, apart from the design of taxation, shippers of high-valued goods may be expected to be relatively insensitive to transport costs anyway (see chapter 3, section 3.6.1).

[xi] The data provided by Dings, Janse, *et al.* (1999) were used for the following reasons:

- they were relatively recent;
- they were calculated in a consistent way for all of the transport modes examined, except for sea transport;
- they applied to transport by Dutch carriers, similar to this study;
- they were based on the principle of marginal cost pricing, similar to what the European Commission envisages.

[xii] As experts may expect transport firms to reveal more than one response, it was considered inadequate to ask them to choose among the propositions. Ranking instead of rating was considered inadequate, because ranking does not reveal the strength of the preference or, in this case, the likelihood of the option (Hensher, 1994: 110-111).

[xiii] Hence six answer options per proposition/question were formulated, which is commonly considered adequate in surveys; a lower or higher number of options per question may lead to unreliable answers (Foddy, 1996: 156). The ‘don’t know’ option was included because in social research, usually 10 to 20 percent of the respondents give substantive answers when such a response option is not explicitly offered but shift to a non-substantial option when one is offered (Foddy, 1996: 110).

[xiv] These estimations were asked against a base index value of 100 for early 2001. Estimations of current rates, transit times, and reliability performance were included in the questionnaire.

[xv] The clarity and completeness of the questionnaire was tested by discussions with two persons working at a freight carrier, two academic researchers, and one person working at an interest group on behalf of road carriers prior to the Delphi survey.

[xvi] Carrier rates and transit times were expressed in indices, with intervals of 25 percent deviations from the base case (2001 = 100); reliability was expressed in three values, namely ‘worse’, ’equal’, or ’better’, compared to the situation in 2001.

[xvii] The historical data are derived from Dings, Metz, *et al.* (1999) who used data provided by specialized and often-consulted data sources. These sources include NEA (road haulage), Drewry Shipping Consultants and UNCTAD (deep sea shipping), AVMARK (airfreight), CBS (road haulage and inland navigation), as well as data provided by transport companies (i.e. European airlines and Railion). Data of rates between 1997/1998 and 2001 lacked. Yet despite the fact that in 2000, a large but merely temporal increase in fuel rates appeared, data of for instance TLN (2001: 95) on road haulage rates did not show a structural change in the development in carrier rates. Therefore, it was assumed that no changes in rates occurred between 1997/1998-2001. The data between 2001 and 2010 originate from the Delphi survey, in which experts were asked to estimate real rates in 2010, expressed in indices (2001 = 100). Based on these estimations, compounded annual growth rates were calculated for the period between 2001 and 2010. Unfortunately, for short sea shipping

historical data on rates lacked. Yet, there are no indications that in this sector, rates would have shown an upward trend.

[xviii] The external cost data for sea shipping are based on T&E (1993). These data are not completely representative, since they are based on ro-ro vessels. More specific data however lacked. Apart from that, the data are to some extent outdated; yet, it was assumed that social cost reductions that may have occurred (e.g. due to lower emissions) have been compensated by opposite effects (e.g. inflation since 1993). Data on average load of containers were derived from Deelen *et al.,* 1999.

[xix] Given the low margins in transport however the potential of the latter type of absorption is not considered large.

[xx] It is not likely that part of the absorptive capacity of *rail* transport will in fact be caused by subsidies because of two reasons: (a) this was not mentioned by experts (although they had the opportunity to add propositions); (b) it would be contrary to the scenario.

[xxi] For this purpose, compare the ton-kilometer tax (in €-cents) from Table 5.7 with the differences between the two bars in Figure 5.11 (also in €-cents).

[xxii] In the partial research on airfreight, it is assumed that demand for airport slots would be 25 percent higher if sufficient slots would be available.

[xxiii] These scenario differences were caused by the fact that only plausible causes of future congestion on the examined transport flows were taken into consideration. For instance, in the partial research on inland navigation, internal, confidential studies conducted by the Dutch Ministry of Transport showed that even if inland shipping would increase dramatically, no substantial delays in Rhine shipping could be expected. In contrast, delays already often occur in the Rotterdam harbor, and more delays due to higher traffic intensity are not imaginary.

[xxiv] For instance, containers usually contain a large variety of cargo, the value of which may differ heavily. In the US, for instance, the average value of cargo in the category of "non-metallic materials" in 1993 averaged about $ 11 per ton, whereas "apparel" averaged $ 19,249 per ton (Forkenbrock, 2001: 322). Obviously, a shipper of the first type of cargo will be much more sensitive to a change in carrier rates than a shipper of the latter category of cargo, which may also affect carriers' responses to for instance a ton-kilometer tax.

6 Production, distribution, and transport in the Dutch printed media industry

6.1 Introduction

In chapter 2 and 3, the interactions between production and distribution, freight transport, and transport costs were explored merely from a theoretical perspective. Chapter 2 demonstrated that the impact of the organization of production and distribution on transport demand is often very situation-specific. In addition, the theory reviewed in chapter 3 suggested that logistical behavior tends to be rather heterogeneous. Chapter 3 concluded with a number of hypotheses on the effects of an increase in transport costs on the organization of production and distribution. Yet given the observation that logistics tends to be heterogeneous, these hypotheses need to be specified. This will therefore be the main goal of this chapter. Apart from that the case studies in the Dutch printed media industry will address issues including:

1. how are production and distribution organized in practice and what have been the main reasons to do so?
2. how are transport operations managed?
3. what have been logistical trends and how have they affected freight transport demand and traffic-intensity?
4. how important are transport cost in decisions related to production and distribution and what impact may increased transport costs have?

Multiple data sources were used, including literature, the internet, statistics, interviews with interest groups, and 41 interviews with firms in the printed media industry (conducted between October 2001 and February 2002). Most of the latter interviews were part of the stated adaptations survey to be presented in chapter 7. Table 6.1 specifies the number of interviews that were conducted as well as response rates[i]. If throughout the text no specific reference is made to the source of information, the information is derived from these interviews.

In section 6.2 through 6.4, the case study results are described for the production and distribution of paper, newspapers, and books. Section 6.5 summarizes the main conclusions.

Table 6.1: Response rates stated adaptations survey

Sector↓	Number of cases (*)	Response (**)	Sample as a percentage of the whole sector (***)
Paper producers	4 + 2 (0) (****)	80% (5)	80.0% (****)
Paper wholesalers	4 (0)	100% (4)	16.0%
Newspaper publishers	4 (0)	80% (5)	2.1%
Newspaper printers	7 (1)	86% (7)	7.0%
Book publishers	5 (1)	86% (7)	1.0%
Book printers	5 (3)	67% (6)	0.2%
Binders	5 (4)	100% (5)	2.5%
Book distributors	5 (3)	100% (5)	2.5% (*****)
Old paper collectors & wholesalers	5 (0)	50% (6)	4.0%

Notes: (*): since some firms were active in more than one sector, the 41 interviews conducted represented 46 relevant cases. Between brackets the number of telephone interviews; these were held with small firms (up to 17 employees) who had limited time and only wanted to co-operate in this way; (**): between brackets the number of firms that were asked for an interview in first instance; in a few cases, additional firms were asked for an interview (***): regarding paper wholesale, newspaper publishing and printing, book distribution, and old paper collection and wholesale, the interview samples represent a (much) larger market share (see chapter 7); (****): two interviews were held with a Scandinavian newsprint producer and a Dutch cardboard producer; (*****): estimate.

6.2 Paper production and distribution

Paper production is a very homogeneous process and involves two main activities (Dohmen, 2001: 10; Guglielminetti, 1998b: 9; Upton, 1995: 75). First, porridge-like pulp is made from wood, old paper, and additives. Second, paper-making machines remove water from the pulp and produce large 'parent reels' of paper of 1,200-1,400 kilo each. These reels of paper are delivered to printers, newspaper publishers, paper wholesalers, the packaging industry, 'format factories' (in which bulk paper is cut into end products on smaller reels or as sheets), and to other users of paper[ii].

Many of the books and newspapers sold in the Netherlands or produced by Dutch firms are made of paper that is supplied by Dutch or Scandinavian paper mills. Hence only these paper producers are examined. Four aspects will be discussed[iii]: (a) the organization of production and distribution; (b) the management of transport operations; (c) logistical trends and their impact on transport-intensity; (d) likely adaptations in production and distribution in response to higher transport costs (in general terms, without specifying the level of the cost increase).

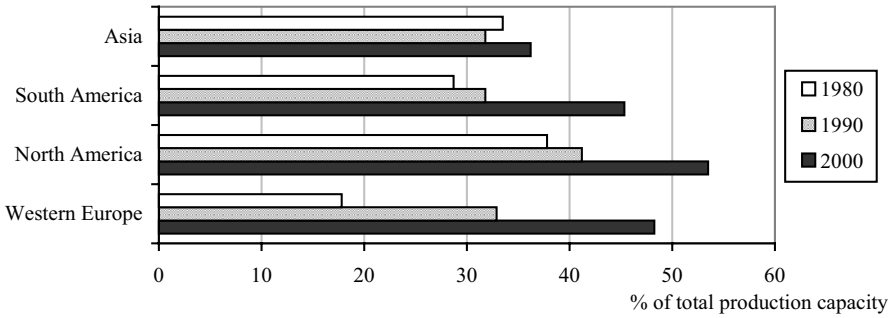
6.2.1 Organization of production and distribution

Dutch paper producers

In the Netherlands, there are 25-30 producers of paper but only five of them produce fine paper (used in book production) or newsprint (used for newspapers). Paper mills are mainly located in the provinces of Gelderland and Limburg (Kockelkorn, 1993: 41). Most Dutch paper producers are part of a large international paper holding; only a few,

relatively small specialized producers are still independent. This is in line with the general trend toward concentration in the paper industry in Europe and elsewhere through mergers and acquisitions (see Figure 6.1 for an indication). Newsprint production is more concentrated than fine paper production, although in the latter sector the concentration trend is continuing.

Figure 6.1: Production capacity share of top-10 producers of paper and board (per continent)



Source: CEPI, 2001: 32.

Until the 1970s, Dutch paper mills relied on cellulose as raw material, and purchased pulp and wood mainly from Scandinavian producers. Things changed when between the 1970s and 1990s paper production in Scandinavia increased (Kockelkorn, 1993: 40; Lehtonen and Holmström, 1998: 21). As a result, more raw material was used by the Scandinavian paper industry, which led to a decline in exports of wood and pulp to the Netherlands. Dutch paper producers largely solved the problem by switching to old paper as raw material. Fine paper however is still largely made of cellulose; only about 29 percent of the input consists of old paper (IPK, 2000a). Newsprint, packaging materials, and sanitary products in contrast are mainly produced of old paper (Vroonhof and Sas, 1996).

Dutch paper producers usually purchase old paper within a radius of 400-450 kilometer. About 57 percent or 1.3 million tons is imported, mainly from Germany (FNOI, 2001). Dutch old paper collectors and wholesalers however operate in a larger geographical area as they serve customers everywhere in Western Europe as well as customers in the Far East (e.g. Singapore, Hong Kong, and Indonesia). 60 percent of the almost 2.45 million ton of old paper that is collected in the Netherlands is exported[iv]. Half of the exports remain in Europe whereas the rest is sent to the Far East (FNOI, 2001; IPK, 2000b). The old paper market is an international one due to differences in old paper qualities demanded and supplied, differences in the availability of old paper, and differences in prices. Old paper collection in contrast is a local activity. This does not only reduce transport costs but also maximizes labor productivity: little driving time means that personnel can use most of their time for collection or additional services such as archive destruction.

Paper producers purchase cellulose (or pulp) in a wider geographical area than in which they purchase old paper. The main suppliers are located in Scandinavia, Portugal, and North and South America. Typically, cellulose suppliers keep large inventories in terminals at discharge ports (e.g. Rotterdam, Vlissingen, or Delfzijl). From there, paper producers call off orders (A.T. Kearney, 1994: 21-24; Wierikx *et al.,* 1993: annex 2).

Paper producers usually keep large safety inventories of raw materials, mainly in order to prevent distortions in production due to unreliable delivery and for price speculations (Wierikx *et al.,* 1993: 6). Yet, an increasing number of deliveries are supplied just-in-time in order to minimize inventory and storage costs.

Paper is usually produced in mass, although fine paper is produced in many qualities (e.g. expressed in weight and color) and therefore is produced in smaller production runs than newsprint. Paper producers generally have considerable inventories due to mass production and varying demand. Yet fine paper producers also produce to customer order; these products are usually kept in low inventories (WNF, 2001).

Dutch paper producers export a main part of their product. Statistics for the paper and cardboard industry for instance show that about 80 percent of turnover originates from exports (CBS, 2000: 3). Fine paper is usually sold within a maximum area of about 2,000 kilometers; most customers however are found within a radius of 500-800 kilometers (i.e. the Benelux, Germany, France, and the UK). Market areas for newsprint are usually smaller and have a maximum radius of 450-500 kilometers. Yet, part of newsprint and fine paper produced in the Netherlands is also exported to North and South America and the Far East. In the last decades exports of paper have increased, notably due to a reduction in trade barriers (Van Veen-Groot and Nijkamp, 1998: 1275).

There are two typical positions of the customer order decoupling point, discussed in section 2.4.2. One, with regular customers long-term agreements (e.g. for a couple of months or even a year) are made to produce certain amounts of paper. Subsequently the product is kept in inventory at the paper mill or at decentral warehouses abroad. Customers can call off from these inventories. Advantages of this concept to customers are short lead times, whereas to producers, it allows mass production without large commercial risks. Prices are usually set at the moment the paper is called off. The second typical position of the customer order decoupling point is in production itself and applies to customer-specific orders.

Several characteristics of customer service levels are summarized in Table 6.2. Delivery reliability is high which is partly due to the fact that printers often want just-in-time deliveries. Yet traditionally delivery reliability in the paper industry has been high. In a study conducted in 1992 only a higher delivery reliability was found in the food/beverages/tobacco industry, which is generally regarded a forerunner in logistics management (A.T. Kearney, 1993: 16).

Table 6.2: Customer service levels offered by Dutch fine paper producers (2001)

Indicator	Value
Order lead time if delivered from inventories	min. 2 days, max. 10-14 days
Order lead time for custom-made orders	min. 1 week, max. 6 weeks
In-time delivery (in percentage of total deliveries)(*)	min. 96%, max. 99.98%
Shipment sizes	both in LTL and in FTL
Just-in-time deliveries	by all producers

Note: (*): deliveries usually are scheduled in days or parts of a day. Source: interviews.

Co-operation between paper producers, their suppliers, and customers has been a trend over the last 10 years. To an increasing extent firms share information about inventories and sales prognoses. In addition, in some segments firms have started to take over responsibility for inventory replenishment (e.g. old paper suppliers arranging replenishments for paper producers and paper producers replenishing inventories of their customers, often just-in-time). Cellulose already used to be delivered from customer-specific inventories at discharge ports. These trends can be considered a form of supply chain management (SCM).

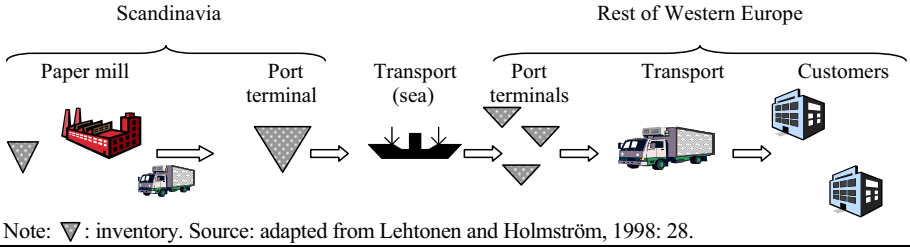
Scandinavian paper producers supplying Dutch customers

Fine paper and newsprint that is imported by Dutch printers and other customers for a large part originate from Scandinavian producers. Traditionally, Scandinavian paper producers are located near forest areas and inland waterways or coasts. Often, they combine pulp with paper production, which saves costs since pulp does not have to be dried before it is transported (Guglielminetti, 1998b: 8; WNF, 2001). Location near raw material sources reduces transport costs significantly, not only because transport distances are small but also because in pulp production, outbound flows are about one quarter of the inbound flow (Ruijgrok *et al.,* 1993: 32-37). However, recently a change is observed. One, a considerable amount of wood is imported from the United States and Canada. This depends on relative prices; when wood prices in Canada for instance are low it may be cheaper to import than to fell own trees (A.T. Kearney, 1994: 21-24). Two, new paper mills are increasingly located in Western Europe near the new source of raw material, i.e. old paper. It is claimed that the Netherlands is no preferred location due to among other things increasing congestion on motorways and a perceived poor performance of rail operators (VNP, 2001).

Newsprint that is produced for European customers is kept in inventory at the paper mill and at terminals in discharge ports on the European continent, from where customers are supplied (NEI, 1999: 27). This decentral distribution structure allows for relatively fast and frequent deliveries of newsprint compared to direct deliveries by sea from the Scandinavian paper mill due to infrequent sailings and long transit times (Lehtonen and Holmström, 1998: 29). Production in Scandinavia often is controlled by the sailing schedule of shipowners; terminals at discharge ports are replenished once enough paper for one shipload is produced. Obtaining high vessel capacity utilization and minimizing port visiting charges (i.e. minimization of direct transport costs) have high priorities in

production planning (Lehtonen and Holmström, 1998: 30-31). Figure 6.2 depicts the typical organization of Scandinavian newsprint producers.

Figure 6.2: Typical organization of production and distribution of Scandinavian newsprint producers



Note: ▽: inventory. Source: adapted from Lehtonen and Holmström, 1998: 28.

Fine paper is usually delivered either via discharge port terminals or directly from paper mill to customers (paper wholesalers, printers, or others). Direct deliveries are usually large orders (e.g. paper reels) or custom-made orders. Inventory policy and customer order decoupling points are similar to those employed by Dutch paper producers (see Lehtonen and Holmström, 1998 or Wierikx *et al.,* 1993).

6.2.2 Management of transport operations

Suppliers of cellulose and old paper are usually responsible for delivery of their product to paper producers (i.e. CIF delivery). Dutch paper producers in turn arrange the transport of paper to their customers. Scandinavian producers in contrast usually only arrange the transport of paper to the terminals in discharge ports (i.e. FOB). Customers have to collect paper from these terminals (Wierikx *et al.,* 1993: 8-11).

Various modes of transportation are used. Dutch paper producers rely mainly on road transport for the distribution of their product to customers located in the Netherlands. Paper deliveries to foreign customers are transported by road, but also by means of inland navigation, short sea shipping, deep sea shipping (in the case of intercontinental transport), or rail transport. In this context, alternative modes to road transport are notably used by producers of relatively low-valued paper, such as newsprint or cardboard. Fine paper producers nearly exclusively use road transport for a number of reasons. One, shipments are small (i.e. LTL) whereas newsprint and cardboard is nearly always shipped in FTL's. Two, due to a lack of connections to rail networks or inland waters, a modal shift requires additional handling and pickup and delivery by road, reducing the attractiveness of alternative modes. Finally, a modal shift requires larger quantities of paper that customers often do not want, as it requires additional storage and raises inventory costs. However due to increasing restrictions on road transport (e.g. bans on road haulage overnight or in weekends) as well as higher taxes on road haulage (Germany for instance has announced a kilometer tax as for 2003), several Dutch paper producers are seriously considering alternative modes of transportation for both raw material supply and (long-distance) paper deliveries.

Scandinavian producers exporting to the European continent usually ship their product by sea to the terminals in discharge ports from where final distribution takes place by road and in some cases also by rail. Often several producers jointly charter a vessel, as this allows for more frequent shipments. Only 10-15 percent of all reels and sheets that are shipped to the European continent are transported by road (NEI, 1999: 27; 71). In the case of relatively high-valued fine paper the share of road transport in total transport is higher, i.e. some 45 percent (NEI, 1999: 27; 71; see also for instance SCA, 2001: 41).

Old paper is almost exclusively delivered to the paper industry by road transport in FTL's. Exports to the Far East are containerized and shipped by inland navigation to sea ports and continue their voyage by deep sea shipping. Cellulose is usually transported by road or inland navigation, either from terminals at discharge ports or directly from the foreign producers.

Paper producers have usually outsourced transport to commercial carriers. Specialized carriers are used in order to reduce damage of paper (Dohmen, 2001: 10). Damaged paper makes it useless and may lead to additional costs as well. Damaged paper may namely lead to distortions in the printing process (e.g. via paper ruptures), the costs of which usually have to recouped by paper suppliers (i.e. producers and wholesalers). In addition, paper suppliers are responsible for recollection of damaged paper, which leads to additional transport costs. Containers are only used in intercontinental paper transport (Nieuwsblad Transport, February 23, 2001).

Old paper collectors and wholesalers often employ own account transport. They are active in return cargo acquisition because transport costs are relatively high (i.e. 15-20 percent for wholesalers; this only relates to the cost of distribution to paper producers). Acquisition of return cargo by old paper *collectors* is however barely possible due to the specialized vehicles and the limited geographical area in which they operate. When transport is outsourced (typically only in distribution to paper producers), often redundant transport capacity of carriers is used. In this context, product is transported in trucks or sea containers that would otherwise run empty (e.g. on return hauls).

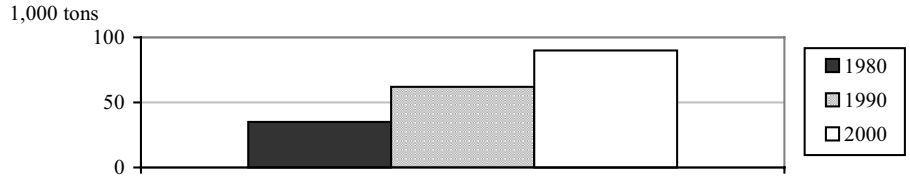
6.2.3 Logistical trends and impact on transport-intensity

In the European paper industry, the following trends in production and distribution are observed (CEPI, 2001; Drewry, 1998; Guglielminetti, 1998b: 9; NEI, 1999: 34; 71; Upton, 1995: 74-84; Wierikx *et al.,* 1993: 5-7) :

- a relocation of pulp and paper production closer to the European continent. The main reason is the increased use of old paper, which is notably available in large consumer markets outside Scandinavia;
- concentration of producers through mergers and acquisitions;
- reduction in the number of suppliers;
- spatial concentration of production, due to both reduction in plants, larger mills (see Figure 6.3), and focused production. The result has been a wider geographical market area (see Table 6.3 for an indication);
- a spatial concentration of inventories;

- a reduction of inventories throughout the supply chain;
- more long-term relationships between supply chain participants, in order to achieve better coordination of goods flows, lower costs, and improved quality;
- a trend toward lead time reduction and higher delivery reliability;
- diversification of paper assortments (notably more high-valued paper).

Figure 6.3: Trends in average size of paper and paperboard mills (Western Europe)



Source: CEPI, 2001: 32

Table 6.3: Developments in geographical aspects of distribution (*)

	1993	**1998**	**2003 (plan)**
Share of distribution facilities serving more than one country	19%	28%	35%

Note: (*): average figures for paper, metals, oil, chemical, and gas industries in Europe. Source: A.T. Kearney, 1999: 8.

These trends are similar to many of the trends that were observed in chapter 1 and that have contributed to an acceleration in transport growth (in ton-kilometers as well as in vehicle-kilometers). In the paper industry the impact of these trends on transport-intensity however is not straightforward. For instance, the concentration of paper producers has led to both a reduction in transport distances because customers are more often supplied from the nearest paper mill ('swapping') and to increased transport distances due to increased paper mill specialization.

More detailed data are only available for the Swedish situation. Here, freight transport of paper in vehicle-kilometers grew at a less faster pace than paper production between 1985 and 1995. This is quite remarkable since in chapter 1 (section 1.4) the opposite was observed in many other industries. Despite the fact that many of the above trends have also occurred in Sweden and in theory would lead to a higher transport-intensity, changes in the management of transport operations have tempered traffic growth (NEI, 1999: 28-34; 71):

- load factors have improved due to increased outsourcing of transport and increased use of computerized vehicle routing and scheduling;
- empty running has been reduced due to an increase in return loading.

In contrast, a Dutch paper producer that was interviewed expected that the envisaged centralization of inventories would lead to a 15-20 percent increase in vehicle-kilometers, given unchanged volumes of paper deliveries. Despite the fact that this producer intended to consolidate more shipments, the net increase in average transport distances was expected to lead to a higher traffic-intensity.

Finally Dutch old paper wholesalers have started exporting to the Far East in the early 1990s, which has obviously resulted in a higher traffic-intensity due to a dramatic increase in average transport distances.

6.2.4 Likely responses to increases in transport costs

Based on available literature, the plausible responses of paper producers to an increase in transport costs will be discussed. Distinction will be made between direct transport costs and costs related to longer transit times or reduced delivery reliability. The latter types of transport costs are combined since they usually are affected by a common variable, namely the extent to which congestion occurs (see chapter 5). Three relevant sectors will be included, namely Dutch paper producers, Scandinavian paper producers supplying Dutch customers, and the Dutch old paper sector.

Higher direct transport costs

Dutch paper producers

To Dutch paper producers, transport costs make up about 6 percent of total costs with extremes of three and 11 percent. This only includes the costs of paper deliveries and transport of cellulose from port terminals to paper mill. The specific share of transport costs in total costs is related to product value density; producers of newsprint or cardboard face relatively higher transport costs than fine paper producers due to a lower product value density[v]. Inventory costs (i.e. interest costs of paper in inventory) on average are 1.3 percent of total costs, whereas storage costs (i.e. warehousing) have an average share of 2.5 percent of total costs. Compared to data from 10 years ago, transport costs have increased whereas other logistical costs have decreased (see Table 6.4). This is probably caused by smaller raw material inventories and more frequent replenishment orders. Logistical costs in the paper industry in Western Europe however are found to be the highest of all industries (Guglielminetti, 1998b: 10).

Table 6.4: Logistical costs in the European paper and paperware sector (as a percentage of total costs)(*)

	Transport	Warehousing	Administration	Inventory	Total logistical costs
Manufacturing	5.2%	3.3%	2.3%	4.0%	14.8%
Wholesale	2.8%	3.6%	1.1%	2.8%	10.3%
Retail	1.7%	3.2%	0.9%	1.4%	7.2%
Overall	3.7%	3.4%	1.7%	3.1%	11.9%

Notes: (*): originally logistical costs were calculated in revenues; assumed was a 10 percent profit.
Source: A.T. Kearney, 1993: 16.

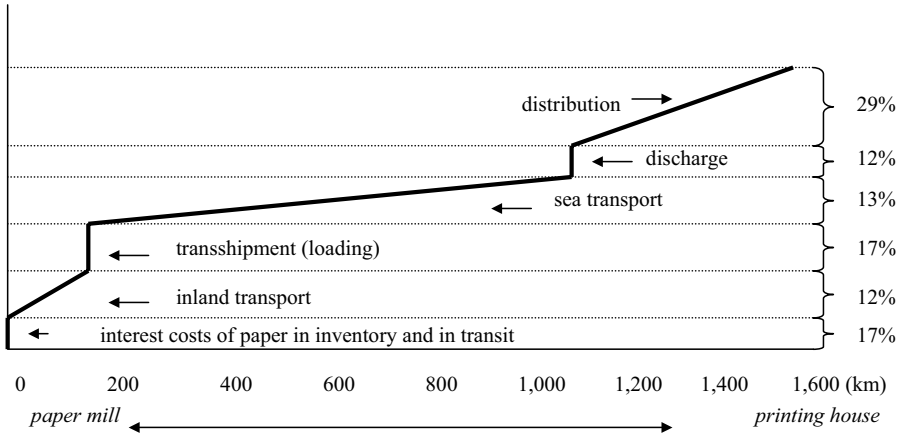
Only one publication was found that addressed the possible effects of higher direct transport costs in paper production. In this publication, a paper producer was asked for likely responses to a rise in transport costs. Related to the organization of production and distribution, the following reactions were reported (Ruijgrok *et al.,* 1993: 45):

- adjusting the geographical market areas that are served by its mills;
- integration of the supply of raw materials with distribution of paper, resulting in higher load factors of trucks.

Scandinavian paper producers

To Scandinavian paper producers that export their product to the Netherlands, the share of transport costs in total costs usually is a few percentages higher than in the case of Dutch producers. This is mainly due to the fact that larger distances have to be covered and because of additional handling at port terminals, although relatively cheap transport by sea is used for a major part of the voyage (see Figure 6.4).

Figure 6.4: Structure of logistical costs of Finnish paper production



Source: Wijnolst and Van der Lugt, 1993: 14.

No specific literature was found addressing the potential impact of higher direct transport costs on production and distribution of paper by Scandinavian producers. However, Tweddle *et al.,* who examined the European paper industry in general, expect that "the impact of increased road transport cost would seem mainly an increase in total delivered price of paper" (op.cit., 1998: p. 46). Three hypotheses for the pulp and paper industry can be deduced from this statement in the case of increased direct transport costs:

- options to reduce transport-intensity are limited;
- higher transport costs will therefore lead to higher paper prices;
- as a consequence, customers will switch to suppliers located nearby.

The latter hypothesized effect can be produced by two mechanisms. One, geographical size of markets of paper mills may be reduced. Two, paper mills may start co-operations with other paper producers, and agree that customers are supplied by the nearest producer (i.e. swapping), similar to what already happens in large paper holdings. This saves both transport costs and reduces lead times. Obviously, this strategy is possible only if paper products have the same quality (Upton, 1995: 75).

Additional evidence comes from a study by NEI, which found little opportunities to reduce traffic that is generated by the production and distribution of paper. The main reason was that trucks and vessels were found to have very high load factors (NEI, 1999: 71). Only when wood is imported from wide geographical areas (e.g. Brazil) may more local sourcing be expected.

Old paper collectors and wholesalers
No literature was found addressing the possible effects of higher direct transport costs on old paper collection and distribution. However due to the relatively high share of transport costs in total costs, it is likely that transport operations are already optimized as far as possible (e.g. expressed in high load factors). Hence similar to paper production and distribution it is likely that increases in direct transport costs will lead to higher prices, which subsequently may lead to smaller market areas or swapping.

Higher costs due to longer transit times and reduced delivery reliability

Dutch paper producers
The costs of longer transit times and reduced delivery reliability are difficult to quantify because they are firm- and situation-specific (see chapter 3, section 3.2). In addition firms may value these costs differently (e.g. interest rates).

No studies were found that address how paper producers might respond or have responded to changes in transit times or delivery reliability. It is however likely that the effects on inventory costs will be limited. These costs are currently low, on average only one percent of total costs, and are mainly caused by keeping paper in inventory in warehouses, not in transit. Hence, longer transit times may not be expected to have severe effects. Yet, due to increasing pressure that customers put on order lead times and delivery reliability, longer transit times and reduced delivery reliability may lead to loss of customers. Paper producers may avoid this in a number of ways. One, they may relocate inventories closer to their customers. Two, larger safety inventories may be kept in the case of standard types of paper. Three, in the case of standard paper that is supplied to regular and remote customers, producers may decide to create in-transit inventory by increasing the frequency of shipments.

Scandinavian paper producers
Longer transit times or reduced delivery reliability may cause additional problems to Scandinavian paper producers, because they usually employ an indirect distribution structure (i.e. intermediate inventories in terminals in discharge ports). Many Scandinavian paper producers are tied to sailing lists of shipowners. Basically the same

effects as those from Dutch producers can be expected. More joint chartering of vessels by multiple paper producers, leading to a higher frequency of replenishment shipments to terminals at discharge ports, is not likely since already large inventories exist in ports.

Old paper collectors and wholesalers
Longer transit times or reduced delivery reliability will probably not cause large problems in old paper collection and distribution. The main reason is that time pressure is not high. If reduced delivery reliability poses problems to customers, it may be compensated by earlier departures. Longer transit times will probably not cause significantly higher interest costs or increased risk of obsolescence and hence will not be problematic. Decentral or higher inventories are not likely because it would raise overall storage costs and hence would inflate old paper prices. However longer transit times could lead to higher direct transport costs because productivity losses of drivers and carriers.

6.3 Newspaper production and distribution

In the Netherlands, various types of newspapers are published. The most well-known newspapers are daily newspapers that have either national or regional editions. Every day, 4.4 million of these newspapers are distributed to Dutch households (KVGO, 2001a: 20), involving an annual freight volume of 450,000 ton (Bus *et al.,* 1999b: 151). Other newspapers are community newspapers that usually have a lower frequency of edition (e.g. weekly or biweekly), professional newspapers, and bulk advertisements. In total there are about 2,500 different titles of newspapers. Dutch firms publish the majority of all newspapers[vi]. In this section the focus will be on daily newspapers because they generate a main part of total transport volumes of newspapers.

6.3.1 Organization of production and distribution

The Dutch daily newspaper sector is relatively concentrated. There are ten national titles that are published by a few large holdings (see Table 6.5). Concentration is an ongoing trend; in 1986 the four largest publishers of daily national newspapers together had a market share of 56 percent, while this share rose up to 80 percent in 1994 (Rekko, 1995). Regional newspaper titles are larger in number but national newspaper publishers own many regional newspaper publishers. Newspaper prices are to some extent co-ordinated as publishers jointly raise newspaper prices and set fixed retail prices. Yet in the near future these forms of price regulation will be forbidden (NUV, 2001: 11).

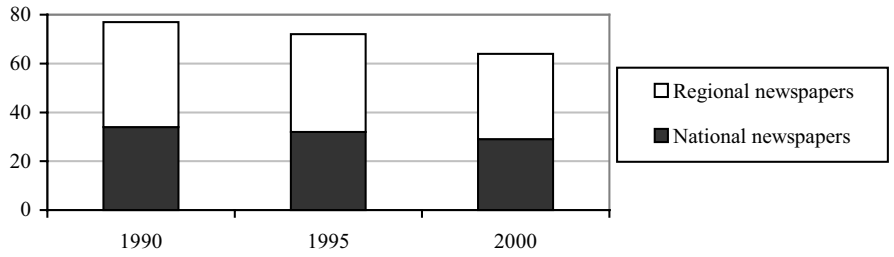
Table 6.5: Titles, editions, and publishers of Dutch newspapers

	N° of titles	**Edition volume**	**N° of publishers**
Regional newspapers	30	2,279,274	20
National newspapers	10	2,131,389	7
Total	40	4,410,663	27

Source: Het Oplage Instituut/Instituut voor Media Auditing, 2001 (www.hoi-online.nl).

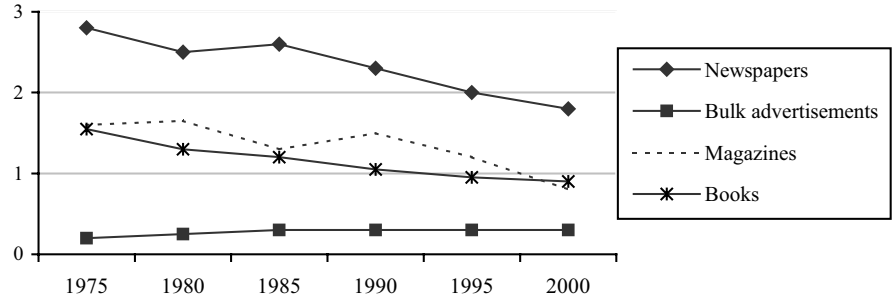
In the last decades newspapers have faced declining sales (see Figure 6.5). Partly therefore, the average time that consumers put in reading newspapers has decreased (see Figure 6.6). Both trends have led to reduced advertisement revenues that make up about 60 percent of total revenues (KVGO, 2001b). This has led to a further concentration in newspaper publishing in order to cut costs (e.g. economies of scale in content).

Figure 6.5: Edition volumes of daily newspapers per 100 households (1990-2000)



Source: Cebuco in NRC Handelsblad, May 14, 2001.

Figure 6.6: Media use in the Netherlands, in hours per week



Source: Volkskrant, January 5, 2002.

Newspaper production involves two distinct stages. The first stage involves writing, collection, and layout of articles. Second, the text is put on a film and subsequently printed. Publishers of daily, national newspapers perform all activities themselves, but other publishers often have outsourced printing (e.g. to national newspaper publishers).

Most national daily newspapers are printed at two locations in the Netherlands. Evening newspapers are sometimes sent digitally to regional printers who then produce for the regional market. Besides the possibility to use spare capacity of regional printers at low rates, a main reason is to avoid congestion on roads (Bus *et al.,* 1999b: 152; Scholtes *et al.,* 1998: 77). Several publishers of evening newspapers however switched to morning editions because of two reasons. One, average lead time for newspaper production and distribution is shorter, which leads to additional time pressure in distribution. Two, a main part of transport takes place in daytime and is increasingly delayed by congestion.

Regional newspapers usually are printed at one location in the region where they are sold. In the case of regional newspapers that are published and printed by national publishers, sometimes a printing location is used that does not seem logical from a logistics view. This however is caused by efforts to optimize total printing capacity, increase flexibility and stability of printing, and minimize total printing costs at firm-level rather than to minimize transport costs or lead times.

Usually editorials close at midnight. Then the printing process starts, which takes on average four hours. However, if important news arrives after the deadline, it may be processed in a new edition for which small changes in the printing process are required. Thus, sometimes subscribers located in different areas receive different editions of the same newspaper (Lijftogt, 2001: 10). Most publishers start distributing the newspapers from the moment that the first pallets are ready. In this context, distribution can be regarded as a continuous process. The first series of newspapers are send abroad by airfreight; after that newspapers are distributed within the Netherlands (outer regions first).

Distribution of national newspapers takes place in two stages (see for instance Lijftogt, 2001: 10). First, bulk volumes of newspapers are sent to decentral hubs by means of direct deliveries. At these hubs, trucks are unloaded. Smaller vehicles then distribute to local delivery agencies on a multi-drop basis. From the local delivery agencies, newspapers are delivered to the customers, commonly by bike. Usually final delivery areas can be served within 45-60 minutes; larger areas would imply too long lead times. The whole process is scheduled on a per-minute basis. Final delivery has to take place before 7:00 AM. Often however distortions occur, e.g. because editors want to include the latest news and therefore postpone printing, or because of technical reasons (e.g. paper ruptures during printing). Delays have to be absorbed in the distribution process, for instance by replacing multi-drop hauls by direct hauls.

Regional newspapers are usually printed in the region where they are delivered, commonly from one location. Similar to national newspapers, printed newspapers are first delivered to decentral hubs (usually in cities) and from there distributed to local delivery agencies. Final distribution takes place by bike or in rural areas by vans.

Local newspapers, bulk advertisements and the like are usually printed by commercial printers or by printing departments of national newspaper publishers. Time pressure is lower than in the case of daily newspapers. Printing and distribution therefore is scheduled outside that of daily newspapers.

Newsprint is partly purchased from Dutch producers but mainly from foreign suppliers. In the latter case, publishers and printers are supplied from terminals at discharge ports, mainly in Rotterdam. Paper is replenished daily, usually at night when the morning newspapers are printed. In these cases, paper supply can be characterized as just-in-time. Apart from that are usually (small) safety inventories kept (Lijftogt, 2001: 10). Ink is delivered in large drums from foreign suppliers and less frequently than paper.

Newspapers production can be typified as make-to-order as about 90 percent of all newspapers sold are subscription-based (KVGO, 2001a: 20; Rekko, 1995). The remainder is sold via retailers such as tobacco stores, kiosks, and petrol stations. Hence, production volumes and delivery addresses are relatively stable so that distribution can be planned relatively well.

The newspaper publishing sector has a very high performance when it concerns customer service. In-time delivery for instance is claimed to be as high as 99.95 to 99.97 percent. The main reason is that delayed newspapers often are worthless to subscribers. High delivery performance is mainly achieved by routine and close co-operation and information exchange between publishers and their carriers (Lijftogt, 2001: 10).

6.3.2 Management of transport operations

Newsprint is sometimes delivered by suppliers and sometimes has to be collected by the newspaper publishers themselves at the port terminals. Various modes of transportation are used: road haulage, rail transport, and inland navigation. In total volumes however road transport dominates.

Transport of newspapers from printing locations to decentral hubs is often performed by own account fleets of publishers, whereas the remaining transport activities are outsourced. Newspapers that are send abroad are usually transported by airfreight or train by commercial express delivery carriers (Bus *et al.,* 1999b: 153; Lijftogt, 2001: 10).

Trucks are to some extent adapted to the volume of cargoes. Large trucks are used for hub transport whereas smaller trucks and vans are employed to supply local delivery agencies (Bus *et al.,* 1999b: 152; Lijftogt, 2001: 10). Yet it appears that overall load factors are low for a number of reasons:

- vehicles are adapted to peak demand that in practice rarely occurs;
- trucks nearly always return empty;
- any delays in printing have to be absorbed in distribution, e.g. by extending the number of direct hauls.

Logistical awareness at newspaper publishers is however emerging. Many of them now have centralized transport operations within their holdings and aim to optimize load factors by consolidating shipments and by acquiring return cargo. Reasons why this has only recently begun, include the increased pressure to cut costs due to falling advertisement revenues and perhaps also the fact that price agreements will be abolished in the near future. In addition, newspaper publishers increasingly face the effects of congestion, despite the fact that distribution commonly takes place at night. One of the reasons is that road maintenance activities are increasingly executed at night.

6.3.3 Logistical trends and impact on transport-intensity

Between 1990 and 1995, the number of vehicle-kilometers driven on behalf of newspapers in the Netherlands has remained constant due to two opposite developments (Bus *et al.,* 1999b: 159):

- a drop in average distances due to the increased use of regional printers;
- a drop in load factors of trucks due to fragmentation of delivery addresses and stricter delivery windows in city centers that reduce opportunities for multi-drop hauls.

Current trends among publishers and printers of newspapers and bulk advertisements, as well as their transport effects, include[vii]:

- inventory minimization in order to reduce inventory costs and storage costs due to a more frequent delivery of replenishment orders. In fact this trend is observed among all paper purchasers (Tweddle *et al.,* 1998: 46). In the newspaper industry this trend does not necessarily imply an increase in vehicle-kilometers because newsprint is typically delivered in FTL's (see section 6.2.2). It could however imply a more continuous flow of newsprint deliveries;
- ongoing concentration of publishers and decreasing diversity of newspapers. This may lead to more efficient transport operations due to consolidation of freight flows;
- many newspaper publishers have started to centralize transport operations within their holdings, which is expected to raise efficiency of transport operations;
- several large publishers of daily newspapers have started a joint venture for distribution of their newspapers. The motive was a scarcity of delivery-men, inflating the costs of final delivery (on average 10-15 percent of total costs). Newspapers will be delivered to the hubs of the new joint venture from where newspapers are transported to local delivery agencies. Consolidation of freight flows that are currently separated may lead to more efficient transport operations, thus reducing total vehicle-kilometers;
- more decentral printing of daily newspapers (in particular evening newspapers) due to increased congestion on roads (see above). This takes away part of transport demand. This trend however partly means a reversion of the (ongoing) trend toward centralization of printing, which has *increased* transport demand due to longer distances.

6.3.4 Likely responses to increases in transport costs

Higher direct transport costs

Given the fact that value density of newspapers is relatively low (e.g. compared to that of books), in theory newspaper production and distribution would be expected to be sensitive to an increase in direct transport costs. Nevertheless, transport costs have a relatively small share in total costs of publishers (on average five percent) and at board-level are not considered very important. It should be noted that this concerns the cost of motorized transport. Final delivery costs namely are considered important since they

make up about 10-15 percent of total costs. Other important logistical costs are related to warehousing and inventory-keeping of paper, although these costs are probably not much higher than those of transport costs. Another indication of the probably low transport cost sensitivity is that in times of overcapacity, newspaper publishers often acquire work from third parties irrespective of location. This suggests that the transport costs related to this work are relatively unimportant (Bus *et al.,* 1999b: 153). Transport is traditionally considered an unavoidable activity that did not receive much attention. Only recently have newspaper publishers started to optimize transport processes and reduce inefficiencies by integrating freight flows within their holdings.

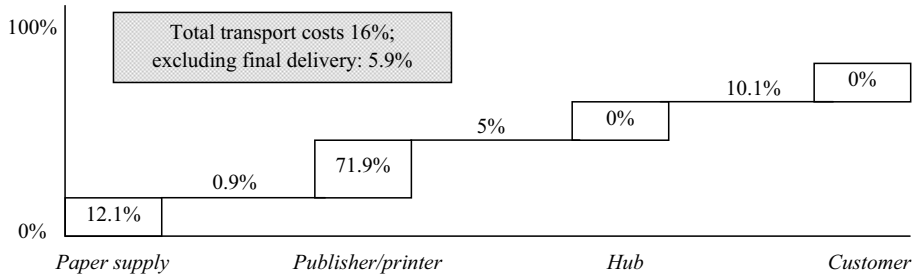
Possibilities to improve consolidation and load factors are constrained by time pressure in newspaper distribution. Nevertheless transport-intensity could be reduced by (Bus *et al.,* 1999b: 161):

- increased regional printing. A complete outsourcing of newspaper printing jobs to regional printers does not seem feasible however, since newspaper publishers have invested heavily in printing presses;
- increased acquisition of return cargo and integration of inbound deliveries with outbound newspaper transport, raising load factors and reducing empty running.

Apart from that, printers may be expected to keep higher inventories of paper if direct transport costs increase. Given the low value density of paper and a low physical perishability, small increases in transport costs may have a significant impact on the trade-off between transport costs, inventory costs, and storage costs. An exception could be printers that use a wide range of paper types since keeping inventories of many different types may barely be an option. Apart from that, higher transport costs could lead to more local sourcing of ink and paper.

Finally, since transport costs have a share of on average six percent in the price of a newspaper (see Figure 6.7), only substantial transport cost increases may lead to a loss of customers. Thus, geographical market areas and volumes of sales will probably not be affected by higher direct transport costs.

Figure 6.7: Transport costs as a percentage of newspaper prices[viii]



Percentages in-between the boxes indicate transport costs. Based on own calculations. Source: interviews.

Higher costs due to longer transit times and reduced delivery reliability

Newspaper publishers will be very responsive to longer transit times and in particular to a decreased reliability. Already publishers are looking for alternatives for their current distribution structures because of increased congestion (Bus *et al.,* 1999b: 153). Because the daily newspapers always have to be delivered before 7:00 AM, in particular reduced delivery reliability may be problematic. The main response to an increase in congestion will probably be a (further) decentralization of printing similar to what is already observed. The main reason is that there are few if any other options since delivery addresses are fixed and newspapers are not kept in inventory. From decentral printers, transport distances are only short; hence possible delays will not cause large problems.

Publishers of newspapers with a low frequency of edition (e.g. weekly) however are probably less sensitive to longer transit times and reduced delivery reliability than publishers of daily newspapers. Due to the longer average production lead time, they may have more possibilities to absorb any delays in transport by a rescheduling of activities. Hence in their case a decentralization will not always be necessary or likely.

6.4 Book production and distribution

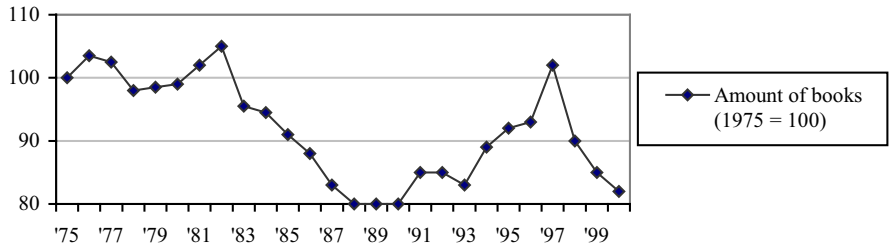
The primary production process of book publishing involves two main activities. First an author writes a manuscript, whether or not by order of a publisher. After editing and final approval, the book production starts, which is a very specialized process that involves usually multiple firms: prepress firms, printers, and binders (Furstner, 1976: 26-27).

Production and distribution of books and newspapers have some similarities, e.g. both need paper and printing. They also reveal strong differences, at least from a logistical perspective:

- books often have a higher value than newspapers and are made of paper of a higher value density;
- newspapers have a tenability of only one day; after that they are useless to most consumers. Even delays of half an hour may make newspapers useless, notably when it concerns morning newspapers. Books in contrast have a longer life cycle, but commercial risk is much higher than that of newspapers. Edition volumes are difficult to estimate, because *ex ante* publishers never know how a book will sell. Newspaper publishers have a much more stable demand;
- production lead times differ significantly. Book publication may take months or years. Newspaper articles are written in several days or weeks and newspapers are printed daily. The difference in lead times is notably caused in the writing process, since the production and distribution of books take about three to five weeks on average;
- newspapers are generally printed in much larger volumes than books, which is not only related to demand but also to the fact that publishers tend to reduce commercial risks by publishing multiple editions of a book when it sells (Heijne den Bak *et al.,* 2000: 14-18).

Books sold in the Netherlands are usually classified according to two criteria: content (educational books, professional or scientific books, and 'general' books) and language. In 1999, total book sales in the Netherlands mounted up to € 1.05 billion[ix]. About 55 percent of total book sales are general books; educational/scientific books and professional books each have a 'market share' of about 23 percent. 25 percent of all books sold in the Netherlands are in foreign language. Data on the amount of books sold are only available for general books. In 1999 about 33.5 million of these books were sold. Sales of general books have shown a decline in the last 25 years (see Figure 6.8).

Figure 6.8: Amount of general books bought in the Netherlands 1975-2000



Source: KVB, 2001, at http://www.speurwerk.nl/bc/19752000.htm.

An important characteristic of the Dutch book market is the vertical price regulation. Publishers fix retail prices for at least two years. Vertical book price regulations exist in many countries. Their main goal is to assure a large assortment of books by means of cross-subsidization (Frowein and Wiercx, 1997: 22). The European Commission officially forbids vertical price regulations but the book sector has a dispensation until 2005 (NUV, 2001: 9)[x].

6.4.1 Organization of production and distribution

Given the fact that most books that are sold in the Netherlands originate from Dutch publishers or are imported by Dutch firms, the focus will be on these firms. This section focuses on the main actors involved in book production and distribution in terms of freight flows, i.e. publishers, printers, binders, paper wholesalers, and book distributors.

Publishers

Book publishers are located all over the Netherlands, but major concentrations are found in the provinces of North and South Holland (Kockelkorn, 1993: 38; KVGO, 2001a: 13). Most publishers focus on activities such as finding and evaluating manuscripts, marketing, and sales. Printing and binding of books are usually outsourced. In general, low-cost printers located in Spain, Portugal, or Eastern Europe print 'common-and-garden' books and children's books in large volumes of only one edition. Other books are usually produced in smaller volumes and multiple editions by Dutch firms (KVGO, 2001b).

There are two types of logistical structures in book distribution to bookstores. One, many publishers of specialized books (i.e. educational books, scientific books, and professional books) operate own distribution centers for storage and distribution to bookstores or to final customers (e.g. schools). Two, most publishers of general, Dutch books have outsourced warehousing and distribution of their books to specialized book wholesalers that are few in number. One of the largest wholesalers, *Centraal Boekhuis*, is owned by Dutch booksellers and publishers. In contrast to most other wholesalers, this wholesaler does not bear the commercial risk of inventories as publishers remain owner of the books.

Throughout the whole supply chain, inventories of books are kept at two locations: at publishers' or wholesalers' distribution centers and in bookstores. Publishers face significant commercial risks because it is never certain whether or not a book will sell. In the UK for instance 2,000 new titles appear per week with an average commercial lifetime of 12 weeks. The result is that both publishers and retailers run a considerable risk of ending up with obsolete inventories of books (Lewis, 2000: 16-20). Many Dutch publishers have positioned the customer order decoupling point of books at book retailers as they base the volumes per edition on (forecasted) orders of retailers. In combination with the retail prices they determine, it means that publishers have passed on a significant part of the commercial risk to retailers[xi].

New 'printing-on-demand' techniques however may allow both publishers and retailers to reduce the risk of obsolete books as well as inventory costs since books are only printed when there is a demand. Production runs are relatively small (100-5,000 copies but even a run of one book is possible). Printing on demand has several advantages and disadvantages (see Table 6.6) and may lead to changes in the logistical structure of book production and distribution, if wholesalers and retailers are circumvented.

Table 6.6: Advantages and disadvantages of printing on demand compared to conventional offset printing

Advantages	Disadvantages
• fast turnaround due to digitization • no films or plate • low make-ready cost • lower unit costs on short runs • easy customization possible • easy keeping up-to-date • avoiding (physical) inventory • easy adjustments • easy archiving	• higher unit costs for long runs • less accurate pre-press proofs • extensive testing and partnering required • reduced paper choice • reduced quality options • fixed press speeds (impossible to run machines slowly for press checks and switch to high speed for production runs)

Source: Beach and Kenly, 1998: 129.

The production of books (i.e. printing and binding) itself is also difficult to plan, because there are always uncertainties about when the final manuscript will be delivered whereas the eventual volumes are often known in a late stage. With printers often agreements are made beforehand about the type and quality of paper that will be bought.

It is claimed that traditionally, publishers have mainly focused on acquisition of new publications, manuscript evaluation, and marketing. Once a manuscript was ready, book production was often organized in a more or less chaotic way: for instance many activities that could be executed parallel with others were in fact performed sequentially (KVGO, 2001b)[xii]. A main reason why publishers have been forced to professionalize the production process is the increasing reduction in lead times (see section 6.4.3 for more details). In addition the threat of increased competition, due to the abolishment of vertical price regulations, forces publishers to concentrate more on costs.

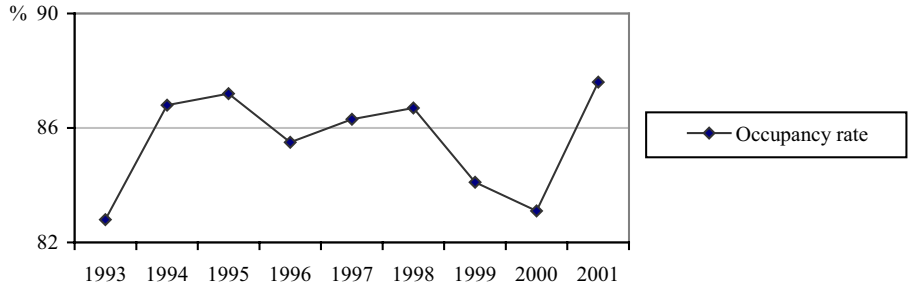
Printers and binders

Most printers have a particular specialization, e.g. simple, black-and-white books or luxury multi-color books, which require specific presses. Most printers do not bind books themselves but outsource this activity. Binders deliver books directly to the next node in the supply chain, i.e. book wholesalers or distribution centers of publishers.

Most printers purchase paper from Dutch wholesalers (Kockelkorn, 1993: 40). Printers have small safety inventories of paper, because of high inventory costs (notably if they use a wide range of paper types) and storage costs since paper is voluminous (Dohmen, 2001: 10). Because eventual volumes of book editions are often known only a few days prior to printing, paper orders are postponed as long as possible. Increasingly just-in-time deliveries are demanded which are directly fed into the printing press. Wholesalers usually deliver within 24 hours and claim a very high delivery reliability.

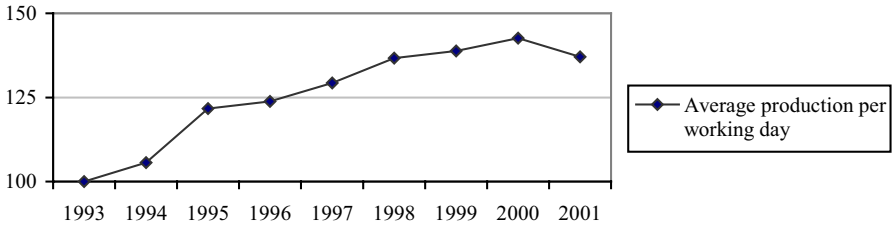
Notably medium-sized and large printers (i.e. 10-100 employees and 100 employees or more, respectively) are opened 14 or more hours a day, in order to optimize capacity of printing presses and reduce lead times (for an indication, see Figure 6.9 and 6.10[xiii]).

Figure 6.9: Trends in occupancy rates of printing presses (*)



Note: (*): expressed in the percentage of time that a press is in use. Source: CBS, 2002.

Figure 6.10: Average production per working day in the graphic industry (1993 = 100)(*)



Note: (*): production expressed in turnover. Source: CBS, 2002.

Paper wholesalers

Paper wholesalers purchase most of their paper from foreign paper producers. Wholesalers are either supplied from inventories of paper producers at discharge ports or directly from the paper mill (e.g. in the case of custom-made orders). They keep substantial paper inventories of a large variety; to large wholesalers it is not uncommon to have a paper assortment consisting of 4,500-5,000 types of paper of different color, weight, and formats. Part of the paper orders is customized by the wholesaler e.g. regarding formats. Fast moving paper types are usually kept in inventory for four to six weeks. Slow-moving paper types may be stored for 5 months or more due to long order delivery times of paper producers and a wide variety of paper orders of printers that all have to be delivered within 24 hours. Paper wholesalers increasingly take over inventory management for printers, as printers usually do not want to keep inventories.

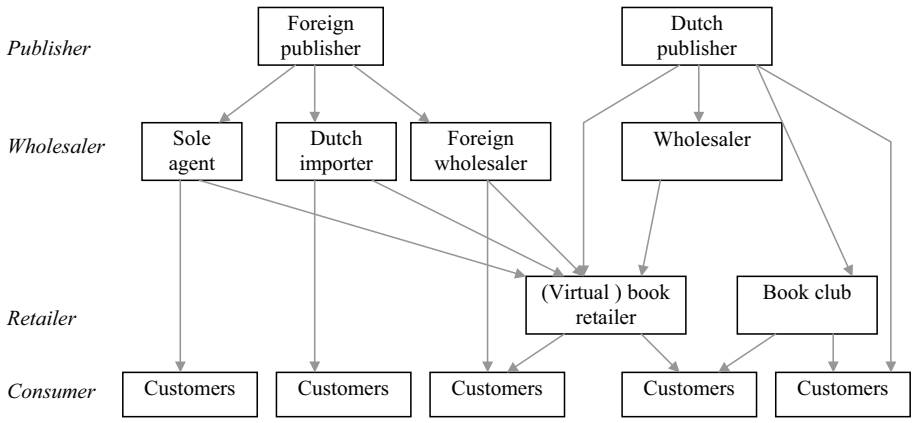
Paper wholesalers claim to have little market power vis-à-vis both paper suppliers and customers. One, there are only a few alternative paper suppliers (see section 6.2.1). Two, regarding their customers it is claimed that overcapacity in paper wholesale exists. In combination with fairly transparent costs (because paper prices are well-known) profit margins are claimed to be small. As a result wholesalers are forced to obey to the ever higher levels of customer service demanded by printers.

Book distributors

As Figure 6.11 shows, books find their way to customers located in the Netherlands in various ways. Traditional bookstores sell two-third of all books (NUV, 2001: 10). Other book retailers are large department stores, book clubs, 'ramsj' stores, and other retailers[xiv]. A new actor is the 'virtual' bookstore that sells books via a website. Their market share is still small (i.e. one or two percent of total book sales), but is growing.

Below two distribution channels are discussed in more detail, namely the traditional bookstores, that currently sell most of the books, and the virtual bookstores, that have a potential to acquire a larger market share in future. The latter are also interesting because they are organized in a different manner. Reasons to exclude the other distribution channels are the limited role in total book sales and the fact that most of them employ a logistical system similar to that of traditional bookstores.

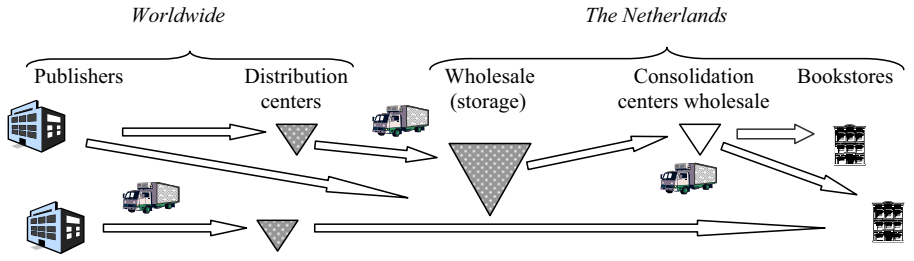
Figure 6.11: Distribution channels of books



Source: Furstner, 1976: 27, updated.

The typical logistical structure employed in traditional book sales via retail outlets is depicted by Figure 6.12. Bookstores are located in areas that are visited by large crowds of potential customers, such as city centers, malls, universities, and railway stations. Publishers are located worldwide, but the majority is located in Europe and North America. Foreign books are delivered via import organizations, whereas Dutch books are delivered by a few wholesalers, via distribution centers of publishers, or sometimes directly from publishers. Orders from Dutch publishers or wholesalers are usually delivered within 24 hours and with a delivery reliability of 97-98 percent. Imported books may take longer, e.g. one or two weeks with an unknown delivery reliability.

Figure 6.12: Logistical structures in traditional book retail

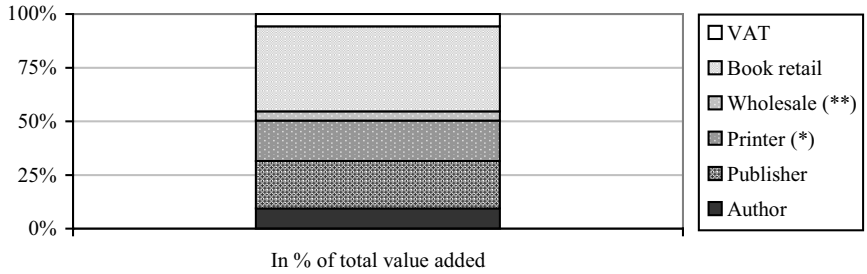


Note: ▽: storage; ▽ : transshipment without storage. Source: Runhaar and Kuipers, 2000: 43.

Bookstores generally have considerable inventories of books in terms of variety and quantities. A main reason is that most customers do not have concrete ideas of the book they are looking for; as an indication about 75 percent of all book purchases are so-

called impulse purchases, which are bought without deliberate choice *ex ante* (Kraaijeveld, 2001). For this reason, bookstores selling only bestsellers are not attractive to most customers. In the total cost of production and distribution, retail costs are relatively high (see Figure 6.13). Partly this is caused by the fact that often large volumes of books remain unsold and hence have to be written-off.

Figure 6.13: Average cost structure of Dutch general books sold via traditional bookstores in percentage of total value added (1998)



Notes: (*): printer including binder; (**): book wholesale excluding interest costs on books in inventory.
Source: confidential.

Virtual bookstores sell books via websites and do not operate physical retail outlets. They deliver at home. Some traditional bookstores also employ websites for book ordering, but generally customers have to collect the ordered books themselves at a bookstore of their choice. In the latter case, the logistical structure as well as the logistical control concept does not differ from that of traditional bookstores.

'Virtualization' of book sales allows retailers to offer a broad assortment of books without the need to keep large or any inventories. For instance, at the end of 1998, Amazon.com (the first 'e-tailer' of books) claimed to offer 3 million titles, compared to a few hundred thousand for the largest traditional bookstores (Timmers, 1999: 60). Compared to traditional bookstores, inventories are significantly lower due to two factors:

- no inventories are kept of (slow-moving) books; instead these are ordered directly from publishers or wholesalers once a customer has placed an order;
- own inventories are to a high degree centralized. In traditional book retail, inventories are kept in every retail outlet. Virtual bookstores in contrast employ distribution centers that serve whole countries or even multiple countries.

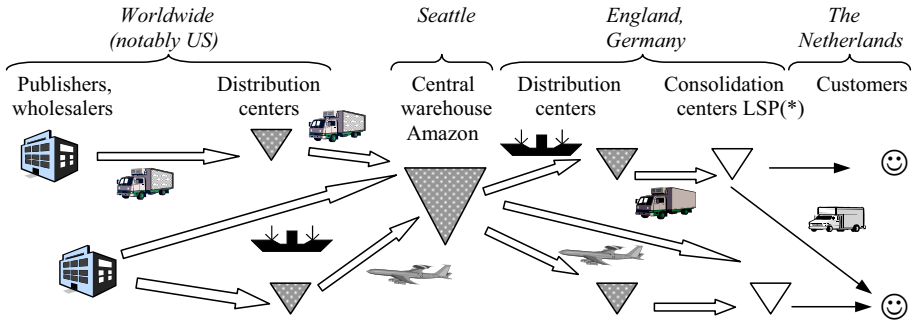
Because of low inventories virtual bookstores can economize on inventory and storage costs and are able to reduce commercial risks considerably although they usually face higher transport costs due to a more fragmented freight flow and home-deliveries (see section 6.4.3). Hence they offer lower prices than traditional bookstores. Due to a high degree of automation, checking the customer's financial status and ordering of books at publishers is done immediately after a customer has ordered a book. In addition, the use

of ICT enables them to provide additional and customized services (e.g. attending customers to other books that may be of interest). Due to customer-specific information options for price differentiation are larger than in traditional book retail. Amazon.com charges for instance lower prices to new customers than to regular ones (Intermediair, n° 38, September 21, 2000). The logistical organization of virtual book retail is nearly completely customer-oriented; logistical activities only start when an order is received.

To customers, a disadvantage compared to buying a book from a traditional bookstore are relatively long delivery lead times of 5-7 days on average. Virtual bookstores try to compensate for this by a high delivery reliability, which may be 97 percent or higher.

As an illustration, Figure 6.14 depicts the logistical structure of Amazon.com, a main internet book retailer in the Netherlands as well as in many other countries. Headquarter and main distribution center are located in Seattle, close to the main publishers and the logistical service providers that take care of the physical transport. Apart from that, Amazon employs several distribution centers; between four and seven in the US and four in Europe (UK and Germany). They are located near densely populated areas in order to reduce transit times[xv]. In principle, customers are supplied from the closest distribution center but in the case of out-of-stocks, are supplied from more remote distribution centers. Slow-moving books are supplied from the central warehouse in the US (Gurãu *et al.,* 2001: 39).

Figure 6.14: Logistical structure of Amazon.com



Note: (*): LSP: logistical service provider; ▽ : storage; ▽ : transshipment without storage. Source: Runhaar and Kuipers, 2000: 44.

6.4.2 Management of transport operations

Responsibilities for transport are usually arranged as follows. Publishers send the manuscripts that have to be printed usually by means of express delivery to printers. Paper wholesalers typically deliver LTL shipments to printers. Printers arrange the movement of printed matter to binders, usually by means of own account transport (vans or small trucks). Finished books are transported by either binders or, more often,

by book wholesalers. Book wholesalers deliver books to bookstores by means of own account transport or by commercial carriers. To publishers it is barely efficient to distribute books themselves from book binders to bookstores, since the number of bookstores is large and volumes are small. Exceptions are publishers of professional and scientific literature that supply small numbers of retailers or customers.

Road transport dominates but international and intercontinental book deliveries are either transported by airfreight or by sea. Load factors of trucks and vans are high when book wholesalers organize transport, because they transport bulk volumes of books and also deliver other cargo on behalf of other retailers. Return cargo consists of obsolete books and roll containers; apart from that often cargo (i.e. books and other products) is collected at binders and other suppliers. In contrast, load factors of printers and binders are often low for two reasons. One, time pressure is high; publishers seldom wait a day to consolidate with other deliveries. Two, own account transport dominates.

Virtual bookstores have outsourced all transport. Sometimes they offer their customers a choice between slow but cheap delivery or fast but more expensive delivery. In the former case intercontinental transport takes place by sea, in the latter by airfreight. Final distribution to the customers' homes takes place by road transport. In this context, Amazon.com for instance uses express delivery carriers that operate own networks for consolidation of shipments.

6.4.3 Logistical trends and impact on transport-intensity

In book production and distribution a number of trends are observed with an impact on transport demand and traffic-intensity, which will be discussed below:

- increased time pressure in book production and distribution;
- inventory minimization by more frequent and smaller orders (both by printers and bookstores);
- supply chain management (SCM);
- increased digitization of books;
- differentiation in distribution channels, including more internet sales.

The first trend is that over the last 10-15 years, time pressure has increased. Publishers and bookstores demand ever shorter lead times for various reasons:

- time-based competition among bookstores: a day delay in availability of bestsellers may cause forgone lost sales if customers buy the books elsewhere;
- publishers increasingly aim to synchronize book editions with events that are of commercial interest, e.g. a royal wedding or the National Book Week, which aims to promote book sales in the Netherlands;
- reducing commercial risks: books usually have a short period in which they are sold. This period may be extended somewhat when books are earlier in bookstores e.g. because books appear a little before competing books do.

The increased time pressure has consequences for all firms involved in the book supply chain. Printers and binders for instance are given less time to print and finish the books. This has led to lower consolidation rates, because usually own account transport is used and less time is available to combine shipments. Another transport effect is that the use of express delivery in book distribution has increased. Although this is outsourced to commercial carriers who consolidate with other cargo, it may lead to more traffic if express deliveries substitute transport by wholesalers. The reason is that the latter combine bulk volumes of books and use large trucks, whereas express delivery carriers use smaller vans, necessitating more vehicles (see chapter 2, section 2.4.2). Binders claim that printers have passed on a disproportional part of the time pressure on them; in other words the required lead time reduction notably has to be realized in the stage of binding and distribution of finished books to wholesalers or customers.

The second important trend is an increased order frequency leading to smaller shipment sizes. In book printing, this is due to a desire to reduce inventory and storage costs. This may in turn lead to lower consolidation factors of paper deliveries and hence more vehicle-kilometers. More frequent orders of bookstores are notably caused by a desire to reduce the commercial risk of keeping large book inventories at the bookstore. In this way part of the commercial risk is passed on to the publisher. Book wholesalers have not experienced lower consolidation factors due to the above trend because *total* volume of books that are delivered to bookstores has largely remained unchanged. This is caused by the claim that the variety of books per order has increased, compensating for the decreased number of books per title.

A third trend is that of supply chain management (SCM). Some printers have taken over responsibility for inventory-keeping for their customers (e.g. publishers). Instead of printing and delivering a relatively large amount of printed matter, printers keep the product in their own warehouse and deliver when a customer calls off orders. This generally leads to more traffic because the number of deliveries is increased and consolidation factors are further reduced (see above). SCM is also observed in the stage of book publication up to retail. Increased co-ordination has emerged and is further expected vis-à-vis:

- information exchange about sales prognoses by bookstores, which may lead to adaptations in volumes of book editions;
- electronic book ordering (facilitating planning of distribution and thus consolidation);
- co-ordination of the order frequency desired by book retailers and the production planning of publishers and vice versa.

The above trend is among other things caused by the fact that the fixed book price will be abolished in the near future, which is expected to balance power relations between publishers and retailers. Instead of publishers dictating how distributors and bookstores are supplied, logistics will be co-ordinated among actors on a more equal basis. This means the opposite from what was expected in chapter 3, namely that SCM will notably occur when one powerful actor is able to force its suppliers to synchronize logistical

activities (see section 3.6.2). Logistical co-ordination as described above may reduce total transport volumes if it leads to smaller volumes of 'redundant book deliveries', i.e. books that are delivered to bookstores but that remain unsold (cf. Bus *et al.,* 1999b: 161).

A fourth trend in book production and distribution is increased digitization of manuscripts or finished books. Sending manuscripts by email to printers may replace express deliveries, thus leading to less transport. It should be noted that these shipments represent a very small share in total freight volumes. A few publishers and book distributors have started digitizing books that are out of print and that can be ordered by individual customers (i.e. printing-on-demand). This may create new transport demand. More differentiated distribution channels are expected, among other things as a result of the abolishment of the vertical price regulations (see e.g. Baarsma *et al.* (2001) for an analysis of school book distribution). More authors are expected to publish on the internet (i.e. 'e-books' or 'paperless publishing'), similar to what has happened in the case of academic journals. This would mean that publishers, printers, binders, wholesalers, and retailers are by-passed. As books are either read digitally or are printed by customers (i.e. decentrally), it may reduce the volume of book movements[xvi]. Also publishers may decide to sell directly to final customers e.g. in co-operation with post order companies. The transport effects are difficult to predict. On the one hand it would mean that book wholesalers and book retailers are left out of the supply chain, reducing the amount of kilometers a book travels. On the other hand, much depends on the organization of transport operations: will it be as efficient in terms of load factors as current distribution?

Related to the above trend is the expectation that more books will be sold by virtual bookstores. Virtual book retail is probably more transport-intensive than book retail in the traditional way for the following reasons (Runhaar and Kuipers, 2000: 43-44):

- orders are home-delivered mostly by van and non-desired books are recollected by van. Traditionally, customers use various modes to go to city centers among which non-motorized modes. People also often 'consolidate' multiple purchases. However it is expected that virtual bookstores will deliver at central facilities close to customers, which improves consolidation and reduces transport costs;
- if customers are not at home, carriers have to return at least once;
- the book flows are relatively fragmented in size, time, and space since they represent individual customer orders. Moreover a relatively high time pressure characterizes the freight flow. Because of these characteristics consolidation opportunities are probably relatively small.

Transport-intensity however is also affected by the organization of transport operations. Virtual bookstores usually have outsourced transport to specialized carriers that consolidate with other cargo. In addition they usually also sell other products, such as toys, magazines, CD's, or even gardening tools, which may offer opportunities for consolidation. In addition virtual bookstores co-operate closely with their carriers. Book orders are directly send to carriers who in turn are able to adapt their planning

schedules. This may lead to improved transport operations. Nevertheless it is expected that overall virtual bookstores are more transport-intensive than traditional retailers, which, regarding retail in general, is in line with the expectations of many others (e.g. Demkes, 1999: 43-44, Leahy, 2000, Matthews *et al.,* 2000, and TLN, 2000[xvii]).

6.4.4 Likely responses to increases in transport costs

Higher direct transport costs

The literature reviewed in chapter 3 suggested that the sensitivity of firms to increases in direct transport costs will depend on the importance of transport costs related to total costs (see section 3.6.1). Although this proposition was criticized for a number of reasons, it is plausible that the inconvenience caused by an increase in direct transport costs will be larger to firms with high transport costs than to other firms. Thus in book production and distribution, higher direct transport costs will notably be problematic to wholesalers (see Table 6.7).

Table 6.7: Average share of transport costs in total costs in book production and distribution (by sector)(*)

Sector	Average share of transport costs in total costs	Remark
Publisher	1%	manuscripts to printers by express delivery
Printer	5.5%	printed matter to binder / customer
Paper wholesale	16%	paper to printer
Binder	6.3%	finished books to customer / wholesaler
Book wholesale (**)	27.5%	books to retailers / other customers

Notes: (*): excluding virtual bookstores for the sake of anonymity and traditional bookstores due to a lack of information; (**): including book retail organizations that distribute themselves. Source: interviews

Paper wholesalers claim to have a weak market position vis-à-vis printers; hence it is not likely that increases in direct transport costs are easily passed on. Neither is it likely that shipment frequency is reduced in order to improve consolidation factors since customers order ever more frequent deliveries of decreasing size. Then the only options available would be swapping with other wholesalers (similar to paper producers; see section 6.2.4.1) or a decentralization of inventories.

Printers and binders operate under increased time pressure which, in combination with a predominant use of own account haulage, has led to low and falling consolidation rates (see section 6.4.3). Higher direct transport costs may lead to more outsourcing of transport, because commercial carriers often are able to achieve higher consolidation factors (see chapter 2, section 2.4.2). If the cost of both own account and commercial transport are raised, it may become attractive to outsource transport. In addition and similar to what was expected in newspaper printing, book printers might decide to reduce order frequency of paper and thus keep higher inventories of paper. An exception could be printers that use a wide range of paper types; to them, keeping inventories of many different types may barely be an option.

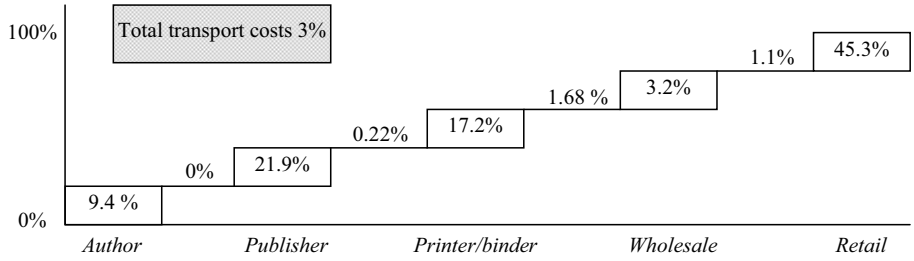
Most publishers face very low transport costs since they only ship manuscripts. Exceptions are publishers that arrange distribution of finished books themselves; these publishers will be treated below. In the other cases, printers, binders, and distributors arrange transport of printed matter and final books. This does not mean that publishers would not have any option to reduce transport-intensity of book publishing. Bus *et al.* for instance expect that an important way to reduce transport of books is a reduction in weight/volume ratio of cargo, which could be achieved by an increased use of paperless publishing. In addition, increased production to order, for instance enabled by digitization or electronic publishing, would reduce commercial perishability of the products. As a consequence, time pressure would be reduced and less obsolete products would need to be transported (Bus *et al.,* 1999b: 161). Higher direct transport costs could provide a stimulus to substitute physical books by electronic ones.

Regarding book distribution, distinction was made between book publishers who arrange their own distribution, book wholesalers and book retailers (including traditional and virtual ones). Publishers that distribute themselves and wholesalers have relatively high transport costs. To wholesalers the other main costs are related to warehousing (e.g. capital costs and writing-off on warehousing equipment). Given the fact that book wholesalers do not always own the books that they keep in inventory, they are not always able to adapt inventory levels. In addition, regarding both inbound and outbound flows, frequency of deliveries is determined by others (i.e. publishers and retailers). Hence their main option will be to adapt the logistical structure of warehouses, e.g. by relocation or by expanding the number of warehouses (see section 3.6.3).

Book publishers who arrange their own distribution will probably not reduce frequency of deliveries to their distribution centers because the transport cost reduction will be minimal. Replenishments (e.g. new editions) are usually send in full trucks to distribution centers, the transport costs of which are low. For instance one publisher indicated that an average shipment represented 3,000 books with a value of € 6,800 (i.e. turnover generated by sales to bookstores). Costs for domestic transport usually are € 90 or 1.3 percent of total value. In contrast, the costs of distributing books from distribution centers to customers is more expensive, since relatively small deliveries have to be send to a multiplicity of addresses. Therefore adaptations are only likely in the final distribution phase.

To traditional bookstores, transport costs only have a marginal share in final book prices (see Figure 6.15). The risk of a loss in turnover as a consequence of a transport cost increase is therefore low. In addition book retailers do not have many options to reduce transport costs. Basically, their only option is to reduce the frequency of deliveries. Yet this would only be necessary if the above actors that are responsible for delivering books raise prices and do not adapt their logistical processes, which is not very likely.

Figure 6.15: Transport costs as a percentage of book prices[xviii]



Percentages in-between the boxes indicate transport costs. Based on own calculations. Source: interviews; value added per sector in book price (sold via traditional bookstore): confidential.

To virtual bookstores, transport costs are probably higher than to traditional bookstores as they are expected to be more transport-intensive. A main cause of the higher transport-intensity is the combination of central inventories, home-delivery, and high time pressure, which leads to a long and fragmented freight flow. Higher transport costs may stimulate virtual bookstores to keep more decentral inventories, which reduces both time pressure and transport costs. Furthermore higher direct transport costs may reinforce the expected trend that book orders are no longer delivered at home, but at central facilities close to the customer (see section 6.4.3). Finally in the case of slow-moving books that are currently send directly from central warehouses to customers, printing-on-demand at locations near the customer might become attractive.

Higher costs due to longer transit times and reduced delivery reliability

Longer transit times or reduced delivery reliability might increase the costs of in-transit inventory and commercial risks when books have to travel over long distances. In the case of printers who receive just-in-time paper deliveries, delays may distort production planning and reduce productivity. In addition, it may deteriorate customer service levels offered by all actors involved in book production and distribution, which may subsequently lead to a loss of customers to competitors. To book distributors however the latter problem will be less severe since they have an oligopoly position and hence many customers are ‘captive’. Finally in paper and book wholesale, lost sales due to out-of-stocks may occur when replenishment orders are delivered (much) too late.

The possible adaptations in the production and distribution of books are not elaborated in the literature but again based on the preceding analysis some deductions can be made.

To publishers, transit times probably will have to increase significantly in order to affect total lead time of book production because transport takes only a few days whereas total production lead times take three to five weeks. Therefore no real problems can be expected, despite the fact that lead times have become increasingly important to publishers. Usually transport distances are short, except when foreign printers or binders are contracted. In the latter case increases in the already relatively long transit times

may lead to the choice for suppliers that are located more nearby. Other adaptations may be found in planning of book production. Less reliable deliveries will probably create problems only when delays of a day or more occur. They may be avoided by switching to suppliers at shorter distances.

Most printers have become dependent on frequent, often just-in-time paper deliveries and often place their orders one day before they need the paper. Longer transit times may become a problem when next-day deliveries are no longer possible. This risk however is rather low since usually Dutch paper wholesalers are contracted. Reduced delivery reliability in contrast may easily distort printing process, notably in the case of just-in-time paper delivery. Rather than avoiding the risk of unreliable supply by keeping large inventories it is likely that printers will switch to wholesalers in their vicinity. In second instance a lower order frequency is imaginable, e.g. by ordering for two or more days. This option leads to additional storage, which due to high storage costs is probably not the preferred option (see section 6.4.1). Regarding the outbound flow of printed matter, some delays will probably not matter since customers (i.e. publishers) are usually located in the Netherlands. If printers face problems because publishers do not accept longer lead times or less reliable deliveries, they might distribute outside peak hours (e.g. more overnight transport) or choose to adapt their planning or extend opening hours in line with the autonomous trend (see section 6.4.1).

To paper wholesalers longer transit times and in particular reduced delivery reliability will be problematic because printers demand frequent, fast, and reliable deliveries. Due to the claimed weak market position of wholesalers they will probably be forced to adapt their logistical organization in order to guarantee fast and reliable deliveries. Plausible options that paper wholesalers have include rescheduling of deliveries (e.g. more overnight transport), swapping, or a decentralization of inventories. The later option will probably be more expensive as it implies additional storage costs and higher overall inventory levels because multiple locations would hold safety inventories (cf. Muilerman, 2001: 284).

Binders usually are supplied by printers and hence depend on them in their planning. Their customers are usually located in the Netherlands, similar to printers. Again there are no indications in the literature which responses might be expected from binders; however it is not likely that they will have more or other options than printers regarding outbound flows.

To book wholesalers and book publishers that distribute themselves, increased congestion may lead to a decentralization of distribution. One of the main book wholesalers already applied this strategy several years ago in response to increased congestion, which, due to time delivery windows for distribution in many cities, made direct deliveries to bookstores during daytime increasingly difficult (and expensive). In the new distribution structure bulk transport takes place overnight to decentral hubs, from where final distribution is conducted over small distances in the morning. Besides reducing the negative impact of congestion it has led to a reduction in transport kilometers and transport costs, although it has raised other costs (i.e. handling and

storage costs). This strategy may be preferred to a decentralization of inventories because it allows distributors to keep central and hence smaller inventories. On the part of traditional bookstores again no adaptations are expected.

Longer transit times and reduced reliability may in particular be problematic in the case of home-deliveries, because it may reduce the attractiveness of book purchases via the internet as compared to visiting a traditional bookstore. Again it might reinforce the autonomous trend that book orders are delivered at central facilities close to the customer rather than at home. In this way delivery may take place outside peak hours. Also the use of central inventories may cause severe problems in the case of increased congestion. Despite the fact that inventories are located near densely populated areas, distances to final customers are still large. Virtual bookstores may avoid congestion in part by adding decentral transshipment centers to their distribution network (similar to book wholesalers), by decentralizing inventories, or in the case of slow-moving books that are delivered from central warehouses, by printing-on-demand near customers.

6.5 Conclusions and refined hypotheses

In this chapter the organization of production and distribution of books and newspapers was analyzed for the following purposes:

- a better understanding of how production and distribution are organized and what factors are important in decisions related to this organization;
- analyze the impact of logistical trends on transport-intensity in order to understand the relationship between in organization of production and distribution and freight transport demand in the printed media industry;
- explore likely adaptations to a change in direct transport costs and in costs related to longer transit times and reduced delivery reliability.

The main conclusions are summarized below.

6.5.1 Organization of production and distribution in the printed media industry

The various sectors involved in the printed media industry revealed a strong heterogeneity in the way production and distribution are organized. This is in line with what was expected in chapter 3, section 3.5.1. Differences between sectors however were much larger than within sectors. In general differences were notably related to:

- geographical areas in which supplies are sourced and in which products are sold;
- organization of distribution: under direct management or outsourced;
- warehousing: degree of automation (e.g. in paper wholesale);
- inventory policy and the number of inventories;
- the position of the customer order decoupling point;
- division of responsibilities for transport operations;
- customer service levels.

Also the importance of transport costs appeared to vary significantly. To notably Scandinavian paper producers, transport costs appeared to be relatively important in locational choice since paper mills are situated near sources of raw materials. Switching to old paper as raw material has led to new investment in Western Europe. In this context, it was claimed that the Netherlands has become relatively unattractive due to congestion and poor service of rail operators (see section 6.2.1). Both indicate that other factors in location decisions (e.g. land prices or the availability of local labor) are either less important or vary less between locations. In contrast, in bookstore location decisions, transport costs do not play any role at all. Instead bookstores are located in areas that attract large amounts of potential customers.

The dominant rationales in the organization of production and distribution also were found to vary between sectors. In newspaper production and distribution for instance, the main logistical goals include optimization of production capacity, postponement of production in order to include as much of the latest news as possible, and a high delivery reliability. The old paper sector is mainly concerned with cost minimization, which can be explained by the fact that old paper is bulky and relatively low-valued.

No evidence was found of intensive logistical co-operation beyond firm boundaries (i.e. SCM). In fact the only sector that perfectly fit the business model described by SCM theory is that of virtual book retail in which highly responsive and co-operative supply chains have been developed. In various sectors some forms of co-operation was found (e.g. 'vendor managed inventories' in book printing, old paper trade, paper wholesale, and paper production). In addition some firms have started sharing information about sales prognoses and inventory levels (e.g. the paper industry and virtual book retailers). These trends however could not be related unambiguously to more complex methods of logistics management, which the SCM paradigm assumes (see chapter 3, section 3.4). The evolutionary approach to logistics management, discussed in chapter 3 (section 3.3), provides a better explanation for logistical trends in the printed media industry. Logistics awareness in notably publishing for instance has started only recently. An explanation could be that until recently firms have operated in a relatively stable environment due to vertical price regulations, which provided probably fewer incentives to concentrate on logistical cost minimization than in other sectors.

6.5.2 Impact of logistical trends on transport-intensity

In all sectors a trend toward increased flexibility and inventory reduction was found, similar to what was observed in chapter 1. As a result firms have become increasingly reliant on more frequent, faster, and more reliable deliveries. Exceptions were the old paper sector and newspaper distribution. In the former sector, cost minimization is the main goal, which implies that notably the cost of collection, transport, and production are minimized. In the latter sector, no inventories are kept and flexibility already is high because delays in newspaper production have to be absorbed in distribution (delivery times are fixed).

Many of the above trends were observed that are similar to those that, according to chapter 1, have caused an acceleration in freight transport growth. Driving forces have been competition on customer service, reduction in inventories, and the emergence of sophisticated ICT applications (e.g. the internet). In the printed media industry however these trends have not always been coupled with a (large) increase in traffic. The main reason is that compensatory measures in transport operations have been taken, similar to what was found in chapter 2. Without these compensatory measures in transport operations, many of the logistical trends would have led to a higher transport-intensity as chapter 2 demonstrated. Thus firms have tried to prevent (too) large increases in transport costs. Nevertheless this indicates that transport cost minimization has had lower priority than minimization of other logistical costs, which supports the two assumptions formulated in chapter 3, section 3.7, i.e.:

A 1: transport costs are one of the factors affecting the organization of production and distribution. The relative importance of direct transport costs has decreased, but that of transit times and reliability has increased;

A 2: the decreased importance of direct transport costs has enabled the trend toward more transport-intensive production and distribution networks.

6.5.3 Role of transport costs

Although transit times and delivery reliability have become relatively more important in the printed media industry, differences exist in the costs that are related to these variables (see Table 6.8). The main cost type are lost sales. This is explained by the fact that customers demand ever higher logistical customer service and hence time-based competition has become standard practice in all sectors except for old paper. Interest costs of freight in transit do not play an important role, which is mainly explained by relatively short voyages and in some situations, relatively low-valued products.

Table 6.8: Main costs related to increased transit times and reduced delivery reliability per sector in the printed media industry

Sector	**Costs related to increased transit times**	**Costs related to reduced delivery reliability**
Paper production	• lost sales	• lost sales
Newspaper publishing/ printing	• loss of product value: less timely product because editorial has to close earlier	• lost sales
Book publishing	• lost sales • commercial risk	• lost sales
Book printing	• loss of productivity • lost sales	• loss of productivity • lost sales
Binding	• lost sales	• lost sales
Book distribution	• lost sales (but minimally)	• lost sales (but minimally)
Traditional book retail	• lost sales	• lost sales
Virtual book retail	• lost sales	• lost sales
Paper wholesale	• lost sales	• lost sales
Old paper	• productivity loss	-

6.5.4 Likely adaptations to increases in transport costs

A tentative analysis was conducted on the potential effects of higher transport costs, irrespective of the level of the cost increase. The analysis yielded a much richer overview of responses to increases in transport costs than the literature reviewed in chapter 3. Differences with chapter 3 are caused by a number of factors, including:

- the extent to which an increase in costs related to transport would be problematic. This depends not only on different shares of direct transport costs in total costs, but also on the fact that firms face different costs related to increased transit times and reduced delivery reliability;
- flexibility of the organization of production and distribution, depending on for instance the availability of substitute suppliers;
- market structure, affecting the extent to which firms are forced to adapt rather than to pass on the costs to their customers.

Table 6.9 and 6.10 summarize the logistical responses to increased transport costs that were discussed throughout this chapter. Basically two types of adaptations were found:

- changes in the existing organization of production and distribution;
- a faster adoption of new production and distribution techniques that are relatively transport-extensive (e.g. decentral printing-on-demand).

Table 6.9: Likely responses to higher direct transport costs

	Logistical structure	**Logistical control concept**	**Customer service**
Paper producers	• pass on higher costs • smaller geographical markets • swapping • more local sourcing of wood	• integration of inbound and outbound flows	-
Old paper suppliers	• pass on higher costs • smaller geographical markets • swapping	-	-
Newspaper production/ distribution	• increased decentral printing • local sourcing (ink, paper)	• higher paper inventories • integration of inbound and outbound flows	-
Paper wholesalers	• swapping • decentralization of inventories	-	-
Book publishers	• electronic publishing	-	-
Printers and binders	-	• outsourcing of transport • higher inventories	-
Book distributors	• relocation of warehouses • decentralization of warehouses	-	-
Traditional bookstores	-	-	-
Virtual bookstores	• deliveries to central facilities • decentral printing-on-demand • decentralization of inventories	-	-

Table 6.9 confirms the first hypothesis from chapter 3 that higher direct transport costs will lead to less transport-intensive supply chains due to a reorganization of production and distribution. In correspondence with the second hypothesis, adaptations are notably related to the logistical structure and inventory management. No changes in customer service levels are expected, similar to what was found in other studies (e.g. McKinnon, 1998 and Muilerman, 2001). Table 6.10 demonstrates that an increase in transit times may affect more dimensions of the organization of production and distribution, again in line with the hypothesis from chapter 3, reflecting that costs related to these variables are often more problematic.

Table 6.10: Likely responses to longer transit times and reduced delivery reliability

	Logistical structure	**Logistical control concept**	**Customer service**
Paper producers	• relocate inventories	• larger safety inventories • more in-transit inventory	-
Old paper suppliers	-	• earlier departures	-
Newspaper production/ distribution	• decentralization of printing	-	-
Paper wholesalers	• swapping • decentralization of inventories	• distribute outside peak hours	-
Book publishers	• less remote suppliers	• adapting planning	-
Printers and binders	• less remote suppliers	• higher inventories • distribute outside peak hours • extend opening hours	-
Book distributors/ distributing publishers	• decentralization of distribution	-	-
Traditional bookstores	-	-	-
Virtual bookstores	• deliveries to central facilities • decentral printing-on-demand • decentralization of distribution • decentralization of inventories	-	-

6.5.5 Implications for the remainder of the study

In the remainder of the research, the expected responses to a change in transport costs will be validated by interrogating a representative group of firms in the printed media industry. From the analysis however it appears that from traditional bookstores little changes in logistical system design can be expected in response to higher transport costs. This sector is inflexible because logistical decisions are made predominantly by publishers and book wholesalers. Therefore traditional bookstores will be excluded in the remainder of this study.

[i] Annex III and IV contain the interview protocol and the names of the interviewees.
[ii] In the supply chain, sometimes also sales organizations and traders in pulp and paper are active. However, freight flows seldom pass these organizations physically (Wierikx *et al.,* 1993: annex 1). Hence, these organizations were ignored in this chapter.
[iii] The focus was on the main freight flows; sub-supply chains such as the supply of capital goods were ignored. Their share in total freight transport generated by the firms under study is negligible since capital goods generally have a long life time and the purchase of these goods is incidentally.
[iv] Half of the old paper collected in the Netherlands originates from households, the other half from industry, offices, and retailers. The costs of collection and transport to old paper wholesalers have to be paid by communities (and citizens via taxes) and firms and are therefore not included in the old paper prices that are charged to paper producers.
[v] As an indication, the costs of producing and distributing corrugated cardboard consist of about 50 percent of old paper purchase and 50 percent of transport costs (LogistiekKrant, March 24, 2000).
[vi] Dutch printers usually print foreign newspapers that are sold in the Netherlands; distribution structures do not differ much from those of national daily newspapers. The main rationale for decentral printing of foreign newspapers is to minimize lead times (Scholtes *et al.,* 1998: 78).
[vii] The trends as well as their transport effects originate from the interviews that were conducted in the context of the stated adaptation survey, described in chapter 7.
[viii] Structure derived from A.T. Kearney, 1994. Assumptions: (1) share of costs of transport and paper in turnover = 100/110 * share in total costs (i.e. 10 percent profit); (2): zero costs of transshipment or capital costs of hubs were assumed because the first are included in transport costs whereas data lacked on the latter. Excluding the costs of delivery of raw material to paper producers due to a lack of data on the cost structure of paper production.
[ix] In 1999 total value of imports and exports of books, brochures, and other printed matter were € 22.8 million and € 27.5 million, respectively (CBS, 2001). Unfortunately there are no specific data on the volume or value of imports and exports of books alone.
[x] Price regulation of imported books was forbidden in 1998 by the European Commission.
[xi] In order to create countervailing power, about 60 percent of all bookstores are organized in a co-operation (e.g. retail chain). The main purpose is to obtain higher discounts on books.
[xii] Only recently logistical handbooks especially for printers have appeared (e.g. Heijne den Bak *et al.,* 2000; Van der Pelt *et al.,* 1998).
[xiii] Note that fluctuations in occupancy rates of presses and the number of general books sold (Figure 6.8) are related, which may partly explain variations in the former indicator.
[xiv] Book clubs are retailers that offer significant discounts to customers who in turn have to order a certain amount of books a year. Ramsj stores trade in remainders of inventories of books that publishers have not sold to regular bookstores. They include specialized bookstores but also the previously mentioned department stores. Other retailers and wholesalers are allowed to sell books with prices under € 18. Books with higher prices may only be sold by non-bookstores if the books are directly related to their business (e.g. wine shops selling wine books).
[xv] Several other distribution centers are located in US states with attractive tax regimes.
[xvi] In fact, freight transport is restricted to the movement of copier paper to the consumer's home. In transport statistics, this category of transport is usually classified under passenger transport.
[xvii] TLN is a Dutch interest group in road transport. It expected that the 3.5 million tons of goods to be sold by virtual stores will lead to a disproportional increase in the number of truck and van movements. Compared to distribution to traditional stores, the number of trips was expected to increase by a factor 8 (TLN, 2000: 27-28), mainly due to an increased number of delivery addresses.
[xviii] Structure derived from A.T. Kearney, 1994. Assumptions: (1) share of transport costs in turnover = 100/110 * share in total costs (i.e. 10 percent profit); (2) value added of printers include 30 share of binding and 30 percent paper costs; (3) transport costs between printer and book wholesaler include transport costs of paper delivery. Excluding the costs of delivery of raw material to paper producers due to a lack of data on the cost structure of paper production.

7 Stated adaptations in the Dutch printed media industry to transport cost increases

7.1 Introduction

In chapter 5 the possible effects of two policy scenarios on future carrier rates, transit times, and reliability of arrivals were explored. In this chapter the focus is on how changes in these variables may influence logistical decision-making in the Dutch printed media industry. Data were collected by means of 41 interviews with logistics managers and other managers responsible for transport and logistics (see chapter 6, section 6.1). Two scenarios were examined in which governmental interventions in the transport sector result in higher transport costs. These scenarios are the same as those that were used in chapter 5 and covered the period between 2001 and 2010. Using more scenarios was expected to yield fatigue effects on the part of the respondents. Due to the survey set-up, the face-to-face interviews took between 45 minutes and one and a half hour. Telephone interviews had to be restricted to 15-30 minutes in order to obtain co-operation of the respondents.

In section 7.2 through 7.9, the stated responses to the two scenarios are discussed and analyzed per sector. Conclusions are drawn in section 7.10.

7.2 Paper production

7.2.1 Selection of cases

In the Netherlands, there are four firms who produce fine paper and only one that produces newsprint[i]. A few foreign newsprint producers however supply Dutch customers from warehouses or mills that are located just across the border. Paper mills typically are large (i.e. ≥ 100 employees). Interviews were conducted with three fine paper producers and two newsprint producers with sales in the Netherlands. In addition a producer of cardboard and packaging paper was interviewed; these products are used to package paper and books[ii].

7.2.2 Stated adaptations to higher direct transport costs

First, the logistics managers were confronted with a scenario in which carrier rates increase significantly due to the introduction of ton-kilometer taxes (the "fair and efficient pricing" scenario; see also chapter 5). The scenario was described on a single sheet, containing the background of the scenario, expected responses of carriers, and consequences for carrier rates (based on the Delphi survey results; see Table 7.1).

Table 7.1: Assumed changes in carrier rates by 2010 in scenario 1

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
+ 50%	+ 40%	+ 50%	+ 25%	+ 50%	+ 40%

The ton-kilometer tax might affect transport costs in two ways, namely:

- transport unit costs, e.g. per ton or ton-kilometer, are raised. In some cases it may become attractive to reduce transport distances (e.g. by local sourcing). In addition, since unit costs for less-than-truck loads (LTL) or less-than-container loads (LTC) are always higher than those for full-truck- or container loads (FTL/FTC), shipping larger volumes of freight (possibly at a lower frequency) may become attractive;
- except for airfreight, the relative increase in rates is almost the same for all modes. Yet, modes that remain absolutely cheaper per ton or ton-kilometer (but that are also slower) may become more attractive, e.g. if shippers want to maintain the same budget for transport expenditures.

The interviewees in the paper industry were asked how the ton-kilometer scenario would affect the organization of production and distribution that was expected to be employed until 2010. The envisaged effects or *stated adaptations* are summarized in Table 7.2. They coincide only in part with those that were anticipated in chapter 6, i.e.:

- higher paper prices;
- smaller markets;
- more local sourcing;
- combination of inbound and outbound deliveries;
- swapping (i.e. co-operations with other paper producers, whereby customers are supplied by the nearest producer).

All but one producer expected to pass on the transport cost increase in paper prices. The exception had over the past years not been able to adapt paper prices to inflation rates due to fierce competition in his market segment. Yet, to him, the cost increase would not pose a large problem, since transport costs (only for paper deliveries) made up only three percent of total costs. The other producers would envisage a slight increase in paper prices, since their transport costs mounted up to 11 percent of total costs. This was basically explained by a lower average product value density (in price per ton) and hence lower total costs per ton compared to the former producer, rather than higher expenditures on transport per ton of paper.

Table 7.2: Paper producers' stated adaptations to scenario 1

Paper producers → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**	**F**
Product and price						
• *Pass on cost increase to customers*	X		X	X	X	X
Production and distribution						
• *Less export outside Europe*						X
• *Decentralization of distribution*				X		
• *Larger raw material inventories*				X		
Management of transport operations						
• *More use of inland navigation – raw materials supply*			X	X		
• *More use of inland navigation – paper distribution*				X		
• *Better information exchange with suppliers, customers, carriers*		X				
• *Use more specialized carriers*		X				
• *Ship more FTL's*			X			
• *Larger trucks (if allowed)*						X
• *More overnight transport*						X

Note: X: indicates that the adaptation in question was mentioned.

Except for a reduction in exports outside Europe, no smaller geographical market areas were expected. The main explanations that were offered, included:

- competitors would also pass on the cost increase in paper prices; hence relative paper prices would not be changed substantially;
- markets had been geographically divided between producers. This was claimed to be due to paper mill specialization within holdings; the increasing concentration in the sector would have enabled this trend;
- paper wholesalers, typically located closer to most customers, would be no alternative since their prices would still be substantially higher compared to direct purchases from paper producers;
- customers would often be relatively loyal, although particularly in the cardboard industry this loyalty had been forced by vertical integration[iii].

The anticipated integration of inbound and outbound freight flows was not mentioned by any paper producer, mainly for the following reasons:

- differences in transport equipment used (e.g. paper can not be transported in tanker trucks or in bulk vessels that are used for pulp deliveries because of different hygiene and humidity demands);
- three producers indicated that inbound and outbound flows already were integrated as much as possible;
- the others claimed that empty returns from or to the paper mill were reduced as much as possible by the carriers;
- load factors were relatively high; LTL's were only shipped in the case of book paper since printers often wanted daily, small deliveries.

More swapping was not expected since due to the concentration in the sector, most customers were already supplied by the nearest producer. Relocation, decentralization, or 'de-specialization' of paper mills was considered too expensive, since investments are taken for a time period that is well beyond the time span in the survey (i.e. 2001-2010).

Respondents who expected that, apart from higher paper prices, this scenario would have no or little effects, argued that transport cost minimization already had been given much consideration in the organization of production and distribution. Options that would further reduce transport, such as increasing the number of warehouses, would only raise total logistical costs.

An increased use of rail transport or inland navigation (i.e. a modal shift) in distribution was considered unfeasible by most producers for a number of reasons. One, although many paper producers have a connection with rail or water networks, many customers have not, and therefore a modal shift would raise the costs of handling and pickup and delivery by road[iv]. Two, a modal shift would raise storage and inventory costs due to larger deliveries. Three, three firms already used inland navigation or rail transport. However two logistics managers expected a more intensive use of inland navigation for raw material supply (old paper and cellulose) and, in one case, for the distribution of finished products. In the latter case, inland navigation would be used to supply decentral warehouses (another effect of the scenario); final delivery to customers would take place by road. This producer however was unique in several respects: it supplied only a few qualities of paper, had long-term relationships with customers, and was located close to inland water.

Overall, firms that had a relatively high share of transport costs in total costs (which coincided with a relatively low product value density) mentioned relatively most logistical adaptations.

7.2.3 Stated adaptations to longer transit times and reduced reliability

The paper producers were also asked about the expected effects of the "insufficient infrastructure provision" scenario, which assumed a strong increase in congestion. Table 7.3 and 7.4 describe the assumed implications of this scenario for transit times and arrival reliability by 2010; again these are based on the results of the Delphi survey[v]. In addition, an increase in carrier rates of 20 percent for all modes of transportation was assumed, corresponding with the average outcomes of the Delphi survey for all transport modes[vi].

Table 7.3: Assumed changes in transit times by 2010 in scenario 2

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
+ 30%	+ 25%	- 5%	+ 20%	+ 7.5%	+ 7.5%

Table 7.4: Assumed changes in arrival reliability by 2010 in scenario 2

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
10% arrivals ≥ 15 minutes late	25% sailings ≥ 4 hours late	25% shuttles ≥ 1 hour late	10% flights ≥ 3 hours late	10% sailings ≥ 1 day late	20% sailings ≥ 0.5 day late

Initially, this scenario has the following effects on logistical costs (see also section 3.2):

- longer transit times may increase inventory costs and the risk of obsolescence. Delays can be reduced by shorter transport distances or the use of faster or more reliable modes of transportation (incurring higher direct transport costs);
- reduced reliability may raise scheduling costs. Yet a high shipment frequency reduces scheduling costs since (a) the risk of delays is spread over multiple shipments and (b) the period in-between two deliveries is shorter.

In addition, customer service levels could be deteriorated, which could mean a loss of sales or of customers.

The following adaptations to increased congestion were anticipated in chapter 6:

- relocation of inventories;
- higher inventory levels;
- a higher frequency of paper shipments (i.e. more in-transit inventory).

Table 7.5: Paper producers' stated adaptations to scenario 2

Paper producers → **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**	**F**
Product and price						
• *Pass on cost increase to customers*				X		X
Production and distribution						
• *Relocate inventory to customer*				X		
• *More decentral/in-transit inventory*						X
• *Customer will call off more in advance*			X	X		
Management of transport operations						
• *Modal shift road-rail*						X
• *Better information exchange in the supply chain and with carriers*		X				
• *Use more specialized carriers*		X				
• *More overnight transport*					X	

Note: X: adaptation was mentioned.

Table 7.5 shows the stated adaptations. Only two interviewees expected an increase in paper prices; cost increases were not expected to be high and would be absorbed relatively easy. Geographical markets would remain unchanged for the same reasons as those that were mentioned in the previous section. Only three producers foresaw

changes in the organization of production and distribution. Again, producers with the highest transport costs and the lowest product value density reported most responses.

One producer expected to relocate part of the paper inventory to his customers. Higher inventories of finished product were expected by two others, since their customers were expected to place orders more in advance, thus raising lead times and in-transit inventories. It should be noted that this concerned standard paper types that were regularly supplied. Raw material inventories were expected to remain unchanged, because of three reasons:

- already high inventories were kept (on average 3 weeks);
- paper was delivered from port terminals nearby;
- raising inventory would be too expensive; one firm stated that transport costs would have to double to make new storage capacity feasible.

One producer indirectly mentioned the anticipated higher frequency of deliveries. He would send particular shipments more in advance by rail; at shunting yards, the product would stay in the wagons (i.e. an additional, decentral inventory point). This enabled more frequent deliveries at lower costs. This strategy was possible because demand was relatively stable. The same applied to another producer, who chose to relocate inventories to customers.

Nevertheless the producers expected not to be able to guarantee a reliable and fast supply anymore in this scenario. In part this is caused by high logistical demands of printers: they were claimed to want frequent deliveries in order to minimize or avoid inventories. In addition many customers other than printers would not allow delivery at night. This situation was considered an important barrier to avoid congestion; therefore, delayed deliveries were regarded primarily as the customers' problem. One logistics manager however indicated that overnight transport would be not attractive to him either, because of higher labor costs.

7.3 Paper wholesale

7.3.1 Selection of cases

Only book paper is traded through wholesalers; newsprint is delivered directly from producer to customer. Some paper wholesalers are specialized in book paper, whereas to others book paper has only a small proportion in total turnover. There are 90 paper and cardboard wholesalers in the Netherlands, of which 72 percent are small (i.e. < 10 employees), 22 percent is medium-sized (10-100 employees), and 6 percent are large (≥ 100 employees) (CBS, 2001). Small wholesalers however do not sell book paper, and therefore were disregarded[vii]. Interviews are held with two medium-sized and two large wholesalers. Large firms therefore are over-represented in the sample.

7.3.2 Stated adaptations to higher direct transport costs

The anticipated responses of paper wholesalers included swapping and a decentralization of inventories. Table 7.6 shows that apart from these adaptations, the four wholesalers that were interviewed envisaged several others. The scenario would induce multiple adaptations by the interviewees; however one wholesaler mentioned only one adaptation related to the design of the production and distribution (i.e. C in Table 7.6). This may be explained by relatively low transport costs of this wholesaler (four percent in total costs, against some 20 percent of the others).

Table 7.6: Paper wholesalers' stated adaptations to scenario 1

Paper wholesalers→ / **Adaptations ↓**	**A**	**B**	**C**	**D**
Product and price				
• *Pass on cost increase to customers*		X	X	X
Production and distribution				
• *Loss of customers/smaller geographical market area*		X		X
• *Optimize geographical markets (i.e. concentration around large customers)*	X			
• *More co-operation with other wholesalers (e.g. combination of shipments or swapping)*			X	X
• *Decentralize inventories*	X			X
• *Order larger shipments of paper*		X		
• *Customers will order larger shipments at a lower frequency*			X	X
• *Relocate more closer to customers (*)*				X
Management of transport operations				
• *Modal shift road-rail incoming paper flow*		X		
• *More co-operation between carriers (e.g. cargo exchange)*			X	

Note: X: adaptation was mentioned; (*): envisaged after 2010.

Three out of four wholesalers expected that part of the higher transport costs would be passed on to customers. As a consequence two wholesalers expected a loss of customers, in particular those that are located at larger distances. Others claimed that since the whole sector would be confronted with the cost increase, relative prices would remain unchanged; thus no customer loss was expected.

Two wholesalers mentioned a decentralization of inventories. This would lead to lower transport costs because paper would be transported in FTL's to decentral warehouses from where final distribution would take place over short distances. The two others did not mention this option because:

- one firm had relatively high storage and inventory costs. Decentralization would probably raise overall inventory levels, because of safety inventories at multiple locations. In fact, avoiding these double costs has been one of the reasons to centralize inventory in many other industries;
- the other already had decentralized part of its inventories, yet in order to avoid congestion rather than to economize on transport costs.

Paper wholesalers typically only serve customers located in the Netherlands. Apart from the slightly smaller geographical market areas that two firms expected and the efforts of another to find new customers near large existing customers, no large spatial changes were expected. More local sourcing was unanimously considered impossible due to a lack of substitute suppliers, which confirms the claim made by paper producers (see section 7.2.2). Only one wholesaler envisaged more swapping. This may be explained by the fact that, in general, distances to customers are relatively short.

One wholesaler envisaged a modal shift from road to rail in the inbound paper flow (i.e. B), in contrast to what paper producers and most other paper wholesalers expected. Yet this firm appeared to be quite unique in that it was located close to rail infrastructure; hence the cost of final delivery by road would be relatively low. A modal shift in outbound flows was unanimously considered unlikely because of short distances to customers, small shipments, fragmented delivery addresses, and the fact that orders were usually delivered within 24 hours.

Options to improve efficiency of transport operations appeared to be largely exhausted:

- most inbound paper deliveries were claimed to arrive in FTL's;
- more consolidation in distribution would not be possible because of small orders of customers, delivery within 24 hours, and fragmented delivery addresses[viii].;
- large shipments, such as reels or multiple pallets, were already sent directly from paper mill to the customer, thus avoiding double transport.

No changes in shipment sizes were expected, although it was recognized that the trend toward smaller and more frequent deliveries had led to a higher transport-intensity. Larger replenishment shipments were not expected to raise load factors. In addition, despite the expectation that paper prices would increase substantially due to the scenario, printers were not expected to adapt their ordering behavior. Two explanations were given. One, logistical awareness of printers was claimed to be low. Printers typically would place their orders *ad hoc* and would not plan these orders more than one day ahead. This practice was not expected to change in this scenario. Two, relatively high storage costs would inhibit logistical adaptations on the part of printers. Fast and reliable supply therefore has become a prerequisite; delayed deliveries often lead to scheduling costs. In this context, one wholesaler claimed that in the absence of safety inventories, a one hour late paper delivery may yield scheduling costs to printers of € 275 to € 900. Hence, the trend of more flexible ordering and ever faster and more reliable customer service was not expected to be reversed by higher transport costs, similar to what was found in other studies (McKinnon and Woodburn, 1996: 156; Muilerman, 2001: 217-218).

7.3.3 Stated adaptations to longer transit times and reduced reliability

In chapter 6, longer transit times and reduced delivery reliability were expected to induce the following adaptations: swapping, decentralization of inventories, and more distribution outside peak hours.

The wholesalers that were interviewed expected that the congestion scenario would be problematic as printers were not expected to accept both deteriorated delivery performance and higher costs. Two wholesalers expected that inferior customer service, notably regarding reliability, would lead to a loss of customers. Apparently some competitors were expected to be more successful in guaranteeing reliable deliveries in this scenario (e.g. those located closer to their customers).

Table 7.7: Paper wholesalers' stated adaptations to scenario 2

Paper wholesalers→ / **Adaptations ↓**	**A**	**B**	**C**	**D**
Product and price				
• *Pass on cost increase to customers*			X	X
Production and distribution				
• *Loss of customers*		X	X	
• *Optimize geographical markets (i.e. concentration around large customers)*	X			
• *More co-operation with other wholesalers (e.g. combination of shipments, swapping)*			X	
• *Decentralize inventories at regular customers*	X			
• *Decentralize inventories at carriers*		X	X	
• *Customers will order larger shipments*			X	
• *Extend opening hours*				X
• *Extend time windows for paper deliveries*				X
Management of transport operations				
• *More overnight transport/weekend transport of deliveries*	X	X		X
• *Responsibility for planning etc. to carriers*		X		
• *More co-operation between carriers (e.g. cargo exchange)*			X	
• *More use of express couriers*				X
• *More information on delivery status to customers (e.g. by tracking-and-tracing)*				X

Note: X: adaptation was mentioned.

One wholesaler would extend his opening hours in order to enable more overnight deliveries and would also extend the time windows for inbound paper deliveries. In this way, logistics processes would become more flexible and less vulnerable to delays. Another wholesaler would co-operate more with other wholesalers in order to cope with this scenario, similar to what was envisaged. Again little flexibility was expected on the part of printers apart from more overnight deliveries; only in one case were larger orders at a lower frequency expected.

Nearly all wholesalers envisaged a decentralization of inventories, either at regular customers (if they agree on it), or at distribution centers of carriers. This would mainly concern fast-moving paper types. For other paper types, orders were claimed to be customer-specific (e.g. quantities and formats), which would make decentralization impossible or too expensive. No relocation of paper inventories from paper producer to wholesalers was expected, in contrast to what one paper producer expected. The paper producer in question however appeared to have regular deliveries of one quality of paper in mind.

Similar to the previous scenario, no large changes in locations were expected. The only changes included a loss of customers that are located further away (B and C) and efforts to concentrate customer areas (A).

Apart from the above adaptations related to the organization of production and distribution, relatively many adaptations in transport operations were envisaged. Distribution would shift more to off-peak hours, in line with what was expected.

7.4 Newspaper publishing and printing

7.4.1 Selection of cases

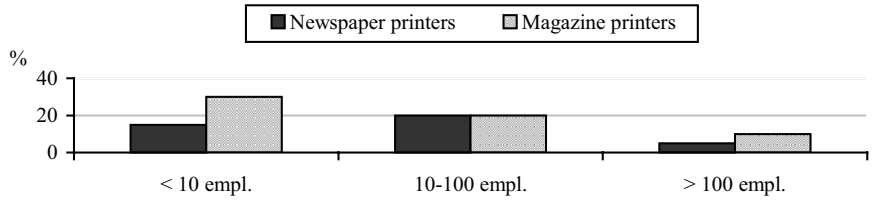
There are 190 firms active in newspaper publishing. 27 of them publish daily newspapers; most of the others are engaged in community or professional newspapers. About 63 percent of all newspaper publishers are small (CBS, 2001); seven large publishers however exclusively make the daily, national newspapers. The latter publishers have their own printing departments whereas other publishers often outsource printing. Different distribution structures are used. Most newspapers are home-delivered, but a few titles are delivered for free to commuters at train stations. The interview sample included:

- three large publisher of daily regional or national newspapers; they all had their own printing departments;
- one small community newspaper publisher who outsourced printing.

At first sight the sample does not seem representative since large publishers are over-represented. However, large publishers own a major part of the community newspaper publishers and have an important impact on their logistics as well (Pekelharing, 2001: 7). Therefore the sample represents a significant, although unknown, part of the market.

The newspaper printing industry is more difficult to identify, since large publishers use their printing departments also for commercial printing of community newspapers and other matter (notably bulk advertisement). Apart from that there are 30-40 commercial printers of (community) newspapers and bulk advertisement (CBS, 2001; KVGO, 2001b). Finally, magazine printers have a (small) role in the printing of newspapers and bulk advertisement. Printers are usually small or medium-sized (see Figure 7.1).

Figure 7.1: Structure of the Dutch newspaper and magazine printing sectors (2000)



Source: CBS, 2001.

The interview sample included:

- one small commercial newspaper printer;
- the above three large newspaper publishers with own printing departments; they also print large volumes of bulk advertisements;
- three large magazine printers.

In the sample magazine printers are over-represented. Although therefore the sample is biased, it allows for a comparison between different types of printers.

Since it appeared that sector boundaries between newspaper publishing and printing are blurred, this section describes the combined interview results of the two sectors.

7.4.2 Stated adaptations to higher direct transport costs

In chapter 6, the following adaptations to an increase in direct transport costs were anticipated:

- integration of inbound and outbound transport flows in order to improve load factors and reduce empty running;
- higher paper inventories and a lower frequency of replenishment deliveries, except for printers that use a wide range of paper types;
- more local sourcing of paper;
- more decentral printing (i.e. closer to the customers).

Table 7.8 shows the stated adaptations of the publishers and printers to the ton-kilometer scenario; they correspond to the anticipated adaptations only regarding inventory management. The integration of inbound and outbound flows for instance was not considered feasible due to the following factors:

- typically, different firms were responsible for the organization of transport of inbound and outbound flows;
- arrival and departure times differed;
- different flexibility in scheduling. Paper usually had to be delivered in time slots of a few hours. Distribution of newspapers however was planned in minutes and often had to be rescheduled in the case of delays in printing in order to guarantee in-time newspaper delivery.

Three firms envisaged higher paper inventories, coupled with a lower frequency of paper deliveries. In two cases this was combined with more deliveries by inland navigation similar to what paper producers envisaged. The other firms either have outsourced printing or claimed that the wide variety of paper types they used inhibited them from keeping higher (if any) inventories.

Table 7.8: Stated adaptations of newspaper publishers and printers to scenario 1

Newspaper publishers/printers → **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Product and price								
• *Pass on cost increase to customers*	X	X	X	X	X	X	X	X
Production and distribution								
• *Larger paper inventories*		X	X	X				
• *Fix deadline editorial at an earlier time in order to allow for more consolidation*			X					
• *Compensate elsewhere (e.g. less reporters)*			X					
Management of transport operations								
• *More paper supply by inland navigation*			X	X				
• *Outsourcing transport*		X						
• *Better fit between vehicles & load volume*		X						
• *Acquisition of additional (return) cargo via carriers (i.e. more consolidation)*		X						
• *More integration of outbound flows (i.e. more consolidation)*				X				
• *More overnight transport (paper), improving consolidation*		X						
• *Own account transport instead of couriers*					X			

Note: X: indicates that the adaptation in question was mentioned.

The geographical area in which newspaper publishers and printers source, was expected to remain unchanged in this scenario. Similar to what paper producers and paper wholesalers claimed, newspaper publishers and printers stated that it is impossible to switch to more local paper suppliers although one newsprint supplier is located in the Netherlands. Apparently, even if transport costs increase substantially, relative price differences still will make it attractive to purchase from foreign suppliers. It should be noted that transport costs make up on average five to seven percent of total costs of paper producers; hence the scenario would not lead to enormous price increases.

Only one printer frequently worked for customers abroad but did not expect to loose remote customers in this scenario: also his competitors would be confronted with the higher transport costs, which would leave relative prices largely unchanged.

Except for the fact that all firms would pass on (part of) the higher transport costs to their customers, Table 7.8 reveals large differences between firms. Five firms for instance would do nothing. Two of them operated within a local or regional area and hence had low transport costs. In addition, both inbound and outbound transport were arranged by suppliers or customers and were thus beyond their control. The other three firms were primarily involved in magazine printing. Options to reduce transport costs by consolidating more deliveries of printed matter were considered unfeasible since customers would not accept longer lead times[ix]. In addition they only recently had started optimizing their inventories, by for instance a more frequent ordering of replenishments. The cost reductions were not expected to be offset by higher transport costs. In addition, transport costs were relatively low and the scenario would thus not be

very problematic. The main reason was that magazine printers do not organize distribution to subscribers, in contrast to newspaper publishers.

The firms that would adapt their logistics in response to the scenario controlled the whole distribution process and hence perceived higher transport costs. In general, however, the interviewees looked at the distribution of their products only; the inbound flow of paper was considered the principal responsibility of paper producers. Only two firms would switch to inland navigation. Modal shift however was enabled by the fact that these firms only used one or a few qualities of paper, and thus bulk deliveries would not pose the potential problem of obsolescence.

7.4.3 Stated adaptations to longer transit times and reduced reliability

Chapter 6 hypothesized that newspaper publishers will be very responsive to longer transit times and in particular to a decreased reliability. The most important anticipated response would be more decentral printing, which in fact was mentioned by three out of seven firms (see Table 7.9). The other firms did not mention this option because:

- transport distances were very small and hence transit times were short;
- magazine printers had a dispersed customer base with irregular orders, and 'optimization' of distribution by adding a decentral printing location would hardly be possible.

Table 7.9: Stated adaptations of newspaper publishers and printers to scenario 2

Newspaper publishers/printers → **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Product and price								
• *Pass on cost increase to customers*			X	X	X		X	X
Production and distribution								
• *Loss of customers*					X		X	
• *More decentral printing by using printing facilities of others*		X	X					
• *More decentral printing by relocating own printing facilities*				X				
• *Larger paper inventories*				X		X		
• *Call off paper earlier*		X						
• *Spread inbound deliveries in time*							X	
• *Fix deadline editorial at an earlier time*				X				
• *Compensate elsewhere (e.g. less reporters)*			X					
Management of transport operations								
• *More paper supply by inland navigation*				X				
• *Shift to rail transport in distribution*			X					
• *Reschedule transport (avoid peak hours)*	X						X	
• *More direct hauls in order to guarantee lead times (i.e. less consolidation)*			X	X				
• *More overnight transport - paper supply*				X				
• *More overnight transport –printed matter*				X		X		

Note: X: indicates that the adaptation in question was mentioned.

The Table shows several other logistical adaptations. Most publishers expected to be able to absorb the increase in transit times by the measures listed in Table 7.9. One newspaper publisher however expected that the deadline for the editorial would have to be fixed at an earlier time in order to guarantee in-time delivery of newspapers; thus newspapers might become less timely. Two magazine printers expected to loose customers as they did not expect to offset completely the longer transit times and reduced delivery reliability.

Passing on (part of) the 20 percent increase in transport costs was not unanimously anticipated. Two firms would not do so since transport costs are relatively low and hence the cost increase would not be problematic. Some of the others had much larger transport costs because they controlled the whole distribution process. They therefore expected to pass on the transport cost increase as well as other cost increases caused by logistical adaptations.

Surprisingly, one publisher anticipated switching to rail transport for the movement of newspapers between printing locations and distribution hubs. This firm expected that in this scenario, rail transport could be faster than road transport on routes beyond 150 kilometers.

The expected larger paper inventories and more in advance ordering of paper are similar to what paper producers expected regarding paper of one or a few qualities and a regular demand, like newsprint. Most of the differences in the remaining logistical adaptations were situation-specific (e.g. the only firm who would spread inbound deliveries in time already faced congestion at its portals) or irrelevant as the adaptation was already put into practice (e.g. overnight transport).

7.5 Book publishing

7.5.1 Selection of cases

There are 525 book publishers in the Netherlands, 81 percent of which have less than ten employees and 64 percent even have less than five employees. Only two percent of the book publishers are large. The sector is quite heterogeneous regarding the types of books they publish (i.e. general, academic or educational books; in Dutch or foreign language). The sample of firms that were interviewed included:

- three small publishers, involved in general, Dutch literature, international, professional books, and international scientific literature;
- one medium-sized publisher of general, Dutch literature;
- one large publisher of general books (Dutch and translations).

The sample did not include publishers that arrange distribution of their books themselves; therefore the sample is not completely representative.

7.5.2 Stated adaptations to higher direct transport costs

It was hypothesized that higher transport costs could induce publishers to substitute physical, printed books by electronic ones. Table 7.10 demonstrates that only one publisher actually expected this effect due to the ton-kilometer tax. This publisher expected that particular authors would switch to electronic publications, since they were claimed to be very sensitive to costs.

Table 7.10: Book publishers' stated adaptations to scenario 1

Book publishers → **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X	X	X
Production and distribution					
• *More electronic publications instead of printed versions (on request of authors)*	X				
• *Lower shipment frequency of deliveries*	X				
• *Switch to book distributors that are located closer to the publisher*					X
• *Switch to large, specialized book distributors (i.e. more consolidation)*					X
• *Increase lead time; reduce time pressure in distribution (more consolidation, lower rates)*					X

Note: X: indicates that the adaptation in question was mentioned.

Publishers will face little difficulties in passing the increased costs on to their customers. Only two publishers foresaw logistical adaptations to the ton-kilometer scenario (i.e. A and E). These publishers did not distinguish themselves from the others regarding the way in which books are transported (i.e. types of distribution channels and responsibilities for transport), inventory policy, locations of printers, or the geographical spread of their customers. Like the other publishers, their responsibility regarding transport was limited to sending manuscripts by express delivery to printers; typically, printers or binders arrange transport of printed matter and finished books. Thus, transport costs were largely invisible to publishers. Yet, in contrast to the three publishers that did not envisage any adaptation, publisher A and E explicitly stated that they expected a significant cost increase *throughout the whole book supply chain* as a consequence of the scenario. This awareness may explain why these two publishers are inclined to adapt to higher transport costs.

Finally, all publishers expected that the ton-kilometer scenario would not lead to the choice for printers or binders that are located more nearby. The reason is that usually the cheapest printers are contracted; relative price differences between printers were not expected to be affected significantly by higher transport costs. Only one publisher would switch to more local distributors. This can be explained that distribution by its nature involves higher transport costs.

7.5.3 Stated adaptations to longer transit times and reduced reliability

Longer transit times and reduced reliability were expected to lead to a switch to less remote suppliers and adaptations in the planning of book production. Table 7.11 shows that the former adaptation was not considered realistic except for by one publisher. In contrast there appeared to be many possibilities to adapt production planning, similar to what was expected.

Table 7.11: Book publishers' stated adaptations to scenario 2

Book publishers → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X			
Production and distribution					
• *More electronic publications instead of printed versions (on request of authors)*	X				
• *Delivery reliability more important in printer selection*				X	
• *Switch to less remote printers (*)*				X	
• *Increase total lead time book production (max. 0.5 day)*	X				
• *Fix deadline for authors at an earlier time*				X	
• *Allow printers more time for printing and delivery (enabling more flexible planning and hence lower prices)*					X
• *Allow printers to deliver books in the evening (i.e. extending delivery window)*	X				
Management of transport operations					
• *Allow carriers more time to deliver (i.e. lower rates but longer lead times)*					X
• *Continue scheduling transport outside peak hours*			X		

Notes: X: indicates that the adaptation in question was mentioned; (*): no certain adaptation.

Despite the heterogeneous nature of the adaptations, reduced delivery reliability was not considered to be a large problem. Book deliveries usually were scheduled on particular days (sometimes more specific, e.g. morning/afternoon), not in hours. A 30 percent increase in transit times was not expected to be very problematic due to the relatively small distances that had to be overcome (mainly within the Netherlands). Problems might only arise when delays mount to one day or more, which was not expected. Nevertheless three out of five publishers would adapt their planning in order to prevent disruptions caused by significant delays. Others would do nothing, either because customers were claimed to be insensitive to delays or because delays would be small.

Passing on the 20 percent transport cost to customers would in one case lead to a substitution of physical publications by electronic ones. Three publishers expected that printers and binders, who typically arrange the distribution of finished books, would pass on the higher transport costs to them in both scenarios. In addition, two publishers expected that printers and binders would combine more shipments or outsource transport. No consensus existed on how this would affect lead times.

7.6 Book printing

7.6.1 Selection of cases

In the Netherlands, about 2,200 firms are active in book printing. Almost two third are small, whereas almost one third is medium-sized. Only two percent are large (KVGO, 2000; 2001a)[x]. Various kinds of books are printed but also other matter. Some firms combine book printing and binding; yet usually binding is outsourced. Five firms were interviewed:

- three small printers, of which one was specialized in academic literature whereas the other two print all kinds of books and other printed matter;
- two medium-sized printers of books and a wide range of other products.

7.6.2 Stated adaptations to higher direct transport costs

The anticipated adaptations of book printers to an increase in direct transport costs were a reduced frequency of paper orders, leading to higher inventories, and more outsourcing of transport. The former adaptation was actually mentioned by only one printer. The more general hypothesis from chapter 3 however is validated: two firms would adapt their logistical structure or inventory policy. These adaptations were similar to what two out of four paper wholesalers expected. Unanimously printers would pass on the higher costs, similar to what publishers expected (see section 7.5.2).

Table 7.12: Book printers' stated adaptations to scenario 1

Book printers → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X	X	X
Production and distribution					
• *Loss of remote customers*			X		
• *Purchase paper from local wholesalers*					X
• *Higher paper inventories/lower delivery frequency*					X
• *Combination of shipments with affiliated firms (i.e. more consolidation)*			X		
Management of transport operations					
• *Outsource transport (more consolidation, lower costs)*			X		

Note: X: indicates that the adaptation in question was mentioned.

The reasons why firms A, B, and D did not mention any adaptation were:

- distribution took place in a small geographical area and usually the weight of shipments was low; hence the cost increase due to the ton-kilometer tax would be limited (firm A and D);
- both inbound and outbound transport were arranged by others; therefore there were no options to adapt transport operations (firm B).

Printer C, who mentioned relatively most adaptations, stated explicitly that although transport costs made up only about 3.5 percent of total costs, yearly these costs involved large amounts of money.

Although the outbound flows typically are fragmented in space and size, printers seldom wait a day or longer to consolidate shipments. One-day delays would be unacceptable to the customer, in contrast to a delay of few hours (similar to what publishers stated). Yet, the fragmented distribution and the high share of own account transport had resulted in low load factors. The scenario would not change this situation, in contrast to what publishers expected. Only one firm would outsource more transport, which might improve consolidation factors. The others expected that despite the scenario own account transport would still be cheaper than outsourcing.

Without exception, adaptations regarding inbound flows were considered to come from paper wholesalers (e.g. by decentralization or relocation of warehouses in this scenario, similar to what several paper wholesalers expected (see section 7.3.2)).

7.6.3 Stated adaptations to longer transit times and reduced reliability

In chapter 6 the following adaptations on the part of printers were expected in response to longer transit times and reduced delivery reliability:

- less remote paper suppliers;
- higher inventories;
- more distribution outside peak hours;
- extension of opening hours.

Table 7.13 summarizes the stated adaptations of the printers to the congestion scenario. The above adaptations in fact were mentioned but not by a majority of the interviewees. Several other adaptations were mentioned that were not envisaged; however they were often mentioned by only one firm.

Similar to the previous scenario, some firms would respond actively to this scenario whereas others would be more passive. Various explanations were provided, including:

- variations in time pressure: in the experiences of printers A and E, the scenario would not cause (large) problems in meeting the lead times demanded by their customers, in contrast to printer C;
- different distances to customers: most of the customers of D were located nearby and usually were supplied by couriers. It was expected that this distribution structure would be less vulnerable to congestion;
- flexibility regarding paper supply: two printers did not expect large problems because paper deliveries were scheduled on certain days, not hours (printer A) or because relatively large inventories of standard paper were kept (printer A and B). Paper wholesalers in contrast however expected that printers would not tolerate delays. This could be explained by firm-specific factors.

Table 7.13: Book printers' stated adaptations to scenario 2

Book printers → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*		X			X
Production and distribution					
• *Loss of remote customers*		X	X		
• *Purchase paper from local wholesalers*				X	X
• *Higher paper inventories/lower delivery frequency*					X
• *Order paper more in advance*				X	
• *Extend opening hours (24 hours/day)*			X		
• *Combination of shipments with affiliated firms (i.e. more consolidation)*			X		
Management of transport operations					
• *More overnight transport – paper supply*			X		
• *More overnight transport – distribution*			X		
• *Continue distribution outside peak hours*	X				

Note: X: indicates that the adaptation in question was mentioned.

Printers C and D however would expect more problems from this scenario. Regarding the inbound paper flow, congestion might endanger the practice of daily, just-in-time deliveries. This would lead to more in-advance ordering or a switch to more local paper wholesalers. Only printer C would adapt the outbound freight flow by extending opening hours and consolidating shipments with others. This rather unique flexibility may be explained by two factors:

- its relatively large size that might render extension of opening hours profitable;
- the firm was part of a large holding in which several opportunities to consolidate shipments of the affiliates were still unexploited.

Only one printer would allow more overnight supply of paper, whereas three out of four paper wholesalers would deliver more overnight in this scenario. The main reason for this difference is that wholesalers notably had large medium-sized or large printers in mind, which often are opened 24 hours a day.

Switching to paper wholesalers located more nearby or keeping higher inventories were expected by two printers, similar to what wholesalers envisaged. Finally, two printers expected to loose remote customers (i.e. more than 200 kilometers away) to competitors that are located closer to these customers.

7.7 Book binding

7.7.1 Selection of cases

Some 200 firms are active in the 'graphic finishing sector' in the Netherlands. They are involved in binding and finishing of books and other printed matter, such a magazines. Only five percent of the binders are large, the rest either are small (i.e. 48 percent) or

medium-sized (i.e. 47 percent) (KVGO, 2001a)[xi]. Interviews were conducted with three small and two medium-sized binders. They were engaged in the production of various types of books: general books, scientific and professional literature, art books, and catalogues.

7.7.2 Stated adaptations to higher direct transport costs

In the case of binding the expected adaptation to higher direct transport costs was an increased outsourcing of transport. A ton-kilometer tax namely only implies higher transport costs in the distribution of finished books from binders to customers. Price increases in the printed matter itself due to the ton-kilometer scenario would not be perceived, since binders do not become owner of the products they bind. Still, as transport costs were relatively high (i.e. on average 6-6.5 percent of total costs), the scenario would have a significant impact on binders' total costs. Transport costs were high due to the intensive use of courier services and the fact that deliveries are seldom consolidated, among other things because customers do not tolerate one-day delays. Outsourcing thus could reduce transport costs. Nevertheless, the interviewees did not envisage this adaptation; rather one binder would employ *more* own account transport. In this case the aim was to reduce the use of express delivery services.

Table 7.14: Binders' stated adaptations to scenario 1

Binders → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X	X	X
Production and distribution					
• *Make production process more flexible, e.g. by extending opening hours, which allows for less use of courier services*			X		
• *Concentrate on local/regional customers*				X	
• *Consolidation of shipments with other binders located nearby*				X	
Management of transport operations					
• *Less express delivery, more own account transport and more consolidation*			X		

Note: X: indicates that the adaptation in question was mentioned.

Overall the scenario would induce little adaptations; three binders would even do nothing but raise prices. Only one binder (D) would concentrate more on regional or local customers in this scenario, in line with what was hypothesized in chapter 3. This response however is facilitated by the trend in his market segment that customers increasingly choose local or regional suppliers in order to guarantee short lead times and reliable deliveries. Two binders would be inclined to combine more deliveries and thus reduce transport costs, in line with what publishers expected (see section 7.5.3). The other binders regarded this strategy unfeasible because of time constraints imposed by customers, among which book publishers. Again, this is in line with what printers expected but contrary to what publishers envisaged.

The binders who would adapt their logistical processes were medium-sized, whereas the others were small. Perhaps their size allowed them to bear the investments required to implement the adaptations, in contrast to the others. No relationship was found between share of transport costs in total costs and the number of stated adaptations.

7.7.3 Stated adaptations to longer transit times and reduced reliability

This scenario was expected to induce two adaptations: more distribution outside peak hours and perhaps an extension of opening hours. Table 7.15 summarizes the stated adaptations.

Table 7.15: Binders' stated adaptations to scenario 2

Binders → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*		X	X		
Production and distribution					
• *Loss of remote customers*			X		
• *Concentrate on local/regional customers*				X	
• *Make production process more flexible, e.g. by extending opening hours*			X		
• *Distribution arranged by customers*			X		
Management of transport operations					
• *Switch to fast and reliable carriers (despite higher rates)*					X
• *Continue scheduling distribution outside peak hours*	X	X	X	X	X
• *Reschedule paper deliveries*					X

Note: X: indicates that the adaptation in question was mentioned.

Two interviewees (A and B) did not expect problems since they already avoided transport during peak hours. The only effect of the scenario could be that departures sometimes would have to be rescheduled in order to continue distributing outside peak hours, similar to what was expected. The few hours' delay would be no problem, in line with what publishers stated. Binders who also distributed during peak hours would face more problems in this scenario. One of them would leave its logistical processes largely unchanged but would switch to faster and more reliable carriers and reschedule paper deliveries (E). Another binder (D) would try to acquire more work from regional customers, similar to his response to scenario 1. Binder C would implement radical changes in his production and distribution organization including the anticipated extension of opening hours. This extreme sensitivity appeared to be rather unique, however. The binder claimed that over the past years, customers had forced him continuously to cut lead times but at the same time refused to accept higher prices (e.g. due to more express delivery). In the case of the congestion scenario, he would no longer obey to his customers' demands. The others did not have such problems.

7.8 Book distribution

7.8.1 Selection of cases

Various types of firms distribute finished books to final customers (i.e. readers, firms, libraries, et cetera). Bookstores of course play an important role; yet in chapter 6 it was decided to leave them out of consideration since they can barely affect transport-intensity of their operations. Other book distributors include importers of foreign books, wholesalers, internet bookstores, and publishers or retailers that arrange distribution themselves. Unfortunately data lack on the number of firms involved in book distribution. According to CBS there are 210 wholesalers of books, magazines, agendas, posters, and other printed products; most of them are small (CBS, 2001). Although bookstores are excluded from the CBS data it is unclear to what extent the other types of book distributors, identified above, are included.

Five book distributors were interviewed: one large book wholesaler, one medium-sized wholesaler (owned by a book retailer), two small firms involved in imports and wholesale of foreign books, and one medium-sized virtual bookstore. They all deliver to bookstores; the two book wholesalers and the internet bookstore also provide home-deliveries. The latter three firms have a major share in their market segments. Publishers that distribute themselves were not included. Because data lack on the total population, it is not possible to assess the extent to which the sample is representative.

7.8.2 Stated adaptations to higher direct transport costs

The anticipated adaptations of book distributors to an increase in transport costs included an increase in the number of distribution centers, a decentralization of inventory, decentral printing-on-demand, and substitution of home-deliveries by delivery at central facilities in city quarters.

Table 7.16 specifies the stated adaptations of the interview sample; for the sake of anonymity, no reference is made to the specific activities in which the respondents were involved. One of the firms that provided home-deliveries would adapt similar to what was anticipated. A decentralization of inventories was not expected by any of the interviewees. Rather, three out of five distributors would reduce the frequency of orders, similar to what was anticipated.

Regarding the remaining adaptations, all wholesalers expected to pass on the higher costs to their customers. The other responses are situation-specific. One firm for instance would no longer import books of which transport costs exceeded the revenue; hence cross-subsidization to a certain extent would be ended. Another firm expected to go bankrupt, since any increase in his prices would induce his customers to perform the distribution activities themselves.

No relationship was found between the share of transport costs in total costs and the number of stated adaptations.

Table 7.16: Book distributors' stated adaptations to scenario 1

Book distributors → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X	X	X
Production and distribution					
• *Loss of customers/bankruptcy*				X	
• *Rationalize book assortment*			X		
• *Reduce frequency of orders at publishers or other wholesalers (i.e. larger inventory)*	X			X	X
• *Co-operate with other distributors in order to improve consolidation factors*	X				
• *Deliver to central facilities instead of at home (i.e. more consolidation)*	X				
Management of transport operations					
• *Switch to more efficient/specialized carriers*	X				

Notes: X: indicates that the adaptation in question was mentioned.

7.8.3 Stated adaptations to longer transit times and reduced reliability

It was anticipated that longer transit times and reduced delivery reliability would notably be problematic in the case of home-deliveries since order lead times already are relatively long. Deliveries were expected to places that are well accessible instead of home-delivery. In addition more decentral inventories was expected in virtual book retail and in book wholesale. Finally, decentral printing-on-demand was expected for slow-moving import books in particular.

Table 7.17: Book distributors' stated adaptations to scenario 2

Book distributors → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X		X
Production and distribution					
• *Loss of customers (in the case of home-deliveries)*			X		
• *Reduce frequency of orders at publishers or other wholesalers*				X	X
• *More distribution centers (break-of-bulk, not storage)*		X			
• *Adapt scheduling of ordering and deliveries*				X	
• *Reduce delivery frequency to customers (i.e. longer lead times)*				X	
• *Deliver to central facilities instead of at home (i.e. more consolidation, less hauls)*	X				
Management of transport operations					
• *Switch to more efficient /specialized carriers*	X				
• *More outsourcing of transport*		X			
• *Acquire more (return) cargo (i.e. more consolidation)*		X			

Notes: X: indicates that the adaptation in question was mentioned.

In general, the stated adaptations coincide with anticipated ones. Two distributors would keep higher inventories whereas one would increase the number of consolidation centers. One firm involved in home-deliveries would deliver to central facilities close to customers rather than at their homes, thus reducing the number of hauls. Another distributor envisaged a loss of customers in the case of home-deliveries (i.e. C). Most distributors would pass on the higher costs to customers except for one firm that would otherwise fear bankruptcy (D).

7.9 Old paper collection and wholesale

7.9.1 Selection of cases[xii]

In the Netherlands about 130 firms are involved in old paper collection and wholesale. About 75 percent of them are small, 15 percent are medium-sized, whereas the remainder is large. Medium-sized and large companies usually are specialized in wholesale, whereas small firms typically collect old paper, which is supplied to wholesalers. Almost half of all firms also destroy confidential papers (e.g. archives) next to old paper collection. With respect to the logistical organizations employed, it is relevant to note that about 20 firms (among which the large ones) export old paper outside Europe (mainly to the Far East). However, churches and sports clubs also collect old paper. Yet, since they usually have no responsibility for freight transport and operate locally, they are disregarded in this study. Finally, many suppliers of old paper (mainly communities that are by law responsible for waste collection at households) are organized in a co-operation that coordinates old paper collection, processing, sales, and distribution to the paper industry[xiii]. This organization could be regarded a 'virtual' old paper wholesaler: it schedules collection, arranges deliveries to customers, and decides on how old paper is transported (e.g. modal choice); yet the physical execution of activities is outsourced.

Interviews were conducted with five firms, namely:

- one large old paper wholesaler, who exports to the Far East;
- one medium-sized firm, involved in both collection and wholesale with exports to the Far East;
- one small old paper collector that delivers notably to large wholesalers but also exports to the Far East;
- one medium-sized firm involved in destruction of confidential papers; old paper collection is a secondary activity;
- the organization that coordinates old paper collection, processing, and distribution in behalf of communities and other old paper suppliers.

In this sample, small firms are under-represented; however the sample contains all the distinct types of firms. In addition, the interviewed firms are responsible for about one third of all old paper that is traded in the Netherlands[xiv].

7.9.2 Stated adaptations to higher direct transport costs

In chapter 6, it was hypothesized that higher direct transport costs would notably lead to higher old paper prices, which in turn would lead to smaller geographical markets. In addition more swapping could occur. Only the first effect was expected by the firms that were interviewed (see Table 7.18). High transport costs appeared to be the main explaining factor. To wholesalers for instance the costs of distributing old paper to paper producers make up 15-20 percent of total costs. Old paper firms therefore aim to minimize transport costs in a number of ways. One, deliveries of old paper to wholesalers or paper producers nearly always are shipped in FTL's. Two, old paper firms claim to be active in return cargo acquisition. When transport is outsourced, often use is made of redundant transport capacity (e.g. by filling empty returns). Three, notably in old paper collection, distances are short; operations generally take place locally. This does not only reduce transport costs but also maximizes labor productivity (see chapter 6, section 6.2.1). Because almost all options to reduce transport costs were claimed to be utilized (which is reflected by the fact that few adaptations were mentioned), the only option in this scenario would be to raise prices.

Table 7.18: Old paper producers' stated adaptations to scenario 1

Old paper firms → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X	X	X	X	X
Production and distribution					
• *Smaller geographical sales markets within Europe*	X	X	X	X	
• *Direct delivery to wholesalers; no intermediate storage*					X
Management of transport operations					
• *More use of inland navigation for old paper deliveries*		X			
• *Use equipment that stow more old paper in truck/container*		X			

Note: X: indicates that the adaptation in question was mentioned.

Old paper suppliers would not engage in swapping, in contrast to what was anticipated. Rather they would 'prefer' to pass on the higher costs and as a result, face smaller geographical market areas. This could be considered a passive way of swapping, since it was expected that customers would be lost to competitors that were located at shorter distances. The limited potential for swapping could be explained by the fact that old paper wholesalers often have long-term contracts with paper producers. These might be endangered when competitors get a chance to capture the customer through swapping.

Smaller geographical market areas as a consequence of higher prices were only expected in the case of old paper sales to paper producers located within Europe. This however is inconsistent with the stated adaptations of paper producers, who would not switch to more local suppliers (see section 7.2.2). This inconsistency however can be explained by the fact that the paper producers that were interviewed contracted old

paper suppliers that were located nearby. No changes in exports to the Far East were expected due to:

- low costs for intercontinental transport of old paper, e.g. compared to distribution within Europe, which usually takes place by road. Intercontinental shipping was claimed to be cheap because between the Netherlands and the Far East many empty containers are transported for repositioning purposes; rates for such back-hauls are usually very low;
- scarcity of old paper in the Far East; hence paper producers were expected to accept the higher prices.

Only one old paper wholesaler would use more inland navigation to supply paper producers located in Europe, similar to what paper producers expected (see section 7.2.2). The main reason was that both paper producers and old paper suppliers stated that the costs of handling and pickup and delivery by road often inhibited a modal shift. Old paper exports to the Far East in contrast are generally transported by inland navigation to sea harbors, since in this case only one additional handling and haul by road is required.

7.9.3 Stated adaptations to longer transit times and reduced reliability

In response to increased congestion only earlier departures in distribution were anticipated, because time pressure is not high in old paper collection and distribution. Longer transit times were not expected to cause significantly higher interest costs or increased risk of obsolescence and hence were not considered problematic. In conclusion, no need for decentral or higher inventories was anticipated; actually these measures would only raise total logistical costs.

Similar to what was envisaged, the interviewees expected that more unreliable deliveries would not pose large problems, since they had to deliver at certain days, not within strict time windows. However, longer transit times of road transport were expected to cause additional costs, because of productivity losses of carriers and own personnel. One wholesaler would extend his opening hours in order to continue processing the amount of old paper that his customers needed for their daily supply. Others would adapt departure times or switch to more overnight transport, similar to what was expected. Two interviewees envisaged an increased use of inland navigation and rail transport, although for different reasons. One expected that rail transport could be faster on certain destinations. The other would use inland navigation and rail transport because paper producers usually have one day to discharge the vessel or wagon, whereas trucks typically leave immediately after arrival. This could provide some flexibility and reduce scheduling costs due to unreliable arrivals.

Only one wholesaler would not raise prices due to productivity losses and the 20 percent higher carrier rates, because the firm expected to fully absorb the cost increases. This firm in addition expected to yield competitive advantage from its location, close to alternative road networks and the port of Rotterdam, and the fact that it collected old paper in very ‘dense’ areas (i.e. many households/km^2).

Table 7.19: Old paper producers' stated adaptations to scenario 2

Old paper firms → / **Adaptations ↓**	**A**	**B**	**C**	**D**	**E**
Product and price					
• *Pass on cost increase to customers*	X		X	X	X
Production and distribution					
• *Smaller geographical sales markets within Europe*	X		X	X	
• *Extend opening hours*	X				
Management of transport operations					
• *More use of inland navigation/rail for old paper deliveries*	X				X
• *Use equipment that stow more old paper in truck/container*		X			
• *More overnight transport – old paper deliveries*		X			
• *Changing departure times*		X			

Note: X: indicates that the adaptation in question was mentioned.

Three out of five firms envisaged smaller geographical market areas due to higher old paper prices. Collection areas would remain unchanged as they are already small.

Finally, higher inventories were not envisaged because delayed deliveries were not regarded problematic. Then the only rationale for higher inventories could be transport cost reduction. The potential of a transport cost reduction however is small since old paper nearly always was shipped in FTL's and larger shipments could only be realized in the case of a modal shift, which would be too expensive (see previous section).

7.10 Conclusions and discussion

7.10.1 Introduction

In this chapter the stated adaptations of firms within the Dutch printed media industry to increases in transport costs were discussed. Two scenarios were examined. In the first scenario ("fair and efficient pricing"), internalization of external social costs of transport results in higher direct transport costs. In the second scenario ("insufficient infrastructure provision"), congestion increases dramatically, resulting in longer transit times and reduced delivery reliability. Below, the results will be discussed and compared with the expected adaptations.

7.10.2 Scenario 1: Higher direct transport costs

Theory and empirical studies discussed in chapter 3 suggested that an increase in direct transport costs would notably lead to larger inventories and shorter transport distances through changes in the (geographical) pattern of logistical structures. The literature also indicated that logistical behavior is often very heterogeneous. As a consequence, actual adaptations to direct transport cost increases might vary between and even within industries. Thus in chapter 6, case studies were conducted in order to refine and specify the above hypothesis on the effects of higher direct transport costs.

Table 7.20 shows the hypothesized adaptations as well as those that were expected by the interviewees. Validation of the hypotheses was conducted in a qualitative manner: a hypothesized adaptation was considered to be validated if at least one firm mentioned this particular adaptation. Validation thus was not concerned with the dominant adaptations, but rather the *nature* of the adaptations if they were mentioned by the interviewees. The Table shows that many hypothesized adaptations were found, as well as many other adaptations that were not anticipated.

Table 7.20: Hypothesized and stated responses to higher direct transport costs

	Logistical structure	Logistical control concept	Customer service
Paper producers	• pass on higher costs (**) • **decentralize distribution (*)** • ~~smaller geographical markets~~ • ~~swapping~~ • ~~more local sourcing of wood~~	• **higher inventories (*)** • ~~integration of inbound and outbound flows~~	-
Old paper suppliers	• pass on higher costs (**) • smaller geographical markets (**) • **eliminate intermediate storage (*)**	-	-
Newspaper publishers & printers	• **pass on higher costs (**)** • **compensate elsewhere (*)** • ~~local sourcing (paper, ink)~~ • ~~increased decentral printing~~	• higher inventories (**) • **fix deadline editorial at earlier moment (*)** • ~~integration of inbound and outbound flows~~	• **less timely product (*)**
Paper wholesalers	• swapping (*) • decentralization of inventories (**) • **pass on higher costs (**)** • **smaller geographical markets (**)** • **optimize markets (*)**	• **higher inventories (**)** • **consolidate with other firms (*)**	-
Book publishers	• **pass on higher costs (**)** • **local/regional suppliers (i.e. book distributors) (*)** • **use specialized book distributors (*)**	• electronic publishing (*)	• **reduce delivery frequency (*)** • **increase lead time (*)**
Book printers	• **pass on higher costs (**)** • **smaller geographical markets (*)** • **local/regional suppliers (*)**	• higher inventories (*) • **consolidate with other firms (*)**	-
Binders	• **pass on higher costs (**)** • **focus on local/regional customers (*)**	• **consolidate with other firms (*)** • **extend opening hours (*)**	-
Book distributors (inc. virtual bookstores)	• decentralization of inventories/ distribution (*) • deliveries to central facilities (*) • **pass on higher costs (**)** • ~~decentral printing on demand~~	• higher inventories (**) • **consolidate with other firms (*)** • **adapt planning (*)**	• **smaller assortment (*)** • **reduce delivery frequency (*)**

Note: shaded: hypotheses are confirmed; ~~strikethrough~~: hypotheses rejected due to contradicting evidence or no evidence at all; **bold**: stated by the respondents but not anticipated; (*): mentioned by one firm; (**): adaptation was mentioned two or more firms in the sample (of, on average, 5 firms).

Some firms anticipated spatial adaptations including a switch to more local suppliers, decentralization of distribution, or smaller geographical market areas. In contrast to what was anticipated in chapter 3, no relocation, decentralization of production, or less focused production were expected. The interviewees explained the inertia as follows:

- investments in production and distribution facilities were generally high and were written off over long periods (i.e. beyond the 10-year time horizon of this study). In addition only a few firms rented distribution facilities, which in theory could offer a higher flexibility in locational choice;
- lack of alternative suppliers located at shorter distances, in particular in the case of paper suppliers that are few in number due to plant specialization and centralization;
- comparative differences between suppliers (e.g. paper wholesalers and printers), which were not expected to be affected much in the scenario;
- competitors would also face the transport cost increase. As a result relative prices and hence geographical market areas would remain unchanged;
- little impact on costs due to short distances to customers or low transport volumes (in the case of paper wholesale, printers, and binders).

Many firms in all sectors expected to pass on (part of) the transport cost increase. In addition, in all sectors except for book publishing and binding, firms would reduce frequency of replenishment deliveries or order larger quantities of replenishments, resulting in higher inventories. Although this means that they would accept a lower customer service of deliveries, few suppliers would adapt customer service levels of outbound flows on their own initiative, in line with the results of similar studies (e.g. McKinnon, 1998: 104-105; McKinnon and Forster, 2000a: 11; McKinnon and Woodburn, 1996: 156; Muilerman, 2001: 217-218). Suppliers namely expected that many customers would not accept deteriorated customer service levels, in contrast to (slightly) higher prices. The trend of lead time reduction and increasingly flexible and frequent deliveries therefore is expected to continue in the printed media industry, even if transport costs increase significantly.

Apart from the above commonalities, also a strong heterogeneity in stated adaptations between sectors and within sectors was found, similar to what was expected. In some situations, stated adaptations only seemed heterogeneous. This was the case when only one or a few firms mentioned particular adaptations that however already were applied by others. 'Real' heterogeneity in stated adaptations within sectors were related to:

- alternative options to reduce transport costs by means of logistical adaptations;
- the (perceived) share of transport costs in total costs. This was related to value density and to the organization of transport (i.e. FOB or CIF delivery; see chapter 3). Only in the case of binders and book distributors, no relationship was found between the importance of transport costs and the number of stated adaptations[xv];
- situation-specific factors: e.g. short distances to customers or locations near to a rail link or inland waters, reducing the costs of a modal shift.

7.10.3 Scenario 2: Longer transit times and reduced delivery reliability

In Table 21, the hypothesized and stated adaptations related to the congestion scenario are summarized. Again many hypothesized adaptations actually were found; in addition many non-hypothesized adaptations were found.

The general hypothesis of chapter 3 was that longer transit times and reduced delivery reliability will induce more responses as well as more diversified responses, which may relate to all dimensions of production and distribution networks that affect transport demand. This hypothesis is validated in part by the stated adaptations to both scenarios since in five out of eight sectors, increased congestion induces both a larger variety and a larger number of stated adaptations. It should be noted however that the main difference between the effects of longer transit times and reduced delivery reliability and those of higher direct transport costs concentrates on the magnitude of lost customers and the resulting changes in geographical market areas. Paper producers would not adapt more dimensions of production and distribution because they stated that delays were notably the customer's problem. The hypothesis clearly has to be rejected regarding the old paper sector, where costs appeared to be of primary importance and hence scenario 1 would induce more reactions.

Differences in the variety or number of stated adaptations to both scenarios could in theory be explained by differences in options available to avoid the negative effects of both scenarios. In a few cases, this was in fact found in the printed media industry (e.g. paper production). In most cases however the stated adaptations could be applied in both scenarios but were only considered feasible in scenario 2. Based on this and on the preceding two indicators, the overall conclusion is that scenario 2 was perceived more problematic than scenario 1. Many respondents had customers that were expected to be more sensitive to deteriorated customer service than to price increases. Nevertheless a larger reduction in demand in scenario 2 compared to scenario 1 was only expected in newspaper publishing/printing, book printing, and binding. Explanations were:

- although delays were expected to be unavoidable, no threshold value would be attained beyond which customers would switch to competitors (stated by several paper wholesalers, book publishers, book printers, binders, and newspaper publishers/printers). In particular in the case of paper wholesale, this would be the result of logistical adaptations rather than flexibility in order lead times;
- customers had to accept delays if they do not adapt their ordering behavior because delays were unavoidable (stated by paper producers).

However, additional explanations for a relatively inelastic demand in the context of a customer service deterioration can be found in differences in market structures. In the following sectors, customers probably will have to accept reduced customer service because they have no option to switch to a competitor and therefore are 'captive':

- books publishing: most books are unique and supplied by one publisher;
- paper production: due to concentration and paper mill specialization, there are few alternative suppliers in Europe;
- book distribution within the Netherlands is also conducted by a few firms.

In turn, the monopolistic or duopolistic market positions may provide the firms in question fewer incentives to actively adapt logistical processes in response to the scenario.

Table 7.21: Hypothesized and stated responses to longer transit times and reduced delivery reliability

	Logistical structure	**Logistical control concept**	**Customer service**
Paper producers	• relocate (decentralize) inventories (*) • **pass on higher costs (**)**	• more in-transit inventory (*) • ~~larger safety inventories~~	-
Old paper suppliers	• **pass on higher costs (**)** • **smaller geographical markets (**)**	• earlier departures (adapt planning) (**) • **extend opening hours (*)**	-
Newspaper publishers & printers	• decentralization of printing (**) • **pass on higher costs (**)** • **loss of customers (**)** • **compensate elsewhere (*)**	• **higher inventory (**)** • **order paper earlier (*)** • **fix deadline editorial at earlier moment (*)** • **spread deliveries (*)**	• **less timely product (*)**
Paper wholesalers	• swapping (*) • decentralization of inventories (**) • **pass on higher costs (**)** • **smaller geographical markets (**)** • **optimize markets (*)**	• **allow more flexible deliveries (*)** • **extend opening hours (*)** • ~~distribute outside peak hours~~	• **larger orders from customers (*)**
Book publishers	• less remote suppliers (*) • **pass on higher costs (**)** • **use more reliable suppliers (*)**	• adapt planning (**) • **electronic publishing (*)** • **allow more flexible deliveries (*)**	• **increase lead time (*)**
Book printers	• less remote suppliers (**) • **pass on higher costs (**)** • **smaller geographical markets (**)**	• higher inventories (*) • extend opening hours (*) • **order paper earlier (*)** • **consolidate with other firms (*)** • ~~distribute outside peak hours~~	-
Binders	• **pass on higher costs (**)** • **smaller geographical markets (**)**	• extend opening hours (*) • **let customers arrange distribution (*)** • ~~distribute outside peak hours~~	• **stop delivering (*)**
Book distributors (incl. virtual bookstores)	• decentralization of distribution (*) • deliveries to central facilities (*) • **pass on higher costs (**)** • **loss of customers (*)** • ~~decentral printing on demand~~ • ~~decentralization of inventories~~	• **higher inventories (**)** • **adapt planning (*)**	• **lower delivery frequency (*)**

Note: shaded: hypotheses are confirmed; ~~strikethrough~~: hypotheses rejected due to contradicting evidence or no evidence at all; **bold**: stated by the respondents but not anticipated; (*): mentioned by one firm; (**): adaptation was mentioned by two or more firms in the sample (of, on average, 5 firms).

Common responses to scenario 2 included passing on higher (transport) costs, although it was mentioned less frequently than in scenario 1. The main reason was that cost increases were claimed to be lower. Another common response was to adapt inventory policy, e.g. less frequent deliveries resulting in higher inventories. Exceptions either already had large or decentral inventories, or had large assortments of product (notably paper) in combination with an unpredictable demand, which would lead to prohibitive inventory risks. Again stated adaptations also appeared to be heterogeneous within and between sectors. Sources were the same as those identified in the analysis of scenario 1.

Finally, in contrast to what was expected in chapter 3, no clear evidence was found for the hypothesis that logistical adaptations to higher transport costs will come from large firms in particular. Only in book printing and in binding, some supportive evidence for this hypothesis was found.

7.10.4 Reflection on methodological approach

In chapter 4 several potential biases were discussed that could lead to invalid responses. Three of them could not completely be avoided in the survey design; the potential of these biases is therefore examined below.

One, policy response bias might occur when respondents exaggerate the effects of the scenarios in order to influence policy outcomes. There was however little evidence of such bias:

- many respondents found the scenarios plausible if not realistic, although several respondents expected a kilometer tax rather than a ton-kilometer tax, which was assumed in scenario 1;
- only a few inconsistencies were found in expectations of firms about how their suppliers and customers would respond and those that were expressed by firms upstream or downstream in the supply chain;
- only in one case, a very extreme effect was expected (namely bankruptcy) that however was reasonably explained by the respondent.

Two, interviewees could state unrealistic adaptations to the two scenarios (i.e. unconstrained response bias). By referring adaptations to the current logistical organization (described by respondents, identified by personal observations, and derived from annual reports that were consulted prior to the interviews), it is expected that such biases were minimized, if not avoided.

Three, in order to avoid interviewer biases (i.e. misinterpretation of statements), interview reports were sent for approval. Almost half of the interviewees responded and reported no or minor corrections. The other half did not respond; it was assumed that they approved the report.

Nevertheless the methodology employed did not allow for a complete assessment of the effects of the two scenarios for a number of reasons. One, the time frame employed appeared to be too short to reveal adaptations in the functional structure and spatial

pattern of supply chains in most sectors (except for old paper). Yet a longer time horizon was expected to reduce validity of responses (see chapter 4, section 4.3.1).

Two, some adaptations will depend eventually on negotiations between firms (cf. Muilerman, 2001: 221). Due to the focus on individual firms this could not be assessed completely; the presence of only few inconsistencies as described above however does not suggest that this has led to large problems.

Three, the existence of 'monopolistic laziness' could not be ascertained mainly due to a lack of insight into options available and their costs.

Four, in particular scenario 1 might in reality induce more adaptations as many firms appeared to have a limited perception of transport costs: firms mainly looked at outbound flows for which they bore responsibility. Most ignored potential cost increases in earlier or later stages in the supply chain, which might inflate prices of inputs and final prices of books and newspapers. Both may induce 'second-order effects' which have not been assessed in the interviews. Yet regarding book and newspaper sales, Figure 6.7 and 6.15 in chapter 6 demonstrated that overall transport costs in book and newspaper prices are relatively low. If the 50 percent increase in road haulage costs from scenario 1 is passed on without any logistical adaptation, average book and newspaper prices increase by 1.5 and 3 percent, respectively. This might only cause problems in the newspaper industry.

Five, in chapter 3 it was already observed that firms often tend to imitate successful logistical concepts of others. The potential of such imitation in the case of the two scenarios was not assessed in the survey, either.

Six, the survey yielded dominant impressions of what might happen rather than responses that are likely with high levels of statistical confidence; statements such as "with 95 percent confidence it may be assumed that 30-35 percent of all firms in sector X will reveal adaptation Y" are not possible. Although the samples were chosen in such a way that they were representative of the whole population regarding firm size and type of activity, chapter 3 suggested that logistical behavior of firms tends to vary with many more features. Yet given the difficulties that other researchers have had in constructing 'logistical families' (see chapter 3), it was decided to focus on a few relevant features that were easily identifiable. Features such as value density were excluded due to a lack of data prior to the interviews. For this reason, no formal correlation analysis was conducted on the interview results either, also because this would require larger numbers of cases.

Seven and finally, the interview samples were not completely representative. Partly this is caused by a lack of unambiguous criteria addressing determinants of logistical behavior, according to which firms could be classified (see chapter 3, section 3.6.1). Another reason is that in light of the alternative criteria used, some biases were found. The main implication of the above for the generalizability of the interview results to the entire printed media industry is that the composition of the adaptations as well as their

distribution may in part be biased. For instance, in the paper wholesale sector, three out of four firms (or 75 percent) would pass on the higher costs of scenario 1 to their customers. If the entire population was interrogated, this percentage might have been somewhat higher or lower. In addition adaptations that were mentioned in low frequencies (i.e. by only one firm) may in part be considered as anomalies. The stated adaptation survey therefore has yielded an impression of what would be dominant adaptations in the case of the two policy scenarios, rather than outcomes that are likely with a statistically high level of confidence.

[i] Data on the Dutch paper producing industry were derived from a database of MarktSelect, a market research consultancy. The database is updated quarterly and contains names of Dutch firms with headquarters in the Netherlands. Regarding paper production, the database appeared to include also firms that were engaged in other activities (e.g. paper wholesale or old paper collection). Eventually five paper producers appeared to be relevant to this research, which was later confirmed by the Association of Dutch Paper and Cardboard Producers (VNP, 2001).

[ii] There are some 25 cardboard producers in the Netherlands (CBS, 2001).

[iii] In this context, packaging industries are more or less obliged to purchase from affiliated cardboard producers.

[iv] Additional handling also raises the risk of damage of paper (NEI/NEA, 1990). Damaged paper is often useless to printers as it may lead to distortions in printing. The costs of those productivity losses are usually recouped on paper suppliers (see chapter 6, section 6.2.2).

[v] Quantifications of the changes in reliability are own estimations, based on current reliability performances, the expected effects of the congestion scenario on reliability (expressed in terms of better/equal/worse), and the relative changes of the scenario on transit times. In chapter 5, no congestion scenario for rail transport was examined, since regarding the rail transport flow under study, this was not realistic. Hence, the autonomous expectations with respect to transit times and reliability are used. Reliability is quantified in the same manner as was done for the other modes.

[vi] A differentiated rate increase (i.e. per mode of transportation) was disregarded in order to reduce complexity of the scenario.

[vii] This was found after a brief telephone survey among paper wholesalers.

[viii] Nevertheless, one wholesaler claimed to consolidate shipments into loads that on average equal a 65 percent load factor of trucks.

[ix] Expressed in time, the lead times of magazine printers exceed those of newspaper publishers and printers; however in the case of magazines, the printing process takes longer (e.g. because the product is larger and requires binding).

[x] Data on the size and structure of the book printing sector were derived from KVGO (2001a), the interest group in behalf of among other things book printers. Both CBS and MarktSelect reported a much lower number of firms. However, the KVGO data are used, since it is expected that these are the most precise.

[xi] CBS (2001) reports almost the same size of the sector, but provides different data about the structure of the sector. Again, the KVGO data were preferred.

[xii] Data on the old paper industry were derived from the FNOI, the Association of Dutch Old Paper Industry, who provided a database with firms, classified according to firm size.

[xiii] Some 60 percent of all Dutch communities are organized in this co-operation.

[xiv] The amount of old paper that is collected and processed in the Netherlands mounts to some 2.5 million tons. The wholesalers that were interviewed, in sum process about 795,000 ton a year (i.e. about one third of the old paper market).

[xv] In the old paper sector, the share of transport costs differed between firms but the stated adaptations (both in numbers and in a qualitative sense) were very homogeneous.

PART IV: SYNTHESIS

8 Production, distribution, and transport costs: an evaluation

8.1 Introduction

The central research question that was addressed in this dissertation was: how will an increase in transport costs affect the organization of production and distribution of goods? The background of the study was the observation that transport-intensity of production and distribution in many sectors has increased and continues to do so, which is partly contrary to transport policy of many European governments. The literature suggests that logistical restructuring that has led to an increased transport-intensity can, among other things, be attributed to continuously falling transport costs (see chapter 1, section 1.4). Therefore, raising the cost of freight transport through for instance taxation was expected to result in less transport-intensive logistical operations.

In this chapter the main findings from the study will be evaluated in light of the purpose of the study. In section 8.2 the main effects of increased transport costs on the organization of production and distribution are discussed. Section 8.3 deals with the main factors that explain the relative importance of transport costs in decisions on the organization of production and distribution. Finally in section 8.4 the research methodology is evaluated.

8.2 Increased transport costs and the organization of production and distribution

In this study the organization of production and distribution was conceived as the typical way in which firms shape and manage their goods flows. In chapter 2 the key dimensions of production and distribution that have an impact on freight transport demand were identified. These dimensions either create a transport need (e.g. due to a spatial dispersion of activities) or set the conditions under which transport has to take place (e.g. through time pressure, affecting modal choice and opportunities for freight consolidation). In Table 8.1 these dimensions are summarized; they can be considered as the operationalized features of ‘the organization of production and distribution’.

Table 8.1: Key factors that affect transport demand and traffic flows generated by production and distribution activities

Logistical structure	Logistical control concept	Customer service
• number of nodes in the production and distribution network • locations of these nodes • nature of product and transformations during production (in value density, volume, etc.)	• number and locations of inventories • inventory levels and frequency/size of replenishment orders • required reliability and lead time of deliveries • position of the customer order decoupling point • availability of return cargo • division of responsibilities for transport and logistics	• order/delivery lead time • frequency of deliveries • delivery reliability

Transport costs were defined broadly. Both direct transport costs (i.e. carrier rates) and indirect transport costs (i.e. costs related to door-to-door transit times and the reliability of deliveries) were included in the analysis. The focus on these so-called generalized transport costs was justified on the basis of both theory and empirical evidence. Both suggest that shippers consider the sum of these costs rather than direct transport costs alone in transport decisions and decisions with transport implications. Below an analysis is made of the impact of increases in the above types of transport costs on production and distribution.

8.2.1 Effects of higher direct transport costs

Chapter 7 revealed that substantially higher direct transport costs will induce mainly two types of logistical adaptations: one, a higher efficiency of transport operations due to improved freight consolidation and two, a reduced need for transport services due to a lower frequency of replenishment orders. Higher direct transport costs will have only limited spatial effects. Decentralization of production or distribution generally is not feasible since the cost of duplicating production or distribution facilities, synergy losses, or increased overall inventory levels will by far exceed savings on transport costs[i]. This is in line with the results of a similar study (McKinnon, 1998: 105-106). Spatial effects will be restricted to smaller geographical market areas due to a loss of remote customers (i.e. a 'passive' decentralization of supply). In some situations also more local or regional sourcing is expected. These spatial effects of higher direct transport costs however are rather sector-specific. Smaller geographical market areas for instance were notably found in the old paper sector where higher transport costs would immediately translate into higher prices due to a low product value density.

Customer service levels in terms of order lead times and reliability of deliveries will not be changed if direct transport costs increase. Neither can a large-scale change in modal choice be expected. Concluding, a substantial increase in direct transport costs will not induce substantial changes in the organization of production and distribution. Except for specific sectors, the distances over which freight is shipped will generally remain unchanged. The main effect will be a more efficient movement of these freight flows, resulting in less vehicle-kilometers than is currently the case.

The types of adaptations to higher direct transport costs found in this study are basically the same as those that were mentioned in the literature, discussed in chapter 3 (see Table 8.2). One specific type of adaptation however was not found, namely a relocation of production or distribution facilities. Within the 10-year time horizon under study, relocation was found to be prohibitively expensive due to sunk investment in plants, machinery, distribution centers, warehouse equipment, and the like.

Table 8.2: Adaptations to higher direct transport costs in theory and in practice

Theoretical adaptation	**Found?**	**In which sector(s)?**
More decentral production or supply	√	paper wholesale (through swapping), book printing (*), binding (*), old paper wholesale (*)
More decentral distribution	√	paper production, paper wholesale, book distribution
Less specialized ('focused') production (or supply in general)	√	old paper wholesale (**)
Reduce shipment frequency/larger inventories	√	paper production, paper wholesale, newspaper printing, book printing, book distribution, old paper wholesale
Smaller area of sourcing	√	book publishing, book printing
Relocation of distribution centers	X	-
Relocation of production centers	X	-
Pass on in higher prices	√	all sectors

Notes: √ : found; X : not found; (*): due to a loss of remote customers, resulting in smaller geographical markets; (**): own interpretation; currently many trade flows are claimed to be caused by specialization but higher direct transport costs will lead to smaller market areas. Table based on chapter 3 and 7.

The relatively modest impact of higher direct transport costs on production and distribution is remarkable since a substantial transport cost increase was assumed (among other things a 50 percent increase in road transport costs, bringing real carrier rates back to the level from the mid 1970s). Logistical trade-offs are rather robust, indicating that considerations underlying the organization of production and distribution (e.g. flexible and fast supply or inventory minimization) are not easily adapted or replaced in the case of external pressure. Results of similar studies conducted in other industries and in other Western European countries suggest that the findings summarized in this section are not unique to the Dutch printed media industry (e.g. McKinnon, 1998; Muilerman, 2001; Musso *et al.*, 1999).

8.2.2 Effects of longer transit times and reduced delivery reliability

Congestion can lead to longer transit times and reduced delivery reliability and with that, raise the indirect costs of freight transport. To shippers, longer transit times and reduced delivery reliability will be more problematic than higher direct transport costs. Many firms in the printed media industry have reduced order lead times and have improved reliability of deliveries, similar to what Muilerman (2001) found in the food and parts services industry. Often their customers drive this trend since fast, frequent, and reliable replenishment deliveries allow them to reduce storage and inventory costs. Competition between suppliers therefore has focused on speed, flexibility, and

reliability of delivery. Increased congestion will endanger this practice. In turn, competitive positions of firms will be deteriorated, which in many sectors will lead to a loss of customers to competitors. In specific sectors, longer transit times are problematic for other reasons. In newspaper publishing for instance there is a very short time-to-market. Delivery times for newspapers are fixed whereas printing is postponed as long as possible in order to include the latest news. Delays due to congestion cannot be absorbed completely by reorganizing transport operations. This implies that adaptations in distribution or even production could be necessary in order to guarantee in-time delivery of timely products.

The main effects of longer transit times and reduced delivery reliability will be a loss in customers (in particular remote ones), a decentralization of production or inventory, adaptations in the planning and scheduling of production and distribution activities (in some cases even an extension of opening hours), and changes in transport operations (notably a switch to off-peak or overnight transport or contracting of more reliable carriers). The main difference with increased direct transport costs is that longer transit times and reduced delivery reliability will lead to a higher loss of customers and larger reductions in geographical market areas. Regarding other aspects of the organization of production and distribution, longer transit times and reduced delivery reliability, similar to higher direct transport costs, will have only a modest impact.

8.2.3 Mechanisms by which increased transport costs affect the organization of production and distribution

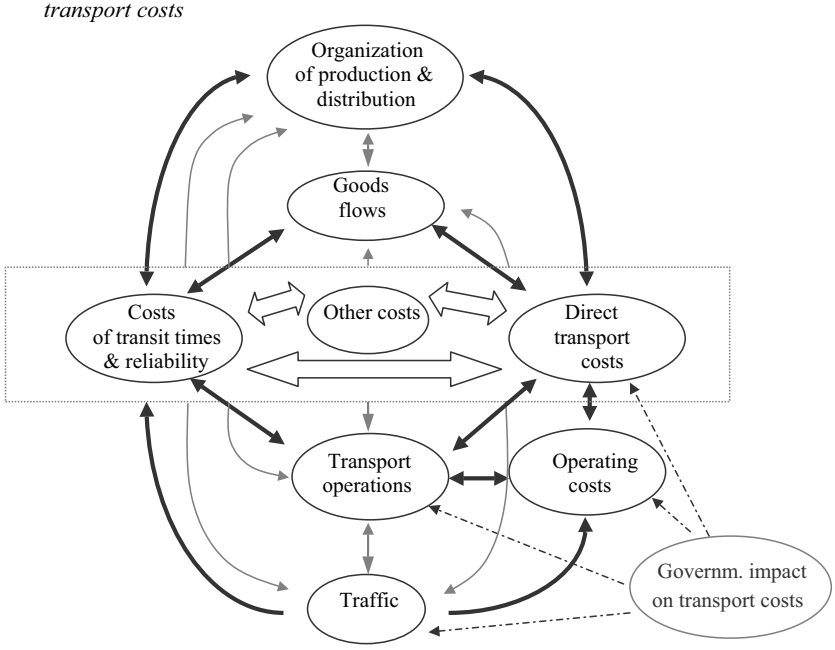
Generic relationships between the organization of production and distribution, freight transport demand, and transport costs

The relationships and interactions between the organization of production and distribution, freight transport demand, and transport costs appeared to be much more complex and less evident than what could be expected from the literature. In addition the conceptual framework that was developed in chapter 1 appeared to be useful to organize the study but oversimplified the aforementioned relationships and interactions. Nevertheless, based on the evidence that was gathered in this study, a generic model of the relationships between production, distribution, transport demand, and transport cost is developed that is depicted by Figure 8.1.

The Figure shows four types of arrows (gray, bold, block, and dotted ones) that represent specific types of relationship. *Gray* arrows show the relationships between the organization of production and distribution and freight transport. Basically, production and distribution activities generate goods flows, consisting of orders and shipments that flow between locations where goods are manufactured, kept in inventory, or sold. The actual physical movement of shipments involves the management of transport operations, which eventually results in traffic flows. The ratio of traffic flows to goods flows (e.g. expressed in load factors) only in part indicates the efficiency of transport operations. The reason is that at the level of production and distribution many of the conditions are set under which transport has to take place (see section 8.2). This

explains the gray arrow that links the organization of production and distribution with transport operations and traffic. Yet, the two-way arrows mean that relationships other than the above exist as well. Delayed traffic for instance may lead to adaptations in transport operations (e.g. rescheduling of departures) or even adaptations in the organization of production and distribution (e.g. higher safety inventories).

Figure 8.1: Interactions between production, distribution, freight transport demand, and transport costs



The *bold* arrows depict the role of transport costs in logistics management. Transport costs were found to have a two-way relationship with the organization of production and distribution. One, they play a (modest) role in decisions on the organization of production and distribution. Two, production and distribution generate a transport demand and thus lead to transport costs. Apart from that, transport costs depend on the way in which transport operations are managed, on operating costs (e.g. wages of truck drivers), and on speed and reliability of traffic (congestion for instance reduces productivity and raises the interest cost of in-transit inventory). Again, the relationships also may work the other way around. When transport costs are considered too high, this may lead to adaptations in transport operations (higher efficiency or negotiation of lower rates of carriers) or in operating costs (e.g. more fuel efficient engines).

The *block* arrows indicate that transport costs affect decisions about the organization of production and distribution through (implicit or explicit) trade-offs between a variety of factors. Direct transport cost and costs related to transit times and reliability of deliveries can also be traded-off against each other. In this context, in order to satisfy

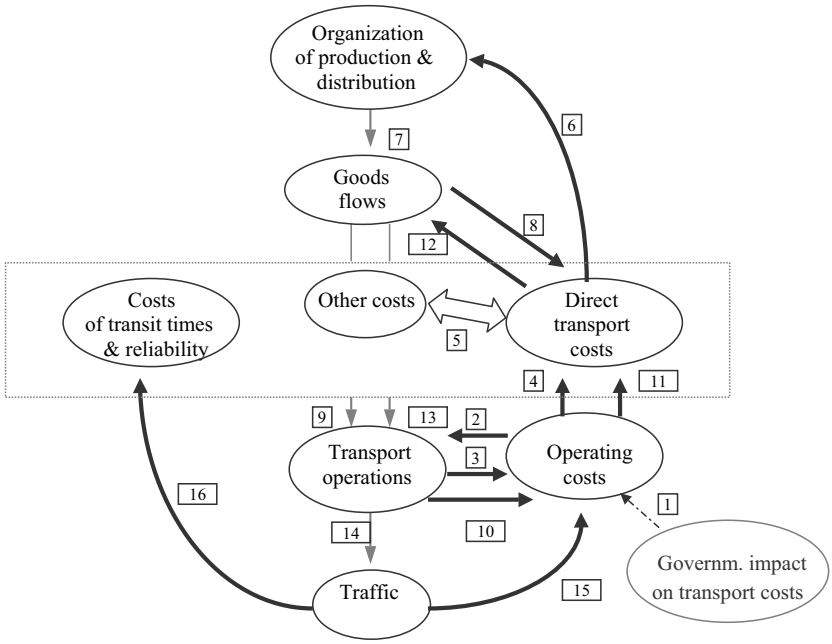
customers, firms often engage in competition on order lead times and delivery reliability, which however usually results in less time for consolidation and thus relatively high direct transport costs.

Finally the *dotted* arrows indicate the ways in which governments can affect transport costs. One, mainly through investment in infrastructure, governments affect average speed of traffic. In this way governments also indirectly affect operating costs of carriers (bold arrow). Two, governments can affect operating costs directly by for instance higher taxes on fuel or other input factors. Three, policy interventions may have an impact on transport operations, e.g. through stricter regulations on emissions of engines or through labor regulations[ii]. Four, policy interventions can directly affect shippers' transport costs (e.g. through the level of VAT taxes on transport services).

Mechanisms induced by increased transport costs

Based on the generic framework from Figure 8.1, the effects of policy interventions with an impact on transport costs can be modeled as a chain of sequential adaptations. Below the effects of increased direct transport costs are discussed as an illustration; these effects are also depicted by Figure 8.2.

Figure 8.2: Mechanisms induced by increased direct transport costs



Consider the implementation of higher taxes on fuel. The first effect will be that operating costs increase (1). Adaptations in transport operations such as an improved consolidation (2) will lead to reduced fuel use, which compensates the increased

operating costs in part (3). Nevertheless the fuel tax increase could lead to an increase in carrier rates (4). This subsequently may affect logistical trade-offs of shippers (5). This study demonstrated that in particular two types of logistical decisions are susceptible to higher direct transport costs, namely decisions on the frequency and size of replenishment orders and decisions to consolidate freight (either within the firm or in co-operation with other firms). If higher transport costs lead to a lower frequency of replenishment orders (6), fewer deliveries are required (7), which reduces direct transport costs (8). In addition the less fragmented goods flows may lead to higher load factors (9), lower operating costs (10), and lower total direct transport costs (11). Effects (9) through (11) can also be caused by increased consolidation on the part of the shipper, affecting goods flows (12) and for instance opportunities to employ large trucks (13). Finally all the above changes in transport operations may reduce the total amount of freight traffic and improve circulation (14), which may lead to a higher productivity of drivers (15) and reduced costs of transit times and delivery reliability (16).

8.3 Explanations for the relatively low importance of transport costs

The preceding sections demonstrated that at the level of production and distribution, transport costs do not have a large impact, with a few exceptions (e.g. the old paper sector). Explanations for this conclusion are provided below.

8.3.1 Factors affecting the relative importance of direct transport costs

In chapter 3, section 3.6.1, a number of factors were discussed that affect the extent to which firms are sensitive to (higher) transport costs. Yet it appeared that there is no consensus in the literature on what the main factors are. From the empirical evidence collected in this study, as well as other studies that were discussed, the following factors can be deduced that affect the relative importance of (increased) transport costs in decisions underlying the organization of production and distribution:

- differences in (unit) costs of logistical inputs and in cost structures of firms;
- sunk investment;
- product characteristics;
- market structure;
- consumers' willingness-to-accept price increases or quality losses.

Differences in (unit) costs of logistical inputs and in cost structures of firms

Relatively high costs of distribution facilities, plants, and inventories appeared to be an important barrier to reorganizing production and distribution in a less transport-intensive way. Although for instance a decentralization of production usually leads to lower total transport expenditures, it would inflate total logistical costs (e.g. due to a loss in economies of scale in production). Therefore one explanation for the relatively low importance of direct transport costs is a difference in the costs of logistical inputs such as inventory, real estate, warehousing equipment, and production facilities.

The cost of using a particular logistical input is a function of its unit costs (e.g. the cost of transport, storage, inventory, and risk of obsolescence calculated per pallet or containerload of product), multiplied by the amount of inputs employed. A relatively high importance of a logistical input such as inventory therefore can be based on high unit costs, high use of these inputs, or a combination. In this context this study found that transport costs usually have a low share in total costs due to relatively low unit costs. In particular cases such as in binding, transport costs are also low because firms make limited use of transport (due to operations in small geographical areas). In contrast, sectors that are specialized in distribution (e.g. paper and book wholesalers) have high transport costs. This characteristic makes adaptations in production and distribution in response to transport cost increases more easily lucrative.

Sunk investment

Increased direct transport costs usually do not lead to relocations. Although to many firms, transport costs are one of the factors affecting locational choice (see also Rietveld and Bruinsma, 1998), sunk investment often are a barrier to relocation if transport costs increase. These sunk costs relate to investment in for instance plants, machinery, and distribution facilities, and labor force[iii].

Product characteristics

The role of (increased) direct transport costs in the organization of production and distribution partly depends on several product characteristics, including commercial perishability and value density. In this context, a decentralization of inventories, which would lead to larger overall inventories, was only considered feasible in the case of newsprint and fast-moving books, because demand for these products is relatively stable. Commercial perishability of these products therefore is low, which reduces the commercial risks of higher inventories. It is likely that the same holds for physically perishable products, which were not found in the printed media industry.

Another relevant product characteristic that affects the extent to which direct transport costs are important in production and distribution, is value density. This is in line with the theory reviewed in chapter 3 (section 3.6.1). If for instance the price per ton of paper would be halved, resulting in a lower value density, total interest costs would also be reduced whereas transport costs would remain the same. This could favor larger orders and higher inventories in order to minimize total logistical costs. Product value density also affects the extent to which a transport cost increase leads to increases in final product prices. In this context, Dutch old paper wholesalers expected to sell less of their product in remote areas in Western Europe, since their product would become too expensive to paper producers.

Market structure

Customers of old paper wholesalers are generally quite flexible in their supplier choice, in contrast to other firms. Paper producers for instance are few in number due to concentration in this sector. A similar phenomenon was observed in old paper supply to

the Far East, where old paper is scarce. In these circumstances customers are forced to accept higher prices due to a transport cost increase. Although it is difficult to prove, firms that can easily pass on cost increases due to a strong market position may also have fewer incentives to adapt their operations in response to higher (transport) costs.

Consumers' willingness-to-accept price increases or quality losses

The relative importance of (increased) direct transport costs eventually depends also on priorities of and conditions set by final consumers. A good example is provided by the newspaper publishing sector. In this sector, direct transport costs are relatively high (i.e. 6 percent in the average price of a newspaper). If direct transport costs increase significantly, publishers have various options to avoid or absorb the transport cost increase. One option is to raise distribution lead times through an earlier closing of editorials. In this way more opportunities become available to consolidate shipments. Yet only one publisher considered this option feasible; the others expected that consumers would prefer a price increase to a quality loss due to a less timely product.

Concluding, falling direct unit costs of freight transport have enabled more transport-intensive operations, but this relationship does not hold in the opposite direction. This paradox can be explained in light of the above analysis. One, logistical costs other than transport have not remained constant but have increased. However, this is not only due to increases in their unit costs or a more intensive employment of these factors, but also by a growing awareness of firms of other logistical costs. Two, inertia in production and distribution inhibit adaptations to higher direct transport costs (e.g. sunk costs).

8.3.2 Factors affecting the relative importance of costs related to transit times and delivery reliability

The relative importance of (longer) transit times and (reduced) delivery reliability in decisions underlying the organization of production and distribution is basically related to the same factors as those that were identified in the previous section. Relatively high unit costs of logistical inputs such as inventory and warehousing have led to more just-in-time paper deliveries to book printers. Unreliable deliveries would be problematic because they could yield productivity losses to printers and could result in a loss of customers by paper suppliers. In other sectors firms fear to loose customers as well if they no longer can guarantee fast and reliable deliveries. Thus, eventually the relative importance of transit times and delivery reliability also depends on customers' willingness-to-accept quality deteriorations.

Again, longer transit times or reduced delivery reliability are not equally problematic to firms. An important explanation is market structure: firms with a high market dominance (e.g. paper producers or book distributors) generally are less worried to loose customers than firms that operate in more competitive markets. Other explanatory factors include product characteristics such as value density. Faster, more frequent, and more reliable delivery of old paper for instance is not feasible since savings on inventory costs would be far outweighed by increased direct transport costs.

The conclusion that the importance of direct transport costs and that of transit times and delivery reliability are affected by the same factors is not surprising. Transport decisions often affect both direct transport costs and costs related to transit times and delivery reliability (see chapter 3, section 3.2). In addition the two types of transport costs are often traded-off against each other. Reliable and fast deliveries are for instance important in book printing due the risk of lost sales and scheduling costs. Increased congestion would increasingly induce firms to spend more on direct transport costs in order to guarantee reliable delivery (e.g. an increased use of express delivery services). The identified factors that have an impact on the relative importance of transport costs (e.g. value density) eventually determine whether the trade-off will be in favor of direct transport costs or of a fast and reliable delivery.

8.4 Reflection on the research design and methodology

When doing research choices have to be made, for instance on what is included and what is left out of the analysis and how the object of analysis is studied. This section will evaluate the main choices that were made and will discuss their implications for the validity and generalizability of the findings. Section 8.4.1 will focus on the structure and process of the study whereas section 8.4.2 will address the research methodology.

8.4.1 Structure and process of the study

The foundations for the empirical analysis of this study were laid in chapter 4. Below four important decisions are discussed, namely:

- the organization of the analysis;
- the geographical limitation of the study;
- the industry selected;
- the transport cost increases examined.

Organization of the analysis

Separate analyses were made of carriers' responses to increasing costs of freight transport and those of shippers. The logic behind this choice was that decisions on the management of transport operations are typically outsourced to commercial carriers, whereas decisions on the organization of production and distribution are usually the responsibility of shippers. However this choice was to some extent artificial, since in practice shippers often still have a significant influence on transport operations (e.g. modal choice, scheduling of departure and arrivals, and vehicle choice). The semi-structured questionnaire used to explore shippers' responses to increased transport costs however left the respondents enough room to address changes in the management of transport operations (see chapter 7). The Delphi survey that addressed carriers' responses to increasing costs or congestion, however, disregarded shippers' influence on how carriers should adapt their operations. Given the fact that shippers differ in their priorities vis-à-vis direct transport costs and fast and reliable delivery (e.g. compare old paper wholesalers with virtual bookstores), the Delphi survey yielded only an indication of how carriers that work in behalf of the printed media industry will deal with

increased transport costs. The indicative character of the Delphi results is also caused by the fact that not all relevant types of transport that are found in the printed media industry were considered in the Delphi survey (e.g. paper transport by road was excluded).

Geographical limitations

The study focused on Dutch firms. National differences in taxes, land prices, transport costs, and other input factors were expected to complicate the analysis of the effects of higher transport costs on the organization of production and distribution. The focus on the Dutch situation seems justified in view of the importance of relative differences in these factors discussed in section 8.3. The outcomes of this study however are not restricted to what could happen on Dutch territory alone, since many firms operated throughout Western Europe. Although no explicit analysis was made of how *foreign* competitors will respond to increased transport costs, in section 8.2.1 it was concluded that at least the findings of this study regarding direct transport costs are comparable with those of similar studies and therefore have a more general validity. In addition, no indications were found that foreign firms could increase their market share in sales in the Netherlands in the case of a general transport cost increase. This may indicate that a transport cost increase will not provide foreign competitors a competitive advantage due to e.g. distribution concepts that are more efficient or less vulnerable to congestion. On the other hand, Dutch firms did not expect to capture more market share abroad, either. Thus, if transport costs increase comparably throughout Western Europe, firms will face equal problems[iv].

Industry selected

The third important choice relates to the industry that was examined. The focus was on a single industry in order to obtain in-depth knowledge. The printed media industry was selected because of differences in logistical characteristics in the various sectors that make up this industry. In this way, heterogeneity in logistical responses to transport cost increases could be assessed. Section 8.2 showed that in general terms higher transport costs will have rather homogenous effects in the sectors that were examined (e.g. limited spatial effects, little changes in modal choice, higher efficiency of transport operations). Moreover, as was discussed above, the outcomes of this study are comparable with those of other studies that assessed the effects of transport cost increases in other industries within and outside the Netherlands. The outcomes therefore do not seem unique to the Dutch printed media industry. At a more detailed level, differences between and within sectors could be observed. For instance in response to increased direct transport costs, paper wholesalers would adapt their inventory policy by decentralizing inventories whereas book distributors would order larger amounts of books. Thus, from a micro perspective, the conclusions of this study cannot immediately be translated to other industries. The identification of the main factors that affect the relative importance of transport costs in section 8.3, however, allows to formulate (generic) hypotheses on how other industries will respond to transport cost increases.

Transport cost increases examined

Only two transport cost scenarios were examined. These scenarios were rather extreme in that they assumed relatively large increases in direct transport costs and in delays. The reason was that the literature suggested that only substantial increases in transport costs will induce changes in the organization of production and distribution (see chapter 1, section 1.5). But how representative are the two transport cost scenarios of others?

The effects of increased direct transport costs were examined by assuming higher taxation, levied by means of a tax per ton-kilometer. Regarding the adaptations of carriers to higher taxation, the scenario is only indicative. Taxes that are based on for instance fuel or labor will probably induce responses of carriers that are oriented more directly on these cost elements. To shippers the ton-kilometer tax has a fixed component (i.e. weight) as well as a variable component (i.e. distance). Since carrier rates are to a large extent based on these two features, the scenario seems to be representative of many other types of direct transport cost scenarios. Obviously the magnitude of logistical adaptations will depend on the level of the transport cost increase assumed.

The second scenario, which assumed a substantial increase in transit times and reduced delivery reliability, is probably more representative because it focused on congestion, which can be regarded an *outcome* of various types of policy interventions. Two types of congestion were identified: congestion at nodes (e.g. ports) and congestion on links (e.g. roads). Per mode of transportation, only one type of congestion was examined. However for three out of six transport modes it was found that substantial delays due to other types of congestion was not very likely. For rail transport, no congestion scenario was examined because substantial delays due to increased congestion were not plausible on the transport flow under study[v]. Therefore only tentative conclusions could be drawn on the way in which rail carriers and users of rail transport would respond to congestion.

8.4.2 Research methodologies employed

The empirical evidence discussed in this study was notably collected by means of a Delphi survey and a stated adaptation survey. In chapter 4, 5, and 7, some limitations of these methodologies were discussed. These limitations will not be repeated here. Rather the focus will be on how useful these methodologies were in light of the central research question of this study.

Strengths and weaknesses of the Delphi survey

The limited knowledge base available on the way in which carriers might respond to higher taxation justified an empirical study in this area. The absence of substantially higher taxes that are introduced in the past and that could be evaluated was an important reason to rely on the opinions and expectations of experts. The outcomes of the Delphi survey are considered indicative rather than predictive for a number of reasons (see the preceding subsection and chapter 5). However as chapter 1 indicated, in the near future several Western European countries plan to implement tax increases on (road) transport. It would be valuable to examine to what extent the judgments of the Delphi panel

correspond with the effects of these tax increases. In this context, the Swiss ton-kilometer tax that was introduced in January 2001 (the so-called *Leistungsabhängigen Schwerverkehrsabgabe*) and that has led to a significant cost increase could serve as an interesting test case[vi]. Prior to the introduction of this tax freight transport by road increased by 7 percent yearly, whereas in 2001 road freight decreased by 5 percent (Nieuwsblad Transport, June 27, 2002). It would be interesting to investigate to what extent this effect has been induced by more efficient operations of carriers.

The empirical validation of the Delphi outcomes by means of an evaluation of the Swiss ton-kilometer tax however is only useful if a number of methodological issues are addressed. One, preferably the evaluation is conducted in a few years in order to correspond with the time horizon that was employed in the Delphi survey (i.e. 10 years). The panel mainly expected short-term adaptations of carriers, which implies that it is not necessary to postpone the evaluation until 2011. In the evaluation of the Swiss ton-kilometer tax an attempt should be made to assess to what extent the Delphi panel has underestimated long-term adaptations of carriers. Two, since chapter 5 showed that foreign carriers often have cost structures that differ from those of Dutch carriers, which may affect their flexibility and absorptive capacity, efforts are required to isolate the impact of for instance differences in geographical characteristics or regulations. These may namely affect decisions and trade-offs that carriers make and may be country-specific. If the differences between the Netherlands and Switzerland appear to be too large, an alternative tax increase that could be evaluated is the German kilometer tax for heavy trucks. A disadvantage however is that this tax, due to its nature, is not completely comparable to the tax increase that was assumed in the Delphi survey (i.e. a ton-kilometer tax instead of a kilometer tax). Finally, efforts have to be made to isolate the impact of autonomous trends in carriers' behavior, e.g. concerning investment and use of planning systems. In the Delphi survey this issue was dealt with by exploring autonomous trends in transport operations in the autonomous scenario.

Strengths and weaknesses of the stated adaptation survey

Shippers' responses to increased transport costs were assessed by means of a survey among (logistics) managers in the printed media industry. Case studies were conducted prior to the survey in order to specify the hypotheses that were deduced from the theory (see chapter 6). The survey demonstrated however that the effects of external pressure on logistics management are difficult to predict. Empirical research therefore has yielded more insights than the literature.

The empirical research has yielded a great variety of adaptations of firms to increased transport costs, although they could be reduced to a few more general adaptations. If one is interested in maintaining this richness of insights, mathematical modeling (i.e. the main alternative to a stated adaptation survey) is not adequate because it focuses on a limited number of variables. This implies that the outcomes of modeling will only be indicative. Although the output of the SMILE model discussed in chapter 2 and 3 in terms of the effects of higher direct transport costs are similar to what was found in this study (i.e. notably adaptations in transport operations and order frequency), it ignores

for instance the influence of many relevant factors on logistics management such as market structure. Dynamics in logistics management are more complex than that the model suggests. In this context, McKinnon concludes that theoretical modeling of the effects of increased direct transport costs "(fails) to take full account of the range of traffic-reduction options available to firms" (op.cit., 1998: 106). To policy makers, the indicative character of model studies may be sufficient to evaluate policy options. To scientists who aim to understand the reasons behind the effects of transport cost increases however it is not completely.

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[i] In book distribution another reason was that alternative technology that enables decentral printing (i.e. printing-on-demand) was not considered mature enough to adopt.

[ii] Sometimes developments in transport operations are a motive for policy intervention; for instance the sharp increase in fuel taxes in 1999/2000 led to some compensation for carriers. Hence the relationship between policy interventions and transport operations could be a two-way relationship. However for the purpose of this study such relationships are left out of consideration, because they have only an indirect relationship with the topic of the study.

[iii] In his dissertation, Pen (2002) for instance found that personnel often are an important barrier to relocation. Relocating therefore might imply that firms have to find new personnel.

[iv] Only if there are differences in the transport cost increase between countries can different responses of shippers be expected.

[v] The main reason was that substantial investment will be made in infrastructure on the trajectory considered (i.e. Rotterdam-Milan).

[vi] For a single haul over less than 300 kilometers, the levy would be between € 98 and €140 (depending on the environmental performance of the engine). Assuming an average rate in international road haulage of € 1, this means a 33 to 47 percent cost increase.

9 Reflection and recommendations

9.1 Introduction

In this final chapter the main conclusions and implications of the study are discussed. Section 9.2 summarizes the main conclusions in light of the basic purpose of the study; their policy implications are discussed in section 9.3. Section 9.4 discusses the main findings regarding theory and formulates recommendations to improve the theory. Limitations of the study and suggestions for future research are treated in section 9.5.

9.2 Main conclusions

Enabled by continuously falling transport costs in the last decades, shippers throughout Western Europe have optimized their production and distribution by substituting expensive input factors such as inventories and plants by cheap transport. This is one of causes of the continuous growth in freight transport, which has not only yielded economic gains but also resulted in increased pollution, traffic unsafety, and congestion.

Increased transport costs were expected to lead to less transport-intensive logistical operations. This study assessed the impact of increases in both direct transport costs (i.e. carrier rates) and indirect transport costs (i.e. costs due to longer transit times or reduced delivery reliability) at three levels of logistical decision-making: (a) the functional structure and spatial pattern of production and distribution networks; (b) the scheduling of product flows within these networks; and (c) transport operations. The first two levels together were defined as the organization of production and distribution.

In most sectors, transport cost increases will have no or only a marginal impact on the first level of logistical decisions. In contrast, higher transport costs have some impact on the second level, since many firms foresee a reduced frequency of orders. The main effect of increased transport costs however will be a more efficient use of transport resources. Thus, referring to the title of this dissertation (freight transport at any price?) it can be concluded that at the level of production and distribution where transport demand is created and conditions are set under which transport has to take place, logistics has its own dynamics, largely irrespective of the price of freight transport. The opposite however holds regarding transport operations, where transport costs do matter.

9.3 Policy implications of the main conclusions

Of the four paths in transport policy that are aimed at reducing the negative effects of freight transport (i.e. a modal shift; technological innovations; a higher transport efficiency; and transport conservation; see chapter 1), transport efficiency seems to be the most feasible. Raising transport costs will induce adaptations by carriers and shippers that, in one way or the other, contribute to an improvement of vehicle utilization. Transport cost increases will also lead to a better use of infrastructure capacity, since carriers and shippers expected to schedule more transport outside peak hours. It is therefore recommended that the policy path of transport efficiency gets priority. Higher taxation is an adequate policy instrument in order to provide carriers and shippers an incentive to raise efficiency of their transport operations; it is not very likely that in particular shippers will do this voluntarily. To them, transport costs generally are of minor importance, which currently makes efforts to improve transport efficiency not attractive. A complementary policy option could be continuation of the 'Transactie Scans'. Partly subsidized by the ministry, shippers' logistical processes are analyzed in order to identify ways of reducing the number of vehicle-kilometers driven by road at low additional costs (see Ministerie van Verkeer en Waterstaat, 2001b). The subsidies, like increased transport costs, eliminate a barrier to shippers to raise transport efficiency, since they reduce the relative cost of efforts that are needed for this purpose. Facilitating a higher transport efficiency however at the same time creates a policy dilemma, since it reduces transport costs and with that, provides shippers with fewer incentives to reduce transport demand by for instance a lower order frequency.

The potential of a modal shift is rather limited, but can be improved if governments shape the conditions that make multimodal transport more attractive vis-à-vis road transport. These conditions are related to the two main barriers to a modal shift. The first barrier is that additional costs and delays occur due to transshipment and pickup and delivery by road. Continuation of investment in multimodal transshipment centers therefore seems adequate because it lowers transshipment costs. The second barrier to a modal shift is an increase in other logistical costs since larger shipments are required. This barrier can be reduced by stimulating innovations in multimodal transport that enable delivery of small shipments (e.g. pallets). The experiment with short-distance distribution of freight by inland navigation ('Distrivaart') seems to offer potential, also because it is initiated by shippers. This experiment therefore deserves full support of the ministry of transport, as well as similar experiments that might be started in future.

The study finally demonstrated that transport conservation is not a very effective path in transport policy. Although in some sectors, production and distribution are organized in such a way that minimizes transport demand, a less transport-intensive organization of production and distribution can hardly be induced by means of policy interventions. In this area, objectives of shippers and the ministry of transport are too divergent.

Because of the qualitative nature of the study, no conclusions can be drawn about the relative effectiveness of the two policy scenarios that were examined (i.e. higher taxation versus insufficient infrastructure provision, resulting in more congestion).

Increased congestion however will yield several responses of shippers that only lead to more traffic, e.g. a more intensive use of express delivery and more direct deliveries instead of multi-drop deliveries. Apart from that the study did not (and neither intended to) address the balance between increasing costs to shippers and carriers as a consequence of (adaptations to) higher transport costs, and the reductions in social costs due to less external effects of freight transport. Eventually, politicians should evaluate these costs and benefits of increased transport costs. The costs of the two policy scenarios however should not be overestimated. Both carriers and shippers appear to be quite flexible in coping with policy interventions in freight transport. In addition, transport costs have generally a low share in prices of final products, indicating that no large effects have to be expected for final consumers. The macro-economic effects of higher transport costs therefore could be low. In this context, in a model study, NEI found that a 24 percent increase in (direct) road transport costs would have an insignificant effect on employment of BNP (NEI, 2001: 51). Concluding, politicians should critically evaluate often stated but overstated claims of interest groups on behalf of carriers and shippers that increasing congestion has led to high economic costs, or that increased taxation would have no effect other than to inflate prices.

A final advice to policy makers is to base transport policy not exclusively on investment in infrastructure. Announcements by the cabinet Balkenende-I indicated a return to traditional transport policy with a major emphasis on investment in (road) infrastructure and limited attention to demand regulation by means of, among other things, taxation (even a *lowering* of fuel taxes was announced). At the time of finalizing this dissertation (October 2002), however, this cabinet fell. It was unknown what the new cabinet would do. If it would adopt the plans of the Balkenende-I cabinet, this will not induce shippers to raise the efficiency of their transport operations. Rather, it will accommodate a further increase in (notably road) traffic, since many firms in the printed media industry anticipate logistical restructurings that require more transport (see chapter 6). Clearly, this will barely contribute to the policy goal of reduced negative effects of freight transport. For this purpose, investment in roads should be coupled with higher taxes.

9.4 Theoretical implications

9.4.1 Main conclusions

A main part of the theory that was used in this dissertation originated from the logistical discipline. To a lesser extent, insights from transport economics were used. Below the main conclusions of this study in light of these two scientific disciplines are discussed.

Conclusions regarding logistical theory

The logistical discipline was chosen as a starting point for the analysis of how shippers organize their production and distribution because of its broad scope, which distinguished it from more specialized theoretical bodies such as location theory. Nevertheless logistical theory, in particular the supply chain management (SCM) paradigm was criticized in chapter 3 for a number of reasons. Below these criticisms are evaluated in light of the empirical evidence found in the printed media industry.

The first comment on the SCM paradigm was that it does not recognize heterogeneity in logistical behavior of firms (both between and within sectors and industries). In practice however heterogeneity appears to be a very relevant issue, which was not only found in the analysis of the printed media industry but also in empirical studies in other industries. One explanation for heterogeneity that was found in this study was a difference in the maturity of logistics management. For instance, in book publishing logistical awareness had only recently emerged. In part this is caused by vertical price regulations that have led to a lower cost awareness than what was found in other sectors (e.g. old paper). Other theoretical sources of logistical heterogeneity were explored in chapter 3, section 3.6.1. Table 9.1 shows to what extent they explained logistical heterogeneity in the printed media industry.

Table 9.1: Sources of logistical heterogeneity found in the printed media industry

Theoretical explanation	**Sector**	**Appearance**
Core competencies approach	book retail	virtual and traditional bookstores employ different resources, rely on other sources of competitive advantage, and employ other distribution structures
	paper wholesale	both horizontal and vertical integration were found, offering different opportunities for e.g. 'swapping' both highly automated and traditional warehousing
Product-market characteristics	book distribution	publishers of general books supply to many bookstores, usually via wholesalers; publishers with as less dispersed customer base distribute themselves
	all sectors, except binding and book distribution	the number of stated adaptations to increased direct transport costs was related to value density/share of transport costs in total costs
		the number of adaptations to increased congestion was related to commercial perishability/time pressure
Cognitive limitations & opportunistic behavior	book publishing	the number of adaptations in the stated adaptation survey was related to differences in perception of transport costs
	all sectors	differences in perceived problems due to scenario 2; firms with large market power (e.g. paper producers) seem less inclined to adapt than others that feared a loss of customers (e.g. paper wholesalers)
Path-dependency	all sectors	paper wholesalers and printers face low flexibility regarding supplier choice due to specialization of paper producers, in contrast to for instance book publishers and customers of paper wholesalers
Locational choice	paper production, old paper	differences in nearness to alternative transport networks, which affects modal choice as well as the flexibility in the case of increased congestion

Related to the above criticism, differences in logistical goals and market power indicate that SCM is not a logical final stage in the logistical development of firms. Some firms are primarily concerned with cost minimization whereas others focus on flexibility, speed, and reliability of their deliveries. Some firms can force their suppliers to adapt logistical processes to their demands whereas other firms simply have to accept the suppliers' conditions. SCM should therefore be considered as one of the possible paradigms in contemporary logistics management rather than 'the one and only'.

The second criticism on SCM theory in chapter 3 was that no inferences could be made about the logistical effects of higher transport costs. In this respect, this study has contributed to the theory in two ways. One, it has revealed the areas within logistics management where an increase in transport costs may have an effect. Two, it has identified the main factors of influence on the relative importance of transport costs in various logistical trade-offs (see chapter 8, section 8.3). These factors provide a foundation to differentiate firms according their sensitivity to transport costs or to other characteristics of logistics management.

The third criticism on SCM theory focused on the plausibility of two of its assumptions: one, that of voluntary co-operation between supply chain participants and two, the claimed importance of logistics to firms. Only in one sector evidence was found of voluntary logistical co-operation, namely in virtual book retail. In this sector various supply chain participants benefited from for instance information exchange. In all other sectors however logistical co-operation was compelled rather than voluntary. The assumption of an increased importance of logistics management was actually validated by this study. In several sectors, logistical awareness had only just emerged whereas in others, no evidence was found that logistics management had decreased in importance.

The fourth and final criticism on SCM was its limited empirical base. The outcomes of this study suggest that although some of the trends that are central to the SCM theory (e.g. inventory minimization, increased competition on customer service) are also found in the printed media industry, the printed media industry is neither a good example of SCM (except for virtual book retail), nor a sector in which SCM is likely to emerge like it emerged in for instance the automotive industry. In this way, this study has revealed some boundaries of the SCM theory. Therefore, a richer set of theories is required to analyze and understand logistical behavior.

Conclusions regarding transport economics

In chapter 1, the need to incorporate the costs of environmental damage, congestion, and other external effects in transport costs was discussed from an economic perspective. The argument was that suboptimally priced transport will lead to an overconsumption of this resource and hence creates allocative inefficiencies. Up to now, economic research in this field has primarily focused on designs of optimal pricing schemes. Little knowledge is obtained on the appearances of allocative inefficiency in transport.

This study showed that inefficiencies are notably found in the management of transport resources. ‘Internalizing’ the external social costs of freight transport would induce carriers and shippers to make more efforts to raise load factors. Carriers for instance were expected to take more time to acquire return cargo, whereas shippers expected to raise load factors by a higher level of shipment consolidation. The latter factor would in part work through inventory policy, since larger volumes of raw materials or inputs would be ordered. As a consequence of these adaptations, the magnitude of external effects will probably decrease. However, other logistical decisions in which transport costs (could) play a role appeared less flexible. Locational choice and centralized

production and distribution facilities for instance require significant investments that are sunk for periods beyond 10 years. Suboptimally priced transport may have biased these decisions and consequently have led to allocative inefficiencies. Yet, implementing 'optimal' pricing schemes will not provide a solution. The main conclusion of this study from a transport economic perspective is therefore that 'optimal' or 'efficient' pricing in transport has its limitations.

9.4.2 Recommendations

Recommendations regarding logistical theory

Logistical theory could be improved if the notion of logistical heterogeneity is accepted. Based on empirical research, efforts should be made to reveal the dominant paradigms in modern logistics management, of which SCM is one. In this context, the typology of logistical configurations that Vermunt and Binnekade (2000) have suggested, may serve as a starting point. The factors that explained the relative role of transport costs and that were identified in chapter 8 (section 8.3) can explain (in part) why firms have chosen a logistical strategy that corresponds with a particular paradigm.

Finally, it is recommended that in logistics theory as well as empirical work, more often a multidisciplinary theoretical framework is used, like the one employed in this study. Logistics management namely relates to a multiplicity of issues that cannot completely be understood by only looking at logistical processes and considerations.

Recommendations regarding transport economics

Transport economists generally consider transport markets inefficient because first-best conditions of, among other things, a reflection of all relevant (marginal) costs in prices are not fulfilled. Yet this assumption is made too easily. Suboptimally priced transport may not automatically lead to allocative inefficiency because it could compensate for suboptimal prices in other markets that generate or affect transport demand (e.g. real estate or labor) (Runhaar, 2001b: 35). In addition, section 9.2.1 demonstrated that at the level of logistics management some allocative inefficiencies are persistent because logistical decisions cannot be reversed easily or only at high costs (e.g. locations). Therefore, it is recommended that more research is devoted to assessing the magnitude of allocative inefficiency caused by the current freight transport prices. Subsequently, an estimation should be made of the welfare gains of internalization by means of higher taxation. This study namely indicated that logistical adaptations to increased transport costs will have their price (e.g. higher inventory costs). In this way, transport economists can be a better support to political decision-makers than that they are now. In this context, the following quote may be illustrative: "It has been a commonplace event for transportation economists to put the conventional diagram on the board, note the self-evident optimality of pricing solutions, and sit down waiting for the world to adopt this obviously correct solution. Well, we have been waiting for seventy years now [..]. Why is the world reluctant to do the obvious?" (Lave, 1995: 464-465).

Finally, another interesting and relevant issue is to explore or develop alternative or 'second-best' policy instruments to reduce allocative inefficiencies in transport operations or in the use of transport services. An example of transport research in this field is that of Roos (1987), who assessed the effectiveness of local property taxes as an alternative to taxes for the purpose of reducing congestion.

9.5 Limitations of this study and suggestions for future research

Throughout chapter 8 as well as this chapter, several limitations to the generalizability of the results of this study were discussed that will not be repeated here. Below only the main limitations are summarized, on the basis of which recommendations for future research are formulated.

One, the results of this study are primarily indicative. The first reason is that not all market segments in freight transport were included in the analysis whereas the examination of production and distribution decisions by shippers was restricted to the printed media industry. In general terms however the results of this study are comparable with the outcomes of the few other studies that have been conducted in this area. In view of observed differences between firms when it concerns the specific type of adaptations to increased transport costs, as well as the recommendation to pay more attention to heterogeneity in logistics, future research could repeat this study among a larger pool of firms inside and outside the Netherlands.

Two, the study outcomes are limited due to the time frame employed. Logistics management was studied in its present form as well as how it is expected to develop in the next decade. Yet, theory and empirical evidence showed that logistics management has shown a continuous evolution. Not certain is which logistical paradigm(s) will be the dominant ones in future or how this will affect the role of transport costs. This will also depend on how costs of logistical factors such as land and interest will develop. Classical location theories of for instance Von Thünen (1842) and Weber (1909) were primarily concerned with transport costs and ignored other costs, which can be explained by the stage of logistics professionalization then and differences in input costs. The opposite is often found in modern logistics. Research into future trends in logistics and implications for the role of transport costs is therefore recommended.

Three and finally, uncertainty has remained about long-term effects of structural transport cost increases on locational choice, centralized production, and specialized ('focused') production. Although theory suggests that they may become variable in the long term (e.g. Rietveld and Bruinsma, 1998), two interesting topics for further research are:

- what exactly is the time horizon for such elements to become flexible again?
- to what extent will a structural transport cost increase be absorbed or mitigated by other adaptations, and what will that imply for the need of relocation, decentralization, or more diversified instead of focused production?

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Mr. R. Erdmann (Aspa Office Equipments).

Mr. G. Jager (Research Department/Royal Associaton of Book Retailers-KVB).

Mr. H. Koning (director FNOI, Association of Dutch Old Paper Industry).

Mr. T. van der Meer (Distribution Center Wolters Kluwer).

Mr. B. Mons (Trade Commission Royal Dutch Association of Book Retailers-KVB).

Mr. A. Noppen (Royal Dutch Association of Printing and Allied Industries-KVGO).

Mr. G. Rosier (Van Heezik, transport company).

Mr. E. Timmermans (Dutch Publishers Association NUV).

Mr. H.P. Wortman (Commission Logistics Paper Industry of the Association of Dutch Paper and Cardboard Producers VNP).

ANNEXES

Annex I: Participants Delphi survey

Mr. J. Aerts (Railion Benelux)[c]

Mr. G.M. Bertholet (terminal manager, Rail Service Center Groningen)[c]

Mr. P.M. Blok (KPMG-BEA)[a, c]

Prof. P.H.L. Bovy (scientific director, TRAIL Research School)[a]

Mr. J. Brouwer (Spliethoff's Chartering Office)[d]

Dr. D.A. van Damme (Technical University of Eindhoven)[a]

Mr. H. Dijkman (Central Planning Bureau; CPB)[a, b, c]

Mr. R. Erdmann (director e-commerce/marketing, Aspa Office Equipment)[a]

Mr. R. Eijgendaal (EVO; shippers' interest group)[a]

Mr. K.H.L. Gerretse (general manager logistics & transport, Corus Logistics and Transport)[b]

Mr. C. de Geus (Danzas Rail Cargo)[c]

Mr. J. Groeneveld (Trailstar)[c]

Mr. A. Guinier (director, ECSA)[d]

Mr. L.A. de Haas (Olympic Airlines)[e]

Mr. C. den Hartog (AVV; Transport Research Center)[b]

Mrs. M. van Helvoirt (CBRB; interest group in inland navigation)[b]

Mr. G.K.H. Hes (former director Tell Circle Consultancy)[a]

Mr. M.J.A. Hijne (logistics manager, Loders Croklaan)[a, b]

Mr. M. van het Hoff (sales department, Singapore Airlines Cargo)[e]

Mr. Y. Hoogland (Panalpina)[e]

Mr. P. Hoppenbrouwers (director corporate network control, Koninklijke Frans Maas Groep)[a]

Mrs. C.A. de Jongh (director, Railforum Nederland)[c]

Mr. E.R. Kampinga (NIWO; interest group in road haulage)[a]

Mr. P. Keemink (Interforest terminal Rotterdam)[d]

Mr. R. Klatten (sales department, Wim Bosman Groep)[a]

Dr. M.J. Kleijn (consultant, NEA)[a]

Dr. H.A. van Klink (Industry Knowledge Team, Rabobank International)[d, f]

Mr. J.W. Konings (OTB; Delft University of Technology)[a, b, c]

Mr. R. Lenoir (KPMG-BEA)[a]

Ms. L.M. van der Lugt (Erasmus University Rotterdam/ETECA)[d, f]

Mr. R. Maas (warehouse and distribution manager, Polynorm)[b, c]

Mr. M. van Muijen (ZHM; environmental group)[b, c]

Mr. J. Nater (ECT)[b, f]

Mr. G.J. Nieuwenhuis (manager international sales intermodal transport, Railion Benelux)[c]

Mr. M. Page (director, Drewry Shipping Consultants)[f]

Mr. K. Pals (Rhinecontainer)[b]

Mr. M.H.O.M. Philips (EVO; shippers' interest group)[b, c]

Mr. W. Ploos van Amstel CPIM (KPMG Consulting/Free University of Amsterdam)[a]

Mr. D. Pol (Business Development, Wijnne-Barends)[d]

Mr. H. Pols (director NPRC, Cooperation of Dutch bargemen that are active on the Rhine)[b]

Mr. P. Poppink (TLN; interest group in road haulage)[a]

Mr. M. Quispel (consultant, NEA)[b]

Mrs. drs. H. van Raalte (director, HR Logistiek)[a, b]

Prof. P. Rietveld (Free University of Amsterdam)[a, c]

Mr. D. Rouwenhorst (AVV; Transport Research Center)[a]

Prof. C.J. Ruijgrok (department of Logistics, TNO-Inro)[a, b, c]

Mr. H.E. Runia (KNV; interest group in road haulage)[a]

Mr. B. Schuurman (logistics manager, Intergamma)[a]

Mr. M.R.J. Speldenbrink (Hartel Shipping and Chartering) [d]

Mr. J.H.M. Steijn (VNO-NCW; shippers' interest group)[b, c]

Mr. J. Teekman (director cargo acquisition, Wagenborg Shipping)[d]

Mr. H. de Valk (revenue manager Europe, Martinair Holland)[e]

Mr. J. Verlaan (JGT De Jong & Graus)[a]

Mr. S. van 't Verlaat (director, Information Center Shortsea Shipping)[d]

Prof. A.J. Vermunt (University of Brabant/NDL/KMA)[a]

Mr. S. Vonk (Amasus Chartering)[d]

Mr. H. Vrenken (consultant, NEA)[c]

Mr. W. Vrijland (director supply chain technology, Dow Benelux)[b, c]

Mr. H.W.E. Vroon (AVV; Transport Research Center)[c, e]

Mr. K. de Waardt (director, VERN; interest group in road haulage)[a]

Mr. E. Wagenborg (director, Wagenborg Shipping)[d]

Mr. A.P. van den Wall Bake (director, Bake Business Support)[b]

Mr. G. van den Wall Bake (route development Asia, Transport Management International)[e]

Mr. B. Wiegmans (KPMG-BEA)[b]

Mr. W. de Wit (vice president Industry Affairs, Martinair Holland)[e]

Dr. P. Zwaneveld (department of Logistics, TNO-Inro)[c]

Two experts indicated that they wanted to stay anonymous.

Legend:

[a]: Part research road haulage

[b]: Part research inland navigation

[c]: Part research rail transport

[d]: Part research short sea shipping

[e]: Part research airfreight

[f]: Part research deep sea shipping

Annex II: Detailed outcomes Delphi survey

Results part research on road haulage

The scenarios

Scenario 1: Introduction of ton-kilometer taxes (road haulage)
In this scenario, the following occurs: the European Commission decides to pass all social costs that are caused by freight transport on to freight carriers. As from the end of 2001, freight carriers pay for all costs they cause, including the cost of infrastructure, environmental pollution, and traffic victims. Passenger transport will not be levied for the moment. The social costs are charged by means of an additional tax per ton-kilometer that is levied on all freight transport from, to, or within the EU. The charge will amount to 5.54 €-cents per ton-kilometer for road freight.

For container transport from Rotterdam to Duisburg, this scenario means a cost increase of €168.- per container (given an average load factor of 12.6 ton), which coincides with 30 percent of the current revenue per container.

Scenario 2: Increased congestion (road haulage)

In this scenario, congestion increases dramatically, as the planned investment in roads appears to be insufficient to accommodate the growth in both passenger and freight transport. With that, the number of queues as well as their length increase. Between 2001 and 2010, the average speed on motorways drops to 50 km/h. Average speeds are higher outside rush hours; during rush hours however traffic sometimes stands still for almost an hour or more.

We assume that container haulage from Rotterdam to Duisburg will take at least 80 minutes longer, which means an increase in the door-to-door transit time of 22 percent compared to currently (including loading and discharge).

Q 1: How likely do you consider the following developments in container haulage from Rotterdam to Duisburg between 2001 and 2010?

N = 26	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	19%	62%	8%		8%	4%
2. Carriers will raise rates in response to the increasing demand for transport services	12%	12%	54%	4%	4%	15%
3. Trips will take longer due to congestion; carriers will not undertake measures to reduce these delays	4%	12%	46%	15%	15%	8%
4. The use of trip and route planning systems will increase	23%	54%	15%			8%
5. Load factors of trucks will improve because carriers will schedule trips more in advance in co-operation with shippers	12%	50%	27%		8%	4%
6. Carriers will acquire more return cargo	8%	65%	23%			4%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	12%	58%	19%	8%		4%
8. More often, small or unprofitable cargoes will be outsourced	8%	46%	27%		8%	12%
9. Carriers will more often than now postpone departure for higher load factors or return cargo	8%	8%	73%	8%		4%
10. Carriers will use larger trucks		42%	27%	19%	8%	4%
11. Maintenance and (replacement) investment will be postponed more frequently		8%	54%	19%		19%
12. Carriers will reduce fuel use (e.g. more economical engines)	8%	69%	12%	8%		4%
13. Carriers will more often change departure times in order to reduce transit times	4%	58%	27%	8%		4%
14. Carriers will more often change departure times in order to guarantee delivery reliability	4%	65%	23%	4%		4%
15. Carriers will drive more often overnight	4%	65%	19%	4%	4%	4%
16. Carriers will choose other routes	4%	35%	42%	4%	4%	12%
17. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	15%	50%	12%	12%	4%	8%
18. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation		42%	35%	8%	8%	8%
19. The number of large firms will increase (e.g. via mergers)	19%	46%	19%	4%		12%

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in container haulage from Rotterdam to Duisburg between 2001 and 2010? (continued)

N = 26	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	58%	38%				4%
2. Carriers will raise rates in response to the increasing demand for transport services	12%	15%	46%	4%		23%
3. Trips will take longer due to congestion; carriers will not undertake measures to reduce these delays	4%	8%	54%	15%	8%	12%
4. The use of trip and route planning systems will increase	31%	50%	8%			12%
5. Load factors of trucks will improve because carriers will schedule trips more in advance in co-operation with shippers	19%	42%	27%		4%	8%
6. Carriers will acquire more return cargo	19%	58%	15%			8%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	27%	38%	15%	8%	4%	8%
8. More often, small or unprofitable cargoes will be outsourced	27%	35%	19%		4%	15%
9. Carriers will more often than now postpone departure for higher load factors or return cargo	12%	8%	65%	4%		8%
10. Carriers will use larger trucks	19%	23%	27%	19%	4%	8%
11. Maintenance and (replacement) investment will be postponed more frequently	4%	12%	50%	15%	4%	15%
12. Carriers will reduce fuel use (e.g. more economical engines)	15%	65%	4%	8%		8%
13. Carriers will more often change departure times in order to reduce transit times	12%	54%	27%			8%
14. Carriers will more often change departure times in order to guarantee delivery reliability	15%	54%	27%			4%
15. Carriers will drive more often overnight	12%	69%	12%			8%
16. Carriers will choose other routes	15%	31%	38%	4%		12%
17. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	23%	46%	4%	8%	8%	12%
18. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation	8%	38%	35%	4%	4%	12%
19. The number of large firms will increase (e.g. via mergers)	12%	50%	15%	4%		19%

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in container haulage from Rotterdam to Duisburg between 2001 and 2010? (continued)

N = 26	**Scenario 2** How likely do you consider this development between now and 2010 if scenario 2 eventuates (increased congestion)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	19%	73%				8%
2. Carriers will raise rates in response to the increasing demand for transport services	12%	19%	38%	4%		27%
3. Trips will take longer due to congestion; carriers will not undertake measures to reduce these delays	4%	12%	42%	27%	4%	12%
4. The use of trip and route planning systems will increase	42%	31%	15%			12%
5. Load factors of trucks will improve because carriers will schedule trips more in advance in co-operation with shippers	31%	27%	27%		8%	8%
6. Carriers will acquire more return cargo	4%	77%	12%			8%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	12%	62%	12%	8%		8%
8. More often, small or unprofitable cargoes will be outsourced	27%	35%	19%		4%	15%
9. Carriers will more often than now postpone departure for higher load factors or return cargo	4%	23%	62%	4%		8%
10. Carriers will use larger trucks	15%	42%	23%	8%	4%	8%
11. Maintenance and (replacement) investment will be postponed more frequently		4%	65%	12%	4%	15%
12. Carriers will reduce fuel use (e.g. more economical engines)	12%	62%	12%	8%		8%
13. Carriers will more often change departure times in order to reduce transit times	50%	31%	12%			8%
14. Carriers will more often change departure times in order to guarantee delivery reliability	62%	23%	8%			8%
15. Carriers will drive more often overnight	58%	35%				8%
16. Carriers will choose other routes	38%	27%	19%			15%
17. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	27%	35%	8%	12%	4%	15%
18. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation	8%	50%	23%	4%	4%	12%
19. The number of large firms will increase (e.g. via mergers)	15%	46%	15%	4%		19%

Due to rounding off, totals may sometimes be more or less than 100%

Q 2: Which rates, transit times, and delivery reliability do you expect in container haulage from Rotterdam to Duisburg in 2010?

Figure 1: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 26)

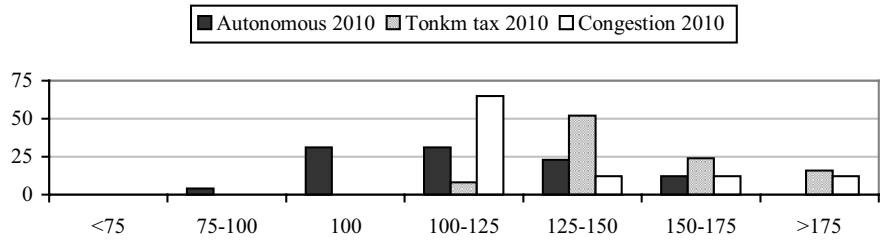


Figure 2: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 26)

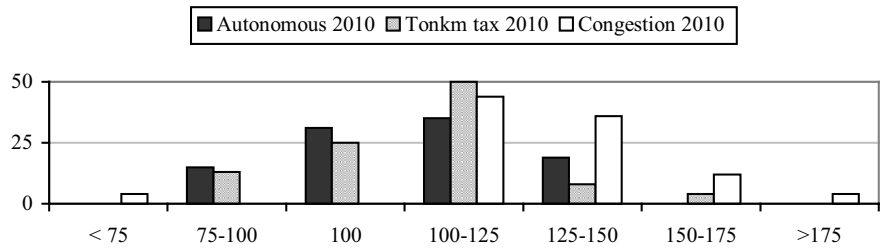
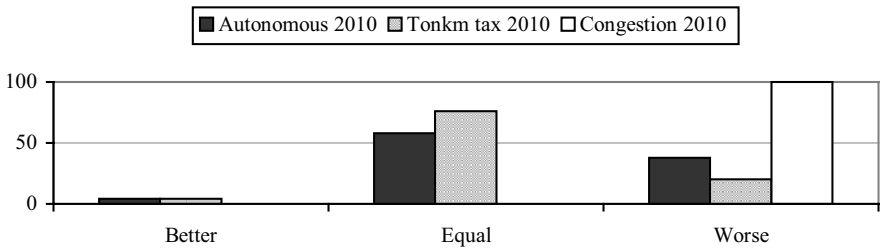


Figure 3: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 26)



Results part research on inland navigation

The scenarios

Scenario 1: Introduction of ton-kilometer taxes (inland navigation)
In this scenario, the following occurs: the European Commission decides to pass all social costs that are caused by freight transport on to freight carriers. As from the end of 2001, freight carriers pay for all costs they cause, including the cost of infrastructure, environmental pollution, and traffic victims. The social costs are charged by means of an additional tax per ton-kilometer that is levied on all freight transport from, to, or within the EU. The tax is 2 €-cents per ton-kilometer for shipowners that engage in inland navigation.

The scenario implies that in inland navigation from Rotterdam to Mannheim, shipowners face an increase in costs of € 176.- per container (given an average load factor of 15 ton per container), which coincides with 56 percent of the current revenue per container.

Scenario 2: Increased congestion in ports (inland navigation)

This scenario assumes substantially increasing congestion, due to a mismatch between infrastructure provision and the growth in inland navigation. Delays notably occur in the port of Rotterdam, where inland vessels are loaded. Delays are caused by increased pressure on the port, for which port infrastructure is not always designed, and by increasing capacity shortages at terminal operators. In 2010, vessels engaged in container shipping from Rotterdam to Mannheim stay on average 12 hours longer in Rotterdam to be loaded than in 2001 (i.e. a delay of almost 9 percent of the current door-to-door transit time). Apart from that, regularly unforeseen, additional delays occur of 8 hours or more.

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Mannheim between 2001 and 2010?

N = 19	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	11%	58%	21%			11%
2. Carriers will raise rates in response to the increasing demand for transport services	11%	32%	32%		11%	16%
3. Sailings will take longer due to congestion; carriers will not undertake measures to reduce these delays		11%	63%	5%	11%	11%
4. The use of planning systems will increase	16%	68%	11%			5%
5. Load factors of vessels will improve because carriers will schedule trips more in advance in co-operation with shippers	11%	63%	21%			5%
6. Carriers will acquire more return cargo	11%	63%	16%			11%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	5%	32%	53%		5%	5%
8. More often, small or unprofitable cargoes will be outsourced	5%	26%	32%	5%	5%	26%
9. Carriers will more often than now postpone departure for higher load factors or return cargo	5%	5%	74%	11%		5%
10. Carriers will use larger vessels	21%	42%	21%			16%
11. Maintenance and (replacement) investment will be postponed more frequently		26%	53%	5%		16%
12. Carriers will reduce fuel use (e.g. more economical engines or sailing)		58%	32%	5%		5%
13. Carriers will more often change departure times in order to reduce transit times		37%	37%		5%	21%
14. Carriers will more often change departure times in order to guarantee delivery reliability		42%	42%		5%	11%
15. Carriers will more often change route choice		21%	53%	5%	11%	11%
16. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	5%	50%	21%	16%		11%
17. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation	5%	37%	26%	11%	11%	11%
18. Carriers will visit more ports during a voyage in order to improve load factors	5%	21%	42%			32%
19. The number of large firms will increase (e.g. via mergers)	5%	42%	32%			21%

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Mannheim between 2001 and 2010? (continued)

N = 19	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	50%	26%	21%			5%
2. Carriers will raise rates in response to the increasing demand for transport services	11%	21%	50%		5%	16%
3. Sailings will take longer due to congestion; carriers will not undertake measures to reduce these delays		11%	68%	5%	11%	5%
4. The use of planning systems will increase	16%	63%	16%			5%
5. Load factors of vessels will improve because carriers will schedule trips more in advance in co-operation with shippers	11%	63%	21%			5%
6. Carriers will acquire more return cargo	26%	53%	11%			11%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	11%	58%	26%			5%
8. More often, small or unprofitable cargoes will be outsourced	11%	37%	26%			26%
9. Carriers will more often than now postpone departure for higher load factors or return cargo		37%	50%	5%	5%	5%
10. Carriers will use larger vessels	16%	53%	16%			16%
11. Maintenance and (replacement) investment will be postponed more frequently	11%	37%	26%	5%		21%
12. Carriers will reduce fuel use (e.g. more economical engines or sailing)	32%	32%	21%	11%		5%
13. Carriers will more often change departure times in order to reduce transit times		11%	53%		5%	32%
14. Carriers will more often change departure times in order to guarantee delivery reliability		21%	53%	5%	5%	16%
15. Carriers will more often change route choice		32%	37%	5%	11%	16%
16. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	16%	11%	50%	16%		11%
17. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation	11%	26%	26%	11%	16%	11%
18. Carriers will visit more ports during a voyage in order to improve load factors	11%	32%	32%			26%
19. The number of large firms will increase (e.g. via mergers)	11%	37%	21%			26%

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Mannheim between 2001 and 2010? (continued)

N = 19	**Scenario 2** How likely do you consider this development between now and 2010 if scenario 2 eventuates (increased congestion)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on		53%	26%			11%
2. Carriers will raise rates in response to the increasing demand for transport services	11%	21%	42%		11%	16%
3. Sailings will take longer due to congestion; carriers will not undertake measures to reduce these delays	11%	53%	11%	11%	11%	5%
4. The use of planning systems will increase	26%	53%	11%			11%
5. Load factors of vessels will improve because carriers will schedule trips more in advance in co-operation with shippers	21%	50%	21%			11%
6. Carriers will acquire more return cargo	16%	50%	26%			11%
7. Carriers will exchange cargo in order to reduce empty running and to improve load factors	16%	50%	32%			5%
8. More often, small or unprofitable cargoes will be outsourced	11%	42%	16%	5%		26%
9. Carriers will more often than now postpone departure for higher load factors or return cargo		32%	53%	11%		5%
10. Carriers will use larger vessels	16%	42%	26%			16%
11. Maintenance and (replacement) investment will be postponed more frequently	5%	26%	50%		5%	16%
12. Carriers will reduce fuel use (e.g. more economical engines or sailing)		32%	42%	16%		11%
13. Carriers will more often change departure times in order to reduce transit times	21%	32%	32%			16%
14. Carriers will more often change departure times in order to guarantee delivery reliability	21%	26%	37%			16%
15. Carriers will more often change route choice	21%	16%	42%	5%	5%	11%
16. Carriers from low-cost countries will obtain a larger market share (assumed that their liberties remain unchanged)	5%	21%	37%	16%	5%	16%
17. Carriers will more often co-operate with firms that are specialized in cargo acquisition and consolidation	11%	32%	21%	11%	5%	21%
18. Carriers will visit more ports during a voyage in order to improve load factors	11%	16%	32%	5%	5%	32%
19. The number of large firms will increase (e.g. via mergers)	16%	32%	32%			21%

Due to rounding off, totals may sometimes be more or less than 100%

Q 2: Which rates, transit times, and delivery reliability do you expect in container shipping from Rotterdam to Mannheim in 2010?

Figure 4: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 19)

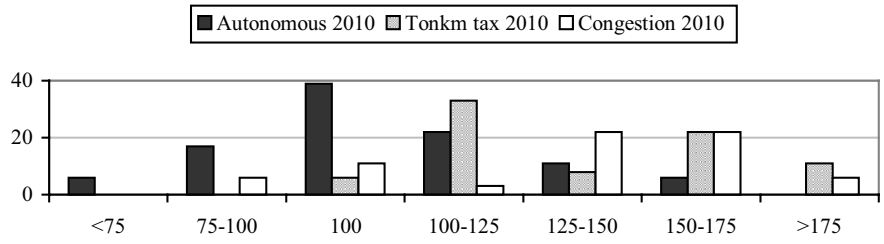


Figure 5: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 19)

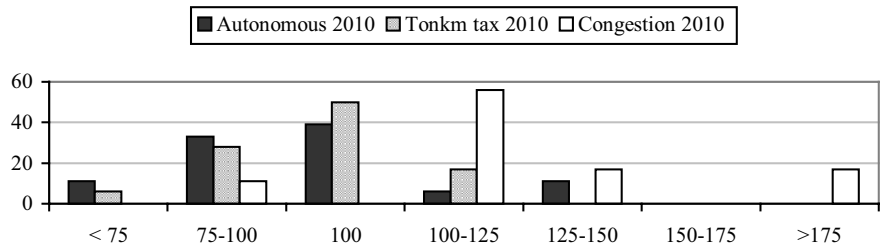
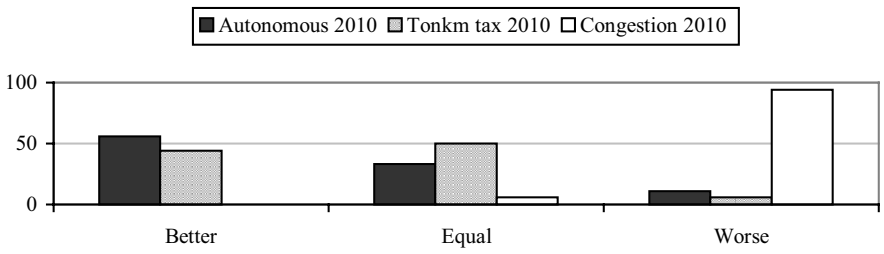


Figure 6: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 19)



Results part research on rail transport

The scenario

Scenario 1: Introduction of ton-kilometer taxes (rail transport)
It is assumed that the ton-kilometer tax that will be levied on rail transport as from the end of 2001 will not include total infrastructure costs, in contrast to the taxes on the other modes of transportation. The reason is that otherwise, rail transport would become disproportionally expensive, which conflicts the policy goal of a modal shift from road to rail. The tax will mount to 2.43 €-cents per ton-kilometer.

For the shuttle container services from Rotterdam to Milan, the scenario implies a cost increase of on average € 402.- per container (given an average load of 16.5 ton), which equals 75 percent of the current revenue per container.

Q 1: How likely do you consider the following developments in container transport by rail from Rotterdam to Milan between 2001 and 2010?

N = 19	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	11%	58%	16%	5%	11%	
2. Carriers will raise rates in response to the increasing demand for transport services	5%	42%	32%	11%	11%	
3. The use of planning systems will increase	26%	50%	16%	11%		
4. Load factors of trains will improve because carriers will schedule trips more in advance in co-operation with shippers	21%	42%	16%	11%	5%	5%
5. Carriers will acquire more return cargo	21%	42%	26%		11%	
6. Carriers will exchange cargo in order to improve load factors		58%	26%	5%		11%
7. Small or unprofitable cargoes will be outsourced more often		32%	32%	5%	11%	21%
8. Carriers will more often postpone departure until a higher load factors or return cargo is obtained		11%	68%	21%		
9. Carriers will use larger trains	16%	42%	37%			5%
10. Maintenance and (replacement) investment will be postponed more often		11%	68%	5%		16%
11. Fuel use will be reduced (e.g. due to more economical engines)	11%	53%	26%	5%		5%
12. En-route, carriers will visit more terminals in order to improve load factors	5%	16%	58%	11%		11%
13. The number of large firms will increase (e.g. via mergers)	16%	68%	5%			11%
14. Competition in rail transport will increase by the entry of other European carriers	21%	79%				

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in container transport by rail from Rotterdam to Milan between 2001 and 2010? (continued)

N = 19 Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Carriers will base rates more on real costs; hence, cost increases will more often be passed on	42%	53%		5%		
2. Carriers will raise rates in response to the increasing demand for transport services	11%	42%	37%	5%	5%	
3. The use of planning systems will increase	32%	42%	16%	11%		
4. Load factors of trains will improve because carriers will schedule trips more in advance in co-operation with shippers	37%	32%	16%	11%		5%
5. Carriers will acquire more return cargo	42%	32%	26%			
6. Carriers will exchange cargo in order to improve load factors	42%	32%	21%			5%
7. Small or unprofitable cargoes will be outsourced more often	11%	37%	21%		11%	21%
8. Carriers will more often postpone departure until a higher load factors or return cargo is obtained	11%	21%	42%	26%		
9. Carriers will use larger trains	37%	32%	21%			11%
10. Maintenance and (replacement) investment will be postponed more often		21%	58%	5%		16%
11. Fuel use will be reduced (e.g. due to more economical engines)	37%	37%	21%			5%
12. En-route, carriers will visit more terminals in order to improve load factors	5%	21%	50%	11%		16%
13. The number of large firms will increase (e.g. via mergers)	32%	50%	5%			16%
14. Competition in rail transport will increase by the entry of other European carriers	26%	68%	5%			

Due to rounding off, totals may sometimes be more or less than 100%

Q 2: Which rates, transit times, and delivery reliability do you expect in container transport by rail from Rotterdam to Milan in 2010?

Figure 7: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 19)

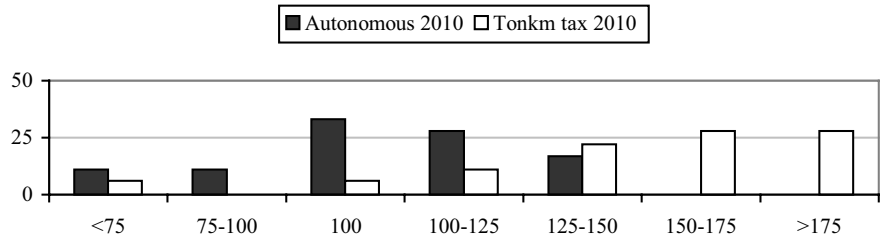


Figure 8: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 19)

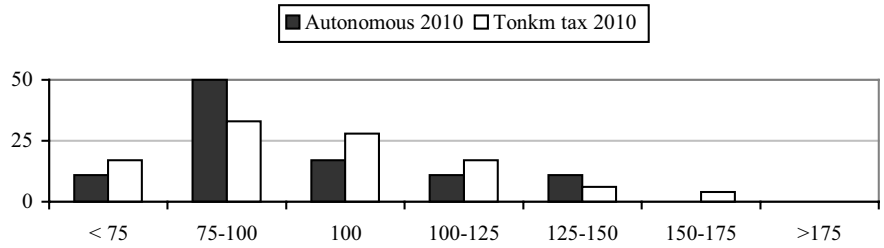
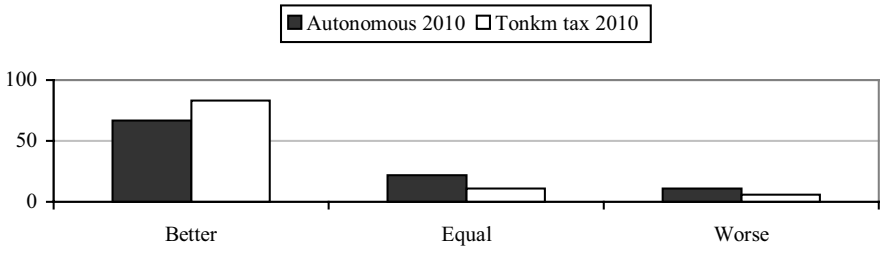


Figure 9: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 19)



Results part research on airfreight

The scenarios

Scenario 1: Introduction of ton-kilometer taxes (airfreight)
In this scenario, the European Commission decides to pass all social costs that are caused by freight transport on to freight carriers. As from the end of 2001, freight carriers pay for all costs they cause, including the cost of infrastructure, environmental pollution, and traffic victims. The social costs are charged by means of an additional tax per ton-kilometer that is levied on all freight transport from, to, or within the EU. In airfreight, the tax is 5.94 €-cents per ton-kilometer.

The scenario implies that airfreight from Schiphol to Japan will be levied a charge of € 1,435.- per pallet (given an average load of 2.5 ton), which equals almost 30 percent of the current revenue per pallet.

Scenario 2: Increased congestion on airports (airfreight)

Intercontinental airfreight from and to Europe is assumed to grow dramatically between 2001 and 2010. The main causes are the ongoing globalization and increased time pressure in logistics. Capacity problems at Schiphol airport as well as many Japanese airports emerge, since capacity limits are attained. Carriers however estimate that if there were no capacity shortages, they could have executed 25 percent more flights than what is possible in this scenario.

Q 1: How likely do you consider the following developments in airfreight from Schiphol to Tokyo between 2001 and 2010?

N = 7	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Airlines will pass cost increases immediately on to shippers	29%	43%	14%			14%
2. Airlines will more often raise rates in response to the increasing demand for transport services	57%	29%	14%			14%
3. Load factors will improve, because airlines will more often plan their flights in advance in co-operation with shippers		14%	29%	14%	43%	
4. Airlines will acquire more return cargo	14%	14%	43%		14%	14%
5. Airlines will more often exchange cargo with other airlines, in order to improve load factors		29%	57%	14%		
6. Airlines will more often refuse unprofitable cargo	43%	14%	43%			
7. Airlines will use larger airplanes		29%	29%	14%	29%	
8. Airlines will more often use full freighters instead of passenger airplanes carrying freight as well		71%	14%		14%	
9. Maintenance and (replacement) investment will be postponed more frequently			29%	57%		14%
10. Airlines will reduce fuel use (e.g. more economical engines)	14%	57%	14%			14%
11. Airlines will more often fly to other Japanese airports and have their cargo transported by road to Tokyo		29%	71%			
12. Airlines will make more stops en-route in order to improve load factors			57%		29%	14%
13. Airlines will add hubs to their networks in order to improve load factors		57%	29%		14%	
14. Airlines will more often co-operate with firms that are specialized in cargo acquisition and consolidation		43%	14%		14%	29%
15. The number of large airlines will increase (e.g. due to mergers)		57%	43%			

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in airfreight from Schiphol to Tokyo between 2001 and 2010? (continued)

N = 7 Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Airlines will pass cost increases immediately on to shippers	43%	43%			14%	
2. Airlines will more often raise rates in response to the increasing demand for transport services	71%	14%				14%
3. Load factors will improve, because airlines will more often plan their flights in advance in co-operation with shippers		43%	14%	43%		
4. Airlines will acquire more return cargo		43%	43%	14%		
5. Airlines will more often exchange cargo with other airlines, in order to improve load factors		57%	14%	14%		14%
6. Airlines will more often refuse unprofitable cargo	29%	43%	14%			14%
7. Airlines will use larger airplanes		14%	71%			14%
8. Airlines will more often use full freighters instead of passenger airplanes carrying freight as well		43%	43%		14%	
9. Maintenance and (replacement) investment will be postponed more frequently			29%	57%		14%
10. Airlines will reduce fuel use (e.g. more economical engines)	43%	29%	14%			14%
11. Airlines will more often fly to other Japanese airports and have their cargo transported by road to Tokyo		14%	71%			14%
12. Airlines will make more stops en-route in order to improve load factors			43%	14%	29%	14%
13. Airlines will add hubs to their networks in order to improve load factors	14%	29%	14%		29%	14%
14. Airlines will more often co-operate with firms that are specialized in cargo acquisition and consolidation	14%	14%	14%	29%	14%	14%
15. The number of large airlines will increase (e.g. due to mergers)		14%	71%			14%

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in airfreight from Schiphol to Tokyo between 2001 and 2010? (continued)

N = 7	**Scenario 2** How likely do you consider this development between now and 2010 if scenario 2 eventuates (increased congestion)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Airlines will pass cost increases immediately on to shippers	29%	43%				29%
2. Airlines will more often raise rates in response to the increasing demand for transport services	71%	14%				14%
3. Load factors will improve, because airlines will more often plan their flights in advance in co-operation with shippers		57%	14%		14%	14%
4. Airlines will acquire more return cargo		43%	29%	14%		14%
5. Airlines will more often exchange cargo with other airlines, in order to improve load factors		14%	29%	43%		14%
6. Airlines will more often refuse unprofitable cargo	43%	29%	14%			14%
7. Airlines will use larger airplanes	29%	29%	14%		14%	14%
8. Airlines will more often use full freighters instead of passenger airplanes carrying freight as well	14%	57%			14%	14%
9. Maintenance and (replacement) investment will be postponed more frequently			29%	57%		14%
10. Airlines will reduce fuel use (e.g. more economical engines)	43%	43%	14%			29%
11. Airlines will more often fly to other Japanese airports and have their cargo transported by road to Tokyo		86%				14%
12. Airlines will make more stops en-route in order to improve load factors			29%	29%	29%	14%
13. Airlines will add hubs to their networks in order to improve load factors		43%	29%	14%	14%	
14. Airlines will more often co-operate with firms that are specialized in cargo acquisition and consolidation		14%	29%	29%	14%	14%
15. The number of large airlines will increase (e.g. due to mergers)		29%	57%			14%

Due to rounding off, totals may sometimes be more or less than 100%

Q 2: Which rates, transit times, and delivery reliability do you expect in airfreight from Schiphol to Tokyo in 2010?

Figure 10: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 7)

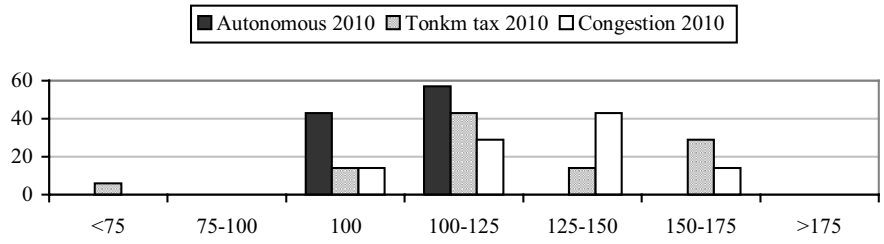


Figure 11: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 7)

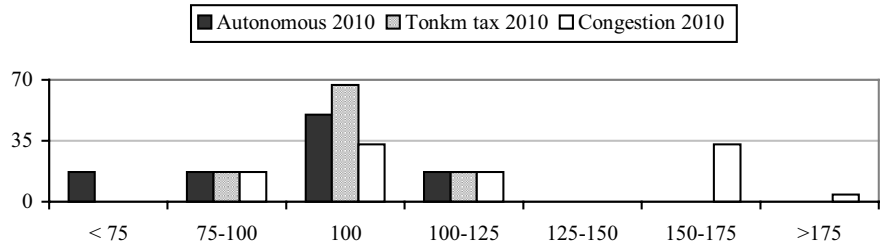
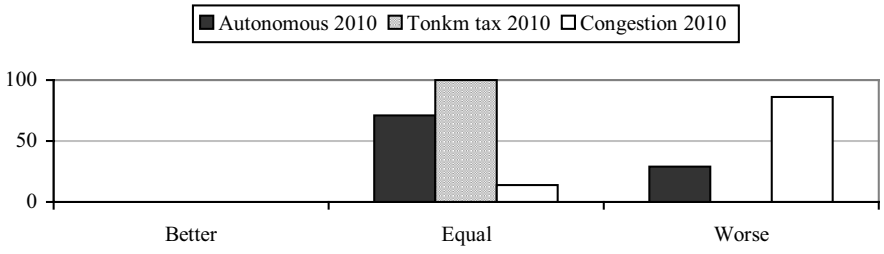


Figure 12: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 7)



Results part research on deep sea shipping

The scenarios

Scenario 1: Introduction of ton-kilometer taxes (deep sea shipping)
The European Commission succeeds in levying charges in intercontinental shipping from and to the European Union. The tax comprises all external social costs of freight transport (including for instance pollution), and is implemented via additional ton-kilometer taxes. They are introduced by end of 2001, and mount to 0.67 €-cents per ton-kilometer.

In container shipping from Rotterdam to Singapore, this means that shipowners face an increase in costs of € 1,045.- per container (given an average load factor of 16.25 ton per container), which equals 75% of the current revenue per container.

Scenario 2: Increased congestion in ports (deep sea shipping)

In this scenario, the following occurs: until 2010 intercontinental shipping to and from Europe increases enormously, largely because of further globalization of the economy. The result is congestion on the main waterways to and from ports and increased congestion in ports, despite new investment in port infrastructure and terminals. Apart from that, the Second Meuse Plateau in Rotterdam has been delayed, which causes additional congestion in the port of Rotterdam. More and more shipowners face difficulties in making agreements with terminal operators that fit to their shipping schedules. On top of that, often unforeseen delays occur due to increased numbers of vessels in ports and small margins in many terminal operators' schedules.

For container shipping from Rotterdam to Singapore, this implies that the average period a vessel spends in port increases from half a day to 3 days, which implies an increase in total transit times of 25 percent. Furthermore, often unforeseen delays of half a day or more occur.

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Singapore between 2001 and 2010?

N = 5 Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases immediately on to shippers	20%	20%	40%	20%		
2. Shipowners will raise rates in response to the increasing demand for transport services	40%	40%	20%			
3. Voyages will take longer due to delays; shipowners do not take counteractive measures to reduce these delays			60%	20%		20%
4. The use of planning systems will increase	20%	60%				20%
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	20%	20%	20%		40%	
6. Shipowners will acquire more return cargo	20%	40%			40%	
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors	20%	60%				20%
8. Shipowners will refuse or outsource more small or unprofitable shipments	20%	20%	20%		40%	
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained	20%	40%		40%		
10. Shipowners will more often use vessels of a higher capacity	60%	40%				
11. Shipowners will increasingly postpone maintenance or (replacement) investment	20%		60%	20%		
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)	20%	60%	20%			
13. Shipowners will more often change departure times in order to reduce transit times	20%	20%	40%			20%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival	20%	80%				
15. Shipowners will choose other ports of call in order to avoid delays in congested ports	40%	40%	20%			
16. Shipowners will visit more ports during a voyage in order to improve load factors		40%	60%			
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation	40%		40%		20%	
18. Average firm size of shipowners will increase (e.g. via mergers)	60%	20%	20%			

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Singapore between 2001 and 2010? (continued)

N = 5 Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases immediately on to shippers	60%	20%	20%			
2. Shipowners will raise rates in response to the increasing demand for transport services	60%	40%				
3. Voyages will take longer due to delays; shipowners do not take counteractive measures to reduce these delays			80%	20%		
4. The use of planning systems will increase	40%	40%				20%
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	20%	40%	20%		20%	
6. Shipowners will acquire more return cargo		80%			20%	
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors	20%	60%				20%
8. Shipowners will refuse or outsource more small or unprofitable shipments		80%		20%		
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained		60%		40%		
10. Shipowners will more often use vessels of a higher capacity	40%	60%				
11. Shipowners will increasingly postpone maintenance or (replacement) investment		20%	40%		20%	20%
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)	40%	40%			20%	
13. Shipowners will more often change departure times in order to reduce transit times	20%	20%	40%			20%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival	20%	80%				
15. Shipowners will choose other ports of call in order to avoid delays in congested ports		40%	40%		20%	
16. Shipowners will visit more ports during a voyage in order to improve load factors		60%	40%			
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation	20%	20%	40%		20%	
18. Average firm size of shipowners will increase (e.g. via mergers)	60%	40%				

Q 1: How likely do you consider the following developments in container shipping from Rotterdam to Singapore between 2001 and 2010? (continued)

N = 5	**Scenario 2** How likely do you consider this development between now and 2010 if scenario 2 eventuates (increased congestion)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases immediately on to shippers	20%		80%			
2. Shipowners will raise rates in response to the increasing demand for transport services	60%	20%	20%			
3. Voyages will take longer due to delays; shipowners do not take counteractive measures to reduce these delays			40%	40%	20%	
4. The use of planning systems will increase	40%	40%				20%
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	40%		20%		40%	
6. Shipowners will acquire more return cargo		40%	20%		40%	
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors	20%	40%	20%			20%
8. Shipowners will refuse or outsource more small or unprofitable shipments		40%	60%			
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained		20%	20%	40%	20%	
10. Shipowners will more often use vessels of a higher capacity	40%	40%	20%			
11. Shipowners will increasingly postpone maintenance or (replacement) investment			40%	20%	20%	20%
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)		40%	20%	20%	20%	
13. Shipowners will more often change departure times in order to reduce transit times	20%	20%	20%		20%	20%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival	60%	20%	20%			
15. Shipowners will choose other ports of call in order to avoid delays in congested ports	80%		20%			
16. Shipowners will visit more ports during a voyage in order to improve load factors			60%	40%		
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation	20%		60%		20%	
18. Average firm size of shipowners will increase (e.g. via mergers)	40%	40%	20%			

Q 2: Which rates, transit times, and delivery reliability do you expect in container shipping from Rotterdam to Singapore in 2010?

Figure 13: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 5)

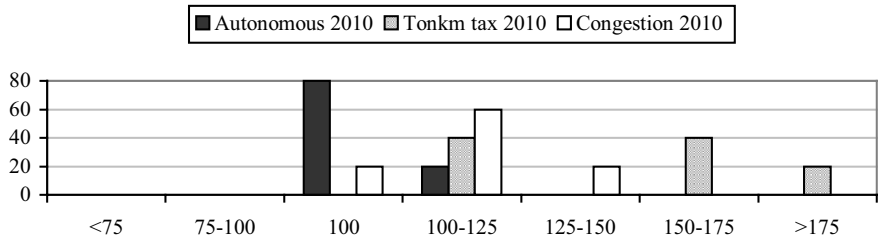


Figure 14: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 5)

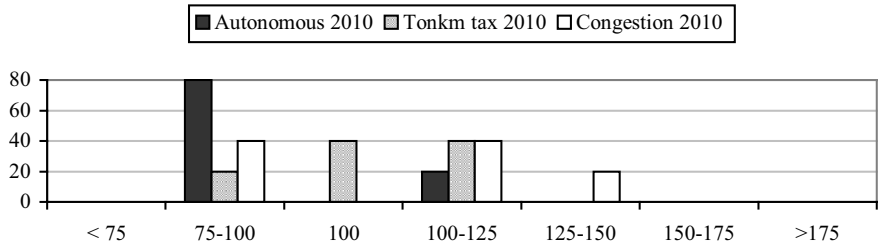
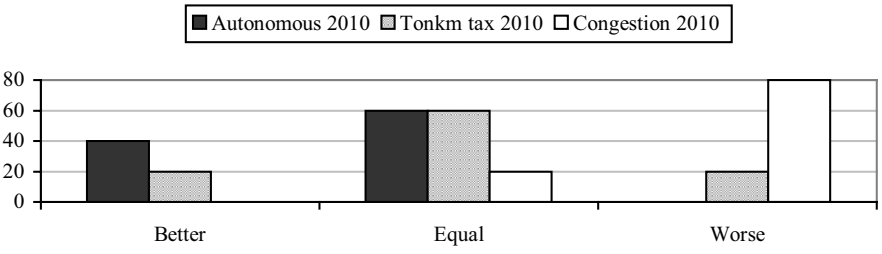


Figure 15: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 5)



Results part research on short sea shipping

The scenarios

Scenario 1: Introduction of ton-kilometer taxes (short sea shipping)
The European Commission decides to pass all social costs that are caused by freight transport on to freight carriers. As from the end of 2001, freight carriers pay for all costs they cause, including the cost of infrastructure, environmental pollution, and traffic victims. The social costs are charged by means of an additional tax per ton-kilometer that is levied on all freight transport from, to, or within the EU. For seaborne transport, the tax will amount to 0.67 €-cents per ton-kilometer.

The scenario implies that short sea shipowners carrying wood and forest products from Sweden to the Netherlands will be confronted with an increase in costs of € 12 per ton, or, expressed in the average revenue per ton, of 75 percent.

Scenario 2: Increased congestion in ports (short sea shipping)

It is assumed that until 2010, short sea shipping will show a dramatic growth. An important reason is that many shippers more often have their cargo transported by sea, in order to avoid the highly congested road networks. The effect is that pressure on ports and on the main sailing routes to and from ports increases, despite new investment in port infrastructure and terminals. More and more often, vessels have to wait before they can be loaded or discharged. This is in particular problematic to short sea shipowners, since they generally call at multiple ports per voyage.

In 2010, vessels that carry wood and forest products from Sweden to the Netherlands stay on average one day longer in ports compared to 2001 (an increase in total transit time of 14 percent). Apart from that, often unforeseen delays occur, due to delays in transshipment of other vessels and the narrow margins in the planning of many terminal operators.

Q 1: How likely do you consider the following developments in short sea shipping from Sweden to the Netherlands between 2001 and 2010?

N = 11	**No scenario** How likely do you consider this development between now and 2010, if neither scenario eventuates?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases directly on to shippers	45%	27%	18%		9%	
2. Shipowners will raise rates in response to the increasing demand for transport services	45%	36%			18%	
3. Voyages will take longer due to port delays; shipowners do not take counteractive measures to reduce these delays	9%		73%	18%		
4. The use of planning systems will increase	18%	64%	9%	9%		
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	18%	45%	27%		9%	
6. Shipowners will acquire more return cargo	9%	91%				
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors		45%	18%		36%	
8. Shipowners will refuse or outsource more small or unprofitable shipments	9%	36%	27%		27%	
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained	18%		55%	27%		
10. Shipowners will more often use vessels of a higher capacity		64%	18%		18%	
11. Shipowners will increasingly postpone maintenance or (replacement) investment			91%		9%	
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)		73%	18%	9%		
13. Shipowners will more often change departure times in order to reduce transit times		45%	27%		18%	9%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival		73%	18%			9%
15. Shipowners will choose other ports of call in order to avoid delays in congested ports		36%	55%		9%	
16. Shipowners will visit more ports during a voyage in order to improve load factors		45%	55%			
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation		55%	18%	9%	18%	
18. Average firm size of shipowners will increase (e.g. via mergers)	27%	45%	9%	9%	9%	

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in short sea shipping from Sweden to the Netherlands between 2001 and 2010? (continued)

N = 11	**Scenario 1** How likely do you consider this development between now and 2010 should scenario 1 eventuate (ton-km taxes)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases directly on to shippers	73%	9%	9%		9%	
2. Shipowners will raise rates in response to the increasing demand for transport services	55%	27%	18%			
3. Voyages will take longer due to port delays; shipowners do not take counteractive measures to reduce these delays	9%		64%	27%		
4. The use of planning systems will increase	18%	55%	27%			
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	27%	9%	64%			
6. Shipowners will acquire more return cargo	18%	73%	9%			
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors		64%	18%		18%	
8. Shipowners will refuse or outsource more small or unprofitable shipments	18%	36%	36%		9%	
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained	9%	36%	45%	9%		
10. Shipowners will more often use vessels of a higher capacity	9%	55%	18%	9%	9%	
11. Shipowners will increasingly postpone maintenance or (replacement) investment		18%	64%		18%	
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)	18%	82%				
13. Shipowners will more often change departure times in order to reduce transit times		36%	36%		18%	9%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival		73%	18%			9%
15. Shipowners will choose other ports of call in order to avoid delays in congested ports	9%	45%	36%		9%	
16. Shipowners will visit more ports during a voyage in order to improve load factors	9%	45%	45%			
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation	9%	45%	18%	9%	18%	
18. Average firm size of shipowners will increase (e.g. via mergers)	27%	64%		9%		

Due to rounding off, totals may sometimes be more or less than 100%

Q 1: How likely do you consider the following developments in short sea shipping from Sweden to the Netherlands between 2001 and 2010? (continued)

N = 11	**Scenario 2** How likely do you consider this development between now and 2010 if scenario 2 eventuates (increased congestion)?					
Possible developments: *(Shaded are questions regarding which a sufficient degree of consensus existed)*	Very likely	Likely	Unlikely	Very unlikely	Differs between firms	Do not know
1. Shipowners will pass cost increases directly on to shippers	64%	18%	9%		9%	
2. Shipowners will raise rates in response to the increasing demand for transport services	45%	36%	9%		9%	
3. Voyages will take longer due to port delays; shipowners do not take counteractive measures to reduce these delays	9%		45%	45%		
4. The use of planning systems will increase	27%	73%				
5. Load factors of vessels will improve because voyages will be planned more often in advance in co-operation with shippers	36%	45%	9%			9%
6. Shipowners will acquire more return cargo	18%	64%		9%		9%
7. Shipowners will exchange more cargo with other shipowners, in order to improve vessels' load factors	18%	55%	18%		9%	
8. Shipowners will refuse or outsource more small or unprofitable shipments	36%	27%	18%		18%	
9. Shipowners will more frequently postpone departures until a higher load factors or more return cargo is obtained	18%	18%	55%	9%		
10. Shipowners will more often use vessels of a higher capacity	27%	45%		18%	9%	
11. Shipowners will increasingly postpone maintenance or (replacement) investment		9%	73%		18%	
12. Shipowners will reduce fuel use (e.g. by more economical engines or by more economical shipping behavior)	9%	73%	18%			
13. Shipowners will more often change departure times in order to reduce transit times	9%	55%	18%		9%	9%
14. Shipowners will more often change departure times in order to guarantee reliability of arrival	27%	45%	18%			9%
15. Shipowners will choose other ports of call in order to avoid delays in congested ports	27%	64%			9%	
16. Shipowners will visit more ports during a voyage in order to improve load factors		45%	45%	9%		
17. Shipowners will increasingly co-operate with firms that are specialized in cargo acquisition and consolidation	9%	45%	18%	9%	18%	
18. Average firm size of shipowners will increase (e.g. via mergers)	36%	36%	9%	9%	9%	

Due to rounding off, totals may sometimes be more or less than 100%

Q 2: Which rates, transit times, and delivery reliability do you expect in short sea shipping from Sweden to the Netherlands in 2010?

Figure 16: Expectations regarding carrier rates in 2010, exclusive of inflation (2001 = 100) (in percentage; n = 11)

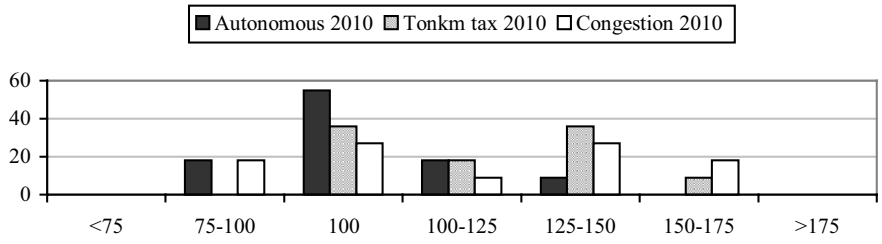


Figure 17: Expectations regarding transit times in 2010 (2001 = 100) (in percentage; n = 11)

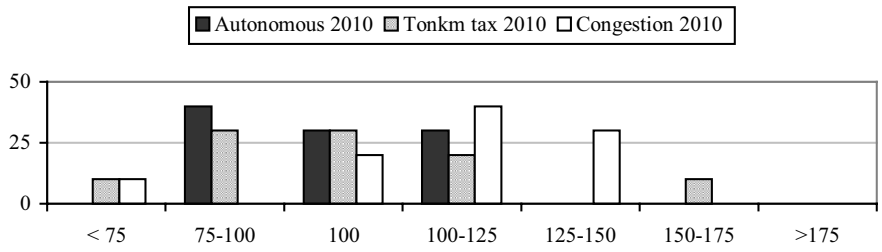
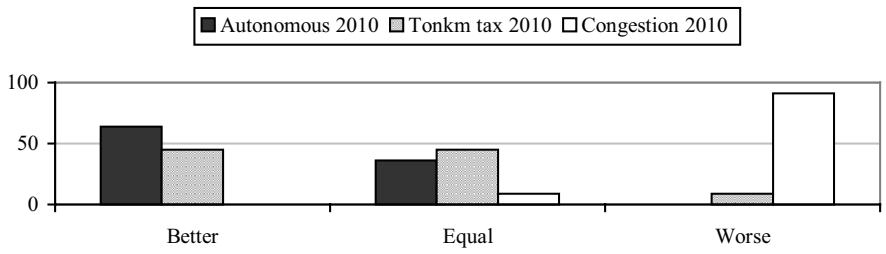


Figure 18: Expectations regarding delivery reliability in 2010 (2001 = 100) (in percentage; n = 11)



Annex III: Participants stated adaptation survey

Mr. E. Baeten (logistics manager; Scaldia; Nijmegen) [b]

Mr. R. Bakker (manager logistics and accounting; Meerssen en Palm; Meerssen) [a]

Mr. L. van den Berg (director/owner; De Stadskrant; Edam) [c, d]

Mr. S. Brockotter (logistics manager; Senefelder Misset; Doetinchem) [c]

Mr. P. Coenen (program manager logistics; Centraal Boekhuis; Culemborg) [g]

Mr. J. Cloosterman (manager inventories; Scaldia; Nijmegen) [b]

Mr. J. Deckers (general manager; Continent Books; Amsterdam) [g]

Mr. W.P. Delput (director distribution; De Telegraaf; Amsterdam) [c]

Mr. W. van Dijk (press manager; Brouwer Rotatie; Delft) [c]

Mr. C. van Doorn (commercial manager; Papier Recycling Utrecht; Utrecht) [h]

Mr. H.J. van Doorn (general director, Publicard; Utrecht) [e; f]

Mr. J. van Duijn (works manager; Drukkerij P. van der Linden; The Hague) [c]

Mr. I. Du Pon (logistics manager; Sihl Benelux; Den Bosch) [b]

Mrs. E. Edelman (office manager; Drukkerij Rob Stolk, Amsterdam) [e]

Mr. J. Enderman (sales director; Stora Enso; Amsterdam) [a]

Mr. J. van Gent (technical director; Koninklijke De Swart; The Hague) [e]

Mr. A. Gerritsen (general director; De Nieuwe Boekerij; Zeist) [g]

Mr. J. Harinck (general director; Certo; Leiden) [h]

Mrs. J. Hemradj (office manager; Van Lennep Boekbinders; Almere) [f]

Mr. W. Heule (director; Uitgeverij De Driehoek; Amsterdam) [d]

Mr. B. ‘t Hooft (general director; Drukkerij G.B. ‘t Hooft; Rotterdam) [e]

Mr. A. van der Horst (manager production; Arbeiderspers; Amsterdam) [d]

Mrs. L.M. ter Horst-ten Wolde (office manager/senior publisher; Delft University Press; Delft) [d]

Mr. J. Kolijn (logistics manager; Wegener Uitgevers Midden Nederland; Amersfoort) [c]
Mr. P. Klomp (general director; Continental Paper; Soest) [b]
Mr. J.M. van der Leeuw (logistics manager; Crown Van Gelder; Velsen) [a]
Mr. D. Libosan (printer; Academische Pers; Amsterdam) [e]
Mrs. N. Mengedé (logistics manager; Vaop; Hilversum) [h]
Mr. R. Mutsaers (logistics manager; BGN Distributie; Deventer) [g]
Mr. G. Nijssen (director; Wed. G.J. Nijssen Papier; Nieuw Vennep) [h]
Mr. E.J. Ouwersloot (logistics manager; Proost en Brandt; Diemen) [b]
Mr. A. Patist (general director, Patist; Den Dolder) [f]
Mr. D. Ropers (managing director, Bol.com; Nieuwegein) [g]
Mr. R. van Rossum (logistics manager; Roto Smeets Utrecht; Utrecht) [c]
Mr. M.W. Rou (logistics manager; Sappi; Nijmegen) [a]
Mr. F. Strauss (director transport; PCM; Amsterdam) [c]
Mr. H. Tegelaar (account manager; Continental Paper; Soest) [b]
Mr. J. van der Ven (logistics and commercial manager; Heijnen Tilburg; Tilburg) [h]
Mr. R. Vrij (manager production; De Bezige Bij; Amsterdam) [d]
Mr. H. van Waarden (general director; Boekbinderij Van Waarden; Zaandam) [f]
Mr. L.J.P. Wennekes (logistics manager; Parenco; Renkum) [a]
Mr. G.C. van Wijngaarden (binder; Lage Weide; Utrecht) [f]
Mr. H.P. Wortman (logistics manager; SCA Packaging De Hoop; Eerbeek) [a]

Legend:

[a]: Paper production
[b]: Paper wholesale
[c]: Newspaper publishing and printing
[d]: Book publishing
[e]: Book printing
[f]: Book binding
[g]: Book distribution
[h]: Old paper collection and wholesale

Annex IV: Questionnaire stated adaptation survey

Introduction

The respondents were informed in the invitation letter about the aim of the interviews, which was to get a better understanding of the role of freight transport and transport costs in logistics management. The interview addressed (1) the way in which production and distribution are currently organized; (2) expected trends in production and distribution between now and 2010/2011; (3) the expected consequences of two freight transport scenarios. The interview questionnaire mainly served as a checklist. Annual reports that were received prior to the interviews already answered some of the questions. Depending on the situation, questions were added or (in the case of telephone interviews) omitted. The respondents were promised that the interviews were processed confidentially. An interview report was sent to the respondents for approval.

Part 1: Current organization of production and distribution

Background

1. How many employees does your firm have?
2. What is (are) the largest freight flow(s) in your firm?
3. Could you provide an indication of the share of the following types of costs in total costs or revenues?
   - transport (expenditures on commercial or own account carriers);
   - inventory costs (interest; depreciation; insurance);
   - warehousing costs (mortgage/rent; equipment depreciation; labor; materials).
4. (In the case of a multi plant firm or a holding) Who decides on the organization of production and distribution (purchasing, customer service, et cetera)?

Inbound logistics

5. Where are the main five suppliers located?
6. What is the average size of an order and how frequently do you reorder?
7. Which modes of transportation are used and who decides on modal choice?

8. Has the inbound flow changed over the past five years and if so, for what reasons? What has been the impact of these changes on transport use (modal choice, consolidation factors, kilometers driven, average distance, et cetera)?

Production

9. Where are your firm's production centers located?
10. What division of tasks exists between these centers?
11. What is the typical route of your firm's product during production and distribution (i.e. which production centers or other facilities do the product flows pass)?
12. To what extent is your product customized to demands of your customers (e.g. percentage of sales that is produced to order)?
13. Where are raw materials, intermediate products, and finished products kept in inventory? Are there products that are not kept in inventory (i.e. JIT delivery)?
14. What is the average period in which products are kept in inventory (days, weeks)?
15. What is the average order lead time?
16. How reliable are deliveries (percentage in-time deliveries)? What criteria are employed?
17. Has production changed over the past five years and if so, for what reasons? What has been the impact on transport use (modal choice, kilometers, et cetera)?

Outbound logistics

18. Where are the five most important customers located? And in which area are most of your customers located?
19. Do you provide JIT deliveries? For which (types of) customers?
20. How are your products distributed (e.g. through distribution centers or direct delivery)?
21. What is the average order size?
22. Which modes of transportation are used and who decides on modal choice?
23. Are your deliveries consolidated with other cargo? Do you organize return cargo?
24. Has the outbound flow changed over the past five years and if so, for what reasons? What has been the impact on transport use (modal choice, kilometers, et cetera)?

Customer service

25. What is the average order lead time in days for the main customers or the main products (i.e. period of time between ordering and delivery)?
26. What is the average reliability of deliveries for the main customers or the main products (percentage of in-time deliveries)? What criteria are employed?
27. What is the average frequency of delivery for the main customers or the main products (per week or month)?
28. Has the customer service changed over the past five years and if so, for what reasons? What has been the impact on transport use (modal choice, et cetera)?

Co-operation with other firms

29. To what extent are logistical activities outsourced to carriers or logistical service providers?

30. To what extent and how do you co-operate with customers, suppliers, or other firms regarding logistical processes (e.g. open book accounting; online ordering; online inventory information)?
31. Has co-operation with other firms changed over the past five years and if so, for what reasons? What has been the impact on transport use?

Part 2: Long-term plans or expectations regarding the organization of production and distribution

32. We have been discussing various aspects of the organization of production and distribution. Do you expect changes in the next five to ten years (including issues like outsourcing)? How certain are these expectations? What are the main reasons?
33. How do you expect that the above changes will affect transport use (modal choice, kilometers, et cetera)?
34. What expectations do you have regarding the following characteristics of freight transport: transit times, delivery reliability, and carrier rates? How have these expectations affected your plans and expectations regarding production and distribution?

Part 3: Stated adaptations to two freight transport scenarios

35. I would like to ask you to read the two pages on which two scenarios are described concerning freight transport. In scenario 1, carrier rates increase due to governmental interventions, whereas in scenario 2, transit times increase and delivery reliability is deteriorated due to increased congestion. The scenarios are plausible and based on an earlier study (the respondents were given a copy of the full Delphi survey report). How would these scenarios affect the plans and expectations vis-à-vis production and distribution that we discussed? What are the main explanations for these adaptations?
36. The adaptations only apply to these and these aspects of production and distribution. Why do you not expect changes in other areas?
37. How do you think that your suppliers and customers will respond to the two scenarios and for what reasons?
38. What will these scenarios eventually mean for the prices of your products (and profits)?

Finally

39. May I mention your name and that of your firm in my dissertation?
40. Do you have other remarks or observations in consequence of this interview?

Summary

Background and research objective

Freight transport has shown a substantial growth in the last decades. It is expected that this trend will only continue, in particular in road transport. This development is partly contrary to current transport policy of various Western European governments and the European Commission, which is aimed at a reduction in the negative effects produced by freight transport (e.g. pollution, congestion, and increased traffic unsafety).

In the coming years, the above governments envisage the employment of various policy instruments in their transport policies. One of these instruments is a higher taxation of (road) freight transport. Yet so far little study has been done to systematically explore the effectiveness of taxation as a means to regulate freight transport. This study aimed to partly fill in this knowledge gap. The focus was on the effects of transport cost increases on logistical decisions of shipping firms (e.g. manufacturers). There were two reasons for this choice. One, shippers typically generate freight transport demand. Two, research has shown that part of the recent transport growth has been caused by a more transport-intensive organization of production and distribution (e.g. due to centralization of inventory), which among other things is attributed to falling transport costs.

Analytical framework

Increased transport costs may reduce transport demand through a myriad of logistical adaptations. The literature suggests that adaptations can be found in particular in the following three areas of logistics management:

- the structure and spatial pattern of the production and distribution network;
- scheduling of the product flow through the network: e.g. the flexibility or frequency of orders and the required lead time and delivery reliability;
- management of transport resources: the process in which individual shipments are converted into physical transport movements.

This study mainly explored effects of higher transport costs in the first and second areas (i.e. the organization of production and distribution), because shippers control these areas. Management of transport resources in contrast is typically left to carriers.

The literature also suggests that shippers, in transport decisions or decisions with transport implications, usually have a broad conception of transport costs. They do not only look at direct transport costs (i.e. carrier rates) but also at indirect transport costs (i.e. costs related to door-to-door transit times and reliability of deliveries, such as interest costs of freight in transit). The so-called generalized transport costs concept was therefore adopted in this study.

Main findings

The impact of higher transport costs on the organization of production and distribution was explored in the case of books and newspapers. The analysis focused on the following sectors: paper producers, paper wholesalers, newspaper publishers, book publishers, printers, binders, book distributors, and old paper collectors and wholesalers.

Two scenarios were examined in which transport costs increase due to particular priorities in transport policy, namely:

- "fair and efficient pricing": in this scenario, all external social costs of transport are passed on to freight carriers that operate in Western Europe;
- "insufficient infrastructure provision": in this scenario, transport infrastructure provision is insufficiently effective in accommodating the growth in (freight) traffic demand, resulting in a strong increase in congestion.

A. The "fair and efficient pricing" scenario : higher direct transport costs

The 'internalization' of all external costs of freight transport was assumed to result in substantial increases in average carrier rates (see Table 1).

Table 1: Assumed changes in carrier rates due to internalization

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
+ 50%	+ 40%	+ 50%	+ 25%	+ 50%	+ 40%

Nevertheless, within the book and newspaper supply chains, this transport cost increase is expected to have only a modest impact. The main logistical adaptations will be a higher efficiency of transport operations due to improved freight consolidation, and a reduced need for transport services due to a lower frequency of replenishment orders. The main spatial effects of higher direct transport costs will be smaller geographical market areas due to a loss of remote customers. In some situations also more local or regional sourcing is expected. Customer service levels in terms of order lead times and reliability of deliveries will not be changed if direct transport costs increase. A substantial increase in direct transport costs will therefore not induce substantial changes in the organization of production and distribution. In most sectors, the bulk of the freight will be shipped over the same distances. Yet, these freight flows will be transported in a more efficient way, resulting in less vehicle-kilometers.

B. The "insufficient infrastructure provision" scenario: higher indirect transport costs

The consequences of the "insufficient infrastructure provision" scenario are summarized in Table 2 and 3. In addition a 20 percent increase in carrier rates was assumed.

Table 2: Assumed changes in transit times due to a strong increase in congestion

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
+ 30%	+ 25%	- 5%	+ 20%	+ 7.5%	+ 7.5%

Table 3: Assumed changes in delivery reliability due to a strong increase in congestion

Road haulage	Inland navigation	Rail transport	Airfreight	Deep sea shipping	Short sea shipping
10% arrivals ≥ 15 min. late	25% sailings ≥ 4 hours late	25% shuttles ≥ 1 hour late	10% flights ≥ 3 hours late	10% sailings ≥ 1 day late	20% sailings ≥ 0.5 day late

Shippers consider longer transit times and reduced delivery reliability as more problematic than higher direct transport costs, mainly due to competition on customer service (i.e. fast, frequent, and reliable delivery). Longer transit times and reduced delivery reliability will lead to less competitive services. In turn, this will lead to a larger loss of (remote) customers than in the case of the "fair and efficient pricing" scenario. Yet, regarding aspects of the organization of production and distribution other than geographical market areas, longer transit times and reduced delivery reliability will have only a modest impact. If shippers foresaw adaptations, these included mainly a decentralization of production or inventory, adaptations in the planning of production and distribution activities (in some cases even an extension of opening hours), and changes in transport operations (e.g. a switch to off-peak or overnight transport).

Explanations for the modest importance of transport costs

The main conclusion is that higher direct and indirect transport costs will have a modest impact on the organization of production and distribution, which can be explained by:

- relatively high costs of other logistical inputs (e.g. inventories or plants);
- sunk investment, inhibiting for instance relocation;
- consumers' preferences. Generally, longer order lead times for the sake of a higher consolidation and lower direct transport costs are not accepted.

Yet it should be noted that heterogeneity exists in the adaptations that a transport cost increase will induce. One explanation can be found in the nature of the product. Products with a low value and a relatively stable demand can be kept in decentral inventories without raising logistical costs prohibitively, in contrast to high valued, customized products. The second explanation is market structure, affecting both the availability of alternative suppliers and incentives for firms to pass on cost increases to customers rather than to absorb such cost increases.

Limitations of the study

Four reasons make the results of this study predominantly indicative of what could happen if transport costs increase. One, a limited set of (Dutch) firms was examined. In general terms however the findings are comparable with those of similar studies that were conducted in other industries throughout Western Europe. Two, only two policy scenarios were examined. Policy interventions that result in other levels of transport cost increases may yield more or less intensive logistical adaptations than those that were found in this study. Three, the study addressed contemporary logistical practices and logistical trends in the next ten years. It is not certain which logistical paradigms will be dominant in future and how they will affect the importance of transport costs. Four, uncertainty has remained about long-term effects of a structural increase in transport costs on locational choice and centralized or focused production.

Implications for theory and practice

The theoretical starting point of the study was logistical theory. This theory does not address heterogeneity in logistical behavior but rather assumes a convergence towards 'supply chain management'. This study however suggests that various logistical paradigms co-exist. Therefore it is recommended that logistical scientists adopt the notion of logistical heterogeneity and explore the main paradigms next to that of supply chain management. A second recommendation is to employ a multidisciplinary theoretical framework, since logistics management can not be understood fully when reducing it to the efficient and effective management of goods flows in order to meet customers' requirements.

Economic theory was used in order to demonstrate the need to internalize external costs of (freight) transport. In theory it could make shippers more aware of the transport implications of their decisions and result in a more efficient use of transport resources. This study demonstrated some limitations of 'optimal pricing', e.g. not all logistical choices can be reversed and it will not necessarily lead to a higher welfare. It is recommended that more research is devoted to the efficiency of optimal pricing in terms of social welfare and the exploration of alternative instruments to pricing.

The main conclusion regarding transport policy is that higher transport costs will primarily result in a more efficient use of transport means. A modal shift can only be realized if two preconditions are fulfilled: (a) innovations in multimodal transport of small shipments (e.g. pallets); (b) a reduction in transshipment costs. Policy makers and politicians should not overestimate claims of shippers and carriers about negative consequences of higher taxes or increased congestion. Logistical processes appear to be quite flexible and eventually, transport costs have a low impact on end product prices. The Dutch cabinet Balkenende-I seemed to have chosen for more asphalt and lower fuel taxes, i.e. *lower* transport costs. This cabinet however fell at the time of finalizing this dissertation. It was unknown what the new cabinet would do. If it would adopt the plans of the Balkenende-I cabinet, it only reinforces an increasing transport-intensity of production and distribution, resulting in more pollution, congestion, and traffic unsafety.

Samenvatting

Achtergrond en onderzoeksdoel

Het goederenvervoer is aanzienlijk toegenomen in de afgelopen decennia. De verwachting is dat deze trend zich zal voortzetten, in het bijzonder in het goederenwegvervoer. Deze ontwikkeling is deels tegenstrijdig met beleidsdoelstellingen die momenteel door verscheidene West-Europese overheden en de Europese Commissie worden gehanteerd. Deze doelstellingen zijn gericht op een afname van de negatieve effecten van het goederenvervoer, zoals vervuiling, congestie en de bijdrage aan verkeersonveiligheid.

Naar verwachting zullen de bovengenoemde overheden in de komende jaren verschillende instrumenten inzetten om hun beleidsdoelen te realiseren, waaronder hogere heffingen op het goederen(weg)vervoer. Tot nu toe is echter weinig systematisch onderzoek verricht naar de effecten van prijsbeleid. Het doel van deze studie was deze kennisleemte deels op te vullen. De nadruk lag op effecten van transportkostenverhogingen op logistieke beslissingen van verladers (producenten, groothandelaren etc.). In de eerste plaats zijn het namelijk verladers die de vraag naar goederenvervoer genereren. In de tweede plaats heeft onderzoek aangetoond dat de recente groei in het goederenvervoer deels is veroorzaakt door een meer transport-intensieve inrichting van productie en distributie (bijvoorbeeld door centralisatie van voorraden en fabrieken), wat is mogelijk gemaakt door gedaalde transportkosten.

Analytisch raamwerk

Toenemende transportkosten kunnen de vraag naar goederenvervoer beïnvloeden via vele soorten logistieke aanpassingen. Volgens de literatuur zijn met name binnen de volgende drie aspecten van de logistiek aanpassingen te verwachten:

- de structuur en het ruimtelijke patroon van het productie- en distributienetwerk;
- de besturing van de goederenstroom, zoals de frequentie van orders per tijdseenheid;
- het management van transportmiddelen: het proces waarin individuele zendingen worden omgezet in fysieke verkeersbewegingen.

Dit onderzoek verkende met name effecten van transportkostenstijgingen op de eerste twee aspecten van de logistiek (de organisatie van productie en distributie genoemd), omdat deze voornamelijk binnen de invloedssfeer van verladers liggen. Het transportmanagement daarentegen wordt doorgaans overgelaten aan vervoerders.

De literatuur geeft ook aan dat verladers gewoonlijk een brede opvatting hanteren van transportkosten in beslissingen die direct of indirect met transport te maken hebben. Zij kijken niet alleen naar de directe transportkosten (de tarieven van vervoerders), maar ook naar indirecte transportkosten die vooral samenhangen met doorlooptijden en leverbetrouwbaarheid (bijvoorbeeld rente op pijplijnvoorraad). In deze studie is daarom het zogenaamde gegeneraliseerde transportkostenconcept gehanteerd.

Belangrijkste bevindingen

De effecten van hogere transportkosten op productie en distributie zijn onderzocht voor twee cases: boeken en kranten. De analyse richtte zich op de hele keten en omvatte de volgende sectoren: papierproductie, papiergroothandel, dagbladuitgeverij, boekenuitgeverij, boekdruk, boekbinders, boekendistributie en oud papierinzameling en –groothandel.

Twee scenarios zijn onderzocht waarin transportkosten stijgen door bepaalde veronderstelde prioriteiten in het vervoersbeleid:

- "eerlijke en efficiënte prijszetting": in dit scenario worden alle externe kosten van het vervoer doorberekend aan vervoerders die in West Europa opereren;
- "tekortschietende infrastructuurvoorziening": in dit scenario is de infrastructuurvoorziening onvoldoende om de groei in het (goederen)vervoer op te vangen, leidend tot een sterke toename van congestie.

A. Het "eerlijke en efficiënte prijszetting" scenario : hogere directe transportkosten

Aangenomen werd dat 'internalisering' van alle externe kosten van goederenvervoer leidt tot een substantiële toename van de gemiddelde vervoerstarieven (zie Tabel 1).

Tabel 1: Aangenomen veranderingen in vervoerstarieven door internalisatie

Wegvervoer	Binnenvaart	Spoorvervoer	Luchtvracht	Intercontinen-tale zeevaart	Short sea shipping
+ 50%	+ 40%	+ 50%	+ 25%	+ 50%	+ 40%

Ondanks de forse toename van transportkosten zal de organisatie van productie en distributie van boeken en kranten naar verwachting ongewijzigd blijven. De voornaamste verwachte logistieke aanpassingen zijn een hogere efficiency van het vervoer door toenemende consolidatie en een verminderde vraag naar vervoersdiensten door een lagere orderfrequentie. Ruimtelijke aanpassingen zullen beperkt blijven tot kleinere geografische afzetmarkten, doordat verder weggelegen klanten verloren gaan.

In sommige situaties worden verder meer lokale of regionale toeleveranciers gezocht. Het niveau van customer service in termen van orderdoorlooptijden en leverbetrouwbaarheid zal niet worden aangepast. Een substantiële verhoging van transportkosten zal daarom niet leiden tot significante wijzigingen in de organisatie van productie en distributie. In de meeste sectoren zal het grootste deel van de vracht over dezelfde afstanden worden vervoerd. Verschil is wel dat deze goederenstromen op een efficiëntere wijze zullen worden afgewikkeld, waardoor minder voertuigkilometers nodig zullen zijn.

B. Het "tekortschietende infrastructuurvoorziening" beleid: hogere indirecte transportkosten

De gevolgen van het "tekortschietende infrastructuurvoorziening" scenario zijn samengevat in Tabel 2 en 3. Daarnaast werd een toename van tarieven met 20 procent verondersteld.

Tabel 2: Aangenomen veranderingen in doorlooptijden door een sterke toename van congestie

Wegvervoer	**Binnenvaart**	**Spoorvervoer**	**Luchtvracht**	**Intercontinen-tale zeevaart**	**Short sea shipping**
+ 30%	+ 25%	- 5%	+ 20%	+ 7.5%	+ 7.5%

Tabel 3: Aangenomen veranderingen in leverbetrouwbaarheid door een sterke toename van congestie

Wegvervoer	**Binnenvaart**	**Spoorvervoer**	**Luchtvracht**	**Intercontinen-tale zeevaart**	**Short sea shipping**
10% aankomsten ≥ 15 min. te laat	25% afvaarten ≥ 4 uur te laat	25% shuttles ≥ 1 uur te laat	10% vluchten ≥ 3 uur te laat	10% afvaarten ≥ 1 dag te laat	20% afvaarten ≥ 0.5 dag te laat

Verladers beschouwen langere doorlooptijden en een verminderde leverbetrouwbaarheid problematischer dan hogere directe transportkosten, vooral omdat zij concurreren op customer service (snelle, frequente en betrouwbare levering). Langere doorlooptijden en een verminderde leverbetrouwbaarheid zullen naar verwachting leiden tot minder concurrerende diensten. Dit zal weer leiden tot een groter verlies aan (verafgelegen) klanten dan in het geval van het "eerlijke en efficiënte prijszetting" scenario. Toch zullen langere doorlooptijden en een verminderde leverbetrouwbaarheid weinig invloed hebben op de organisatie van productie en distributie, buiten de omvang van geografische markten. De verladers die logistieke aanpassingen voorzagen, noemden vooral een decentralisatie van productie of voorraden, aanpassingen in de planning van logistieke activiteiten (soms zelfs langere openingstijden) en wijzigingen in het vervoer (zoals meer nachttransport).

Verklaringen voor de bescheiden invloed van transportkosten

De belangrijkste conclusie is dat hogere transportkosten slechts een bescheiden invloed zullen hebben op de manier waarop bedrijven productie en distributie organiseren. Dit kan worden verklaard door de volgende factoren:

- relatief hoge kosten van andere logistieke inputs (zoals voorraden of fabrieken);
- verzonken investeringen, die verplaatsing van fysieke faciliteiten verhinderen;
- voorkeuren van de klant. Langere orderdoorlooptijden met als doel het transport efficiënter af te wikkelen, worden bijvoorbeeld meestal niet geaccepteerd.

Er bestaan echter verschillen in de reacties van bedrijven. Eén verklaring heeft betrekking op producteigenschappen. Laagwaardige producten met een relatieve stabiele vraag kunnen tegen geringe meerkosten decentraal worden opgeslagen, in tegenstelling tot hoogwaardige producten die op klantspecificaties worden gemaakt. De tweede verklaring is marktstructuur, van invloed op de beschikbaarheid van alternatieve leveranciers en de prikkels die een bedrijf heeft om transportkostenstijgingen op te vangen c.q. door te berekenen.

Beperkingen van het onderzoek

De resultaten van dit onderzoek zijn vooral indicatief voor wat er kan gebeuren als transportkosten stijgen. Hiervoor zijn vier redenen. Ten eerste is een beperkte groep van (Nederlandse) bedrijven onderzocht. In algemene termen zijn de uitkomsten echter vergelijkbaar met soortgelijke studies in andere sectoren in heel West-Europa. Ten tweede zijn er slechts twee beleidsscenario's onderzocht. Beleidsinterventies die leiden tot andere niveaus van transportkostenstijgingen kunnen meer of minder intensieve reacties tot gevolg hebben dan in deze studie zijn gevonden. Ten derde ging deze studie in op hedendaagse logistiek en de trends in de komende tien jaar. Onduidelijk is welke logistieke paradigma's in de toekomst zullen domineren en welke invloed dat zal hebben op de rol van transportkosten. Tenslotte blijft onzekerheid bestaan over lange-termijneffecten van een structurele transportkostenstijging op locatiekeuze en gecentraliseerde of gespecialiseerde productie.

Implicaties voor theorie en praktijk

Het theoretische uitgangspunt van het onderzoek was de logistieke theorie. Deze discipline heeft geen aandacht voor heterogeniteit in logistiek gedrag maar veronderstelt een convergentie richting 'supply chain management'. Dit onderzoek suggereert echter dat verschillende logistieke paradigma's naast elkaar bestaan. Daarom wordt aanbevolen dat logistici de notie van logistieke heterogeniteit erkennen en de belangrijkste logistieke paradigma's naast supply chain management in kaart brengen. Een tweede aanbeveling is om een multidisciplinair theoretisch raamwerk te hanteren, omdat logistiek niet volledig kan worden begrepen als dit wordt teruggebracht tot de efficiënte en effectieve besturing van goederenstromen met als doel aan klantenwensen te voldoen.

De economische theorie is gehanteerd om de noodzaak aan te tonen van doorberekening van externe kosten van (goederen)vervoer. In theorie zou het verladers namelijk bewuster kunnen maken van de vervoersimplicaties van hun logistieke beslissingen wat kan leiden tot een efficiënter gebruik van schaarse (transport)hulpmiddelen. Dit onderzoek toonde de grenzen van 'efficiënte' of 'optimale' prijszetting aan. Zo zijn niet alle beslissingen flexibel of terug te draaien. Tevens staat niet op voorhand vast dat de totale welvaart door internalisering wordt verhoogd. Aanbevolen wordt om meer onderzoek te doen naar de welvaartseffecten van beprijzing en naar 'second-best' instrumenten naast beprijzing.

De belangrijkste conclusie voor het ministerie van Verkeer en Waterstaat is dat hogere transportkosten vooral leiden tot efficiënter vervoer. Grootschalige veranderingen in de vervoerswijzekeuze zijn niet te verwachten. Het ministerie kan daarom beter zijn aandacht besteden aan de accomodatie van vervoersefficiency. Beleidsmedewerkers en politici wordt tevens aanbevolen om uitspraken van vervoerders- en verladersorganisaties over de negatieve gevolgen van prijsbeleid of congestie kritischer te evalueren. Dit onderzoek heeft namelijk aangetoond dat logistieke processen vrij flexibel zijn en dat transportkosten uiteindelijk een zeer beperkte betekenis hebben in de prijzen van eindproducten. Het kabinet Balkenende-I leek gekozen te hebben voor meer asfalt en lagere brandstofprijzen en dus voor een verlaging van de transportkosten. Dit kabinet viel echter vlak voor de afronding van dit proefschrift. Het was nog niet bekend wat het nieuw te vormen kabinet zou gaan doen. Indien dit echter de beleidslijn van het kabinet Balkenende-I zou doorzetten, zal dit de trend van een toenemende transport-intensiteit van productie en distributie alleen maar versterken, leidend tot meer vervuiling, congestie en verkeersonveiligheid.

About the author

Hens Runhaar was born in Almelo (the Netherlands) on the 1st of May, 1971. After graduating from the Christelijk Lyceum Almelo in 1989, he studied Public Administration at University of Twente in Enschede.

During his studies, Hens was particularly interested by courses in economics and sociology. He acquired practical experience via two internships, one at the Chamber of Commerce in Chartres (France), and a second at the Transport Research Center (AVV) in Rotterdam. In 1994 he completed his Master's thesis on card and tariff systems in public transport.

During Hens' work at AVV, he became interested in research in the field of transport and traffic. After his military service in 1995, he began working as a researcher at the Erasmus University in Rotterdam, in the department of Regional, Port and Transport Economics. During 1997-1998, Hens worked as an advisor at AGV Consultancy for transport and traffic in Nieuwegein.

Following his ambition to qualify as a scientific researcher, Hens started a PhD study at Delft University of Technology, in the Economics of Infrastructures section, in December 1998.

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