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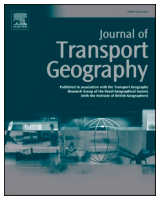

The limited regional employment benefits of XXL-logistics centres in the Netherlands

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ABSTRACT

In the Netherlands, a shift occurred over the last two decades from positively framed spatial-economic policies promoting the development of extra-large distribution centres (DCs) and their claimed positive employment benefits towards a critical stance questioning the benefits of such policies, fuelled by the connected debate regarding the extensive land use and environmental impacts of DCs. In this paper, we unravel the assumed regional employment benefits of DCs into (i) direct employment benefits within the DCs, (ii) indirect employment benefits in the supply chain, and (iii) employment benefits from structural changes in regional production systems around DCs. We analyse these benefits using detailed business microdata and logistics-building data over a 20-year timeframe in the East-Southeast freight corridor (from Rotterdam to Germany). In the corridor, logistics footprint has doubled, and average DC size has tripled in this timeframe. We demonstrate that, although part of the hypothesised benefits can be spatially identified, employment benefits of new DCs decrease over time, due in part to automation and use of migrant labour. The expected co-agglomeration of manufacturing near DCs does not occur structurally, and although DC-favouring regions have successfully established competitive logistics business ecosystems, they can be vulnerable to a spatial-economic lock-in, relying primarily on the logistics sector. The spatial-economic policy narratives framing DCs as employment catalysts are thus of limited validity.

1. Introduction

Globally, extra-large distribution centres (XXL DCs) have grown at an unprecedented rate to accommodate the growing e-commerce sector and to support multinationals in buffering their inventories (Heitz et al., 2017; Lafrogne-Joussier et al., 2022; Onstein et al., 2019; Witte, 2014). The potential of logistics clusters—and logistics services within broader clusters—as drivers of employment and economic growth has been suggested by various researchers (Hesse, 2020; Palazuelos, 2005; Rivera et al., 2014; Sheffi, 2012). The assumed importance of DCs in providing direct and indirect employment, productivity gains due to innovative *smart-logistics*, services for citizens and companies, and broad contributions to regional prosperity are typically the main arguments (Danyluk, 2019; Hesse, 2020, p.8). Long-standing trade hub regions such as Rotterdam and Chicago have constructed narratives around their position as a vital gateway (Cronon, 1991; Nefs et al., 2022). Regions in the hinterland of such hubs often tap into the possibilities of logistics, being the "conveyor belt of the globalized world" that has gained great power to organise regions (Hesse, 2020, p. 7). Logistics is seen as "the flattener" in the playing field of suppliers (Sheffi, 2012, 2013, p. 267) that makes it possible for any connected region to attract businesses in the same fashion as metropolitan centres. Similarly, Stimson et al. (2006, pp. 8- 9, 214) claim that the presence of large-scale logistics is a pre-condition for a regional competitive environment. Nearly three decades ago, Castells (1996) considered logistics and other network systems as vital conditions in the *network society* to concentrate services, production, capital, and power.

More recently, there are concerns about the added value of DCs. Since the late 1990s, regional economic policy goals have gradually shifted from generating employment in absolute numbers to simultaneously increasing the wages and living conditions within a region (Stimson et al., 2006, p.3). It is argued that flexible, precarious jobs in e-commerce DCs are linked with undesirable working conditions and decreasing income (WRR, 2020; Yuan, 2019, p. 535). In the

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Netherlands, this discussion includes critiques that DC-favouring policies lack proof of local added value and sustainability, instead resulting in extensive land use, congestion, and *landscape boxification* (CRa et al., 2019; Rli, 2016). Several Dutch regions nonetheless attempt to stimulate, attract, and facilitate logistics cluster development, through regional and local policies or as part of national strategies, such as the Dutch *Topsector* policy (identifying and providing stimulus for the industries in the Netherlands with the highest added value, including logistics) and a *Freight Corridor* strategy (EZK, 2019; IenM, 2017; I&W, 2019; Panteia et al., 2019; Raspe, 2012). Since the economic crisis of the 1980s, characterised by large unemployment particularly in the Netherlands, job creation has been a key motivator to stimulate and facilitate spatial policies that favour logistics developments in the Netherlands (Nefs et al., 2022; VROM, 1988).

Currently, a public-private narrative is under development, which concentrates on so-called *smart logistics*, or the integration of logistics and reshoring of manufacturing (Dhyne et al., 2022); in the Netherlands, these are branded with names like Make it in Tilburg[1] and Makes & Moves. The indirect employment reasoning for the development of DCs is often based on successful case-study evidence, such as the value-added logistics activities of the automobile DC in the Port of Rotterdam (Sheffi, 2012, p. 142). Similarly, the reasoning of poor labour conditions is based on fragmented and exemplary information (van Bergeijk, 2019). Overall, it remains unclear how spatial employment effects of large DCs have structurally developed across regions in the Netherlands beyond the limited number of harmful or beneficial practices reported in the literature and media. Specifically, more clarity is needed regarding the different employment effects of spatial policies promoting XXL logistics developments to inform current policy approaches between the polarised extremes from full stimulation to a construction ban.

Much of the recent growth in the number and size of DCs worldwide has occurred in hinterland regions (Hesse, 2004; Raimbault, 2021; Yuan, 2019), some of which have actively stimulated logistics developments through spatial-economic policies. It can be argued that these regions distinctly changed their spatial employment structure (towards distribution-related activities) compared to similar regions that did not adopt such policies. The contribution of this study is to analyse this argument by investigating three employment effects: (i) direct employment growth in DCs; (ii) indirect effects in manufacturing and supplying sectors; and (iii) agglomeration effects concerning the regional business ecosystem with an enlarged and more dedicated regional production system.

Although these effects have been discussed in existing literature on aggregate level—for instance, estimating the employment share of logistics at around 5% of total employment and the regional (employment) density of warehousing—a systematic quantification at the individual firm level is largely absent, arguably due to limited availability of detailed data (Cidell, 2010; Coe and Hess, 2013; Yuan, 2021). In our case, we have the rare opportunity to combine microdata on the firm and building level, concerning logistics real estate developments and employment numbers in the entire country over a long period.

The main question addressed in this paper is as follows: *How have employment patterns in regions with spatial policies favouring logistics developments evolved compared to nearby and similar regions without these policies?* We address this question by analysing the Dutch East-Southeast freight corridor, which is the main transportation axis between the port of Rotterdam and Germany, in the period between 2000 and 2020. We use establishment microdata of employment numbers as well as data on the development of individual logistics buildings. Our establishment level microdata do not contain information on the quality or skill-level of employment. A complementary literature, largely from California, points to increasing automation and low-skill migrant labour in DCs, as well as declining working conditions and employment benefits in DCs (Bakker et al., 2019; De Lara, 2013; Emmons Allison et al., 2018; Gutelius, 2015; Husing, 2004; Yuan, 2019).

In Section 2, we formulate our hypothesis by reviewing the literature on the employment effects of logistics cluster developments and spatial policies favouring specific sector clusters such as logistics. Section 3 presents our three-fold methodology to unravel three complementary employment effects over time and introduces the datasets. Subsequently, we analyse the case of the East-Southeast corridor in the Netherlands, focusing on policy approaches regarding DC developments. In Section 4, we interpret the study results. In Section 5 we propose a framework for the evaluation of employment impacts of spatial policies favouring clusters of a particular industry such as logistics. Finally, in Section 6 we conclude on policy implications and opportunities for further research.

2. Spatial policies aimed at employment effects: a review applied to logistics

Job creation through sector-specific spatial policies as a form of place-based policy (Barca, 2009; Neumark and Simpson, 2015) has been adopted in many regions across the globe, based on the belief that beneficial spatial conditions will attract firms and thus create employment opportunities (Kline and Moretti, 2013). Conversely, these conditions may attract skilled talent and thereby knowledge-intensive firms (Florida, 2000). While intuitive to practitioners, the causal mechanism underlying place-based employment policies is the subject of a long-standing debate among researchers (Steinnes, 1982; Hoogstra et al., 2017). A related question is whether these place-based policies result in local employment or outsourced effects in other locations in the production chain through interurban growth transmission (Pred, 1977). In Dutch spatial-economic policy, logistics developments have often been proposed to reduce unemployment (Nefs et al., 2022). In line with current literature, we evaluate the regional employment effects of logistics developments from three perspectives: direct, indirect and agglomeration effects.

2.1. Direct effects: distribution centres as employment generators

Stimulation of DC development is generally associated with significant growth in blue-collar jobs and positive yet limited growth in technical and managerial jobs within the DCs (BCI, 2019; Hesse, 2020; Yuan, 2019). Coe and Hess (2013, p. 34) describe a bifurcated labour market with on the one hand "the growing need for skilled workers to operate in a sector that is partly driven by technological innovation" and on the other hand a large workforce "characterized by low skills, low wages, contingency, insecurity and racialization." Logistics employment growth may be partially offset by relocation effects caused by (de)centralising distribution structures (Cidell, 2010; Onstein et al., 2019) and employment loss in retail due to e-commerce (Anderson et al., 2003). Furthermore, the effectiveness of DC development as a policy strategy to reduce unemployment may be partially offset by regional scarcity of specific skills and competencies and unavailability of low-skilled personnel. This may result in labour migration (Bakker et al., 2019) as well as automation to substitute for routine labour inputs (Autor, 2015). A benefit of automation is that it is shown to increase the knowledge intensity of DC employment (Yuan, 2019). Many researchers and policy makers have assumed logistics locations to be fungible, partly footloose, and therefore spatially homogeneous (Santos, 2006; van Geenhuizen and Nijkamp, 2005), while others have emphasised the heterogeneity and concentration of DC locations (Heitz et al., 2019). As there is no consensus on this issue, the first analysis of this study seeks to assess the direct employment growth of logistics and its spatial patterns in detail across regions, by analysing microlevel direct logistics employment.

[1] Midpoint Brabant https://midpointbrabant.nl/smartlogistics/ and Dinalog https://www.dinalog.nl/

2.2. Indirect effects: employment benefits of distribution centres in related sectors

The discourse on indirect effects of DCs is rooted in the economic clusters and place-based policies, which have become increasingly popular since 2000 (Delgado et al., 2010; Porter, 1998, 2000). Proponents of logistics cluster development claim that employment spillovers occur in nearby locations through co-agglomeration by attracting other logistics firms, manufacturers (e.g. tech, agrifood), retailers, and service providers in the value chain (Chhetri et al., 2014; Sheffi, 2012, p. 121). An example of indirect employment creation is value-added logistics (VAL) which enable *product differentiation* closer to the end user, services for (SME) manufacturers, and the *servicification* of the manufacturing sector (Hill, 2020, p. 61; Soinio et al., 2012). VAL is a particularly relevant example of indirect employment effects organised in the DCs themselves, generating "relatively complicated jobs commanding higher salaries" (Sheffi, 2012, pp. 121–122, 140) and inter-spatial competition (Danyluk, 2019, p. 94).

The precise identification of this spatial-economic multiplier effect of logistics is a subject of debate. Political and business proponents of DC developments, for example, in free trade (sub)zones in the U.S., have used manufacturing job generation as a primary argument for over a century, despite the inability of researchers to fully identify the net employment effects (Orenstein, 2019, pp. 176, 185). While there are some notable successful examples of (reshoring of) manufacturing and high-skilled jobs related to DCs (Sheffi, 2012), the geographic scope of these effects is not clear. In contrast, others argue that DC development is needed to keep up with existing growing regional manufacturers (Stec Group, 2020), in which case increasing manufacturing jobs might also be expected. Although new forms of manufacturing—in tandem with logistics—are considered to be of importance to circular and socially inclusive regions (Hill, 2020), there is still a lack of evidence of DC developments structurally attracting manufacturing firms in regions. In the Dutch context, this issue would relate to subsectors such as agrifood and (high)tech manufacturing, which can co-evolve with and depend on logistics activities (Van Oort et al., 2015). This second empirical analysis, therefore, focuses on whether firms that may be involved in such supply chain spillovers should structurally locate nearby DCs.

2.3. Agglomeration effects: distribution centres as catalysts in regional business ecosystems

Regional agglomeration effects of co-agglomerating economic activities were first classified by Marshall (1890); they reduce search costs associated with labour demand and supply matching (labour pooling), subcontracting relations (input-output linkages), and learning relations (knowledge spillovers). Such effects explain the success of several economic clusters by reducing the cost of moving goods, people, and ideas. Ellison et al. (2010) determined that input-output linkages were most influential in co-agglomeration, followed by labour pooling and knowledge spillovers in the U.S. More recent studies focusing on sector heterogeneity (Faggio et al., 2017) have found that "technology-intensive industries value knowledge spillovers more, while labour market pooling and input-output linkages are more relevant for low-skilled industries" (Diodato et al., 2018; Steijn et al., 2022, p. 2). In addition, knowledge spillovers have become more important than the other two agglomeration effects, stimulated by increased skill intensity of most sectors as well as trade and technology shocks (Diodato et al., 2018; Steijn et al., 2022). While the Marshallian effects are rooted in regional specialisation, diversification of economic activities has also been found to determine agglomeration effects (Jacobs, 1969; Van Oort et al., 2015), or combinations thereof, such as *smart-specialisation*.

According to Van den Heuvel et al. (2014), clusters with co-agglomerated logistics establishments produce the three Marshallian agglomeration effects: (1) availability of truck drivers and warehouse personnel, (2) scale and scope advantages regarding transport capacity, accessibility and expansion opportunities, and (3) better maintenance and logistics services. The study offers disadvantages of logistics agglomeration as well, such as infrastructure congestion and increased land prices. Logistics clusters also have the potential to facilitate knowledge spillovers (Van Oort and Bosma, 2013). Furthermore, Warffemius (2007) states that "economies of agglomeration—and not the air transport services themselves—are the most important location forces responsible for the attraction of EDCs [European DCs] into the Schiphol area". This third analysis therefore assesses the role of DC developments as a catalyst of regional agglomeration effects.

We empirically assess the employment effects of DC developments in Dutch regions pertaining to the ESE-corridor as generally accepted in policy and research to test the threefold hypothesis that DCs (i) stimulate direct employment in situ, (ii) attract nearby manufacturers and suppliers in the value chain, and (iii) create regional agglomeration effects. Particularly for dedicated XXL logistics developments, with international rather than local linkages as well as rapidly changing operational contracts, we analyse whether logistics activities are spatially co-agglomerated with other sectors locally and regionally.

3. Methodology and case study corridor

3.1. Methodology and data

We use three applied methods from economic geography to test the three multilevel employment effects hypothesised in the previous section. These methods are not only effective in evaluating the separate effects, but they are also able to take longitudinal business microdata as input. As such, they provide a coherent view of the three effects in the same period in the same local and regional areas, in comparison with the case study corridor and national scales. The three effects are complementary rather than cumulative or overlapping. First, we assess the direct employment effects of DCs by mapping detailed spatial employment density. Second, we assess indirect effects by applying the co-agglomeration index (Ellison et al., 2010; Steijn et al., 2022), showing the degree of physical proximity of logistics firms to other industries in our study area. Third, we assess regional agglomeration effects by identifying the national, industry-mix, and regional components of employment growth in a shift-share analysis—utilised by Marti (1982) and Adão et al. (2019) for distribution applications. We use the results of the threefold methodology to propose an evaluation framework for the impacts of spatial policies favouring developments of an economic sector such as logistics over time. Our approach to employing these methods is briefly outlined below.[2]

For the analyses, we use longitudinal employment microdata containing full and part-time jobs per firm establishment location (geo-specific points) for all firms in the Netherlands, organised per 5-digit sector code for the years 2000, 2010, and 2017.[3] We aggregate these data into different spatial units: 100mx100m grid cells and NUTS3 labour market regions for direct employment, NUTS4 municipalities and the corridor for co-agglomeration, and NUTS3 versus the national level for regional agglomeration effects. By taking this approach, our analysis is more detailed than many studies that utilise only regional data. Additionally, we use a dataset of approximately 26.000 logistics buildings located in Dutch business estates (Nefs, 2022a), including

[2] Results for all three parts of the analysis are reproducible via a technical appendix and scripts in the repository (DOI:https://doi.org/10.4121/21438021)

[3] This data is gathered by the LISA Foundation (Stichting LISA) from municipal surveys in collaboration with local chambers of commerce, similar to the facility level data available in Belgium (Strale, 2020, p. 3). This proprietary and privacy-sensitive data can only be published in aggregated or treated form, not revealing individual firm information. An academic license can be petitioned at https://www.lisa.nl/

employment figures for those buildings.[4] In the literature, a DC is often broadly defined as any warehouse to stock products to (re)distribute to retailers, wholesalers, or consumers. Real estate consultancy tends to focus on the subsector of large logistics service providers and e-fulfilment DCs because they are financed and developed differently than other types of real estate (Bak, 2021; Raimbault, 2021). We choose the rather broad definition to capture as much as possible of the disputed employment effects associated with the spatial development of DCs. Therefore, we use a large subset of the logistics-building data, including the logistics subsectors of trade, import and export and goods transportation, warehousing, e-commerce, and logistics services, similar to Heitz et al. (2019) and Strale (2020), in size categories ranging from S ($<2.500m^2$) to XXL ($>40.000m^2$). Particularly for newer DCs, employment data are lacking. To generate density maps, we compensated for this by interpolating average employment numbers of DCs with the same function and size.[5]

3.1.1. Direct effects: mapping employment density score

We generated a comprehensive raster map that displays the employment density of the logistics sector in cells of a 100mx100m grid. This provides a spatial detail that is comparable to individual buildings. We used a kernel density estimation (KDE) heatmap algorithm in QGIS from the individual company points to calculate the density scores. The algorithm is weighed by the number of employees and uses a *quartic* spatial decay function (similar to a normal Gaussian curve) which is a common function for this type of research (Ward, 2016, p. 38). The radius of the decay is set to 2 km, which is similar to the size of a medium-sized business estate in the Netherlands. We found that smaller radii result in a map of individual DC developments without showing cluster effects, while larger radii produce a flat map in which employment concentration areas are not distinguishable. The resulting map provides a highly detailed representation of the spatial concentration of employment in the logistics sector. It enables the identification of emerging and declining sites in the time intervals between 2000, 2010, and 2020. Specifically, the concentration of employment in designated XXL logistics parks is well represented via increasing density scores. Additionally, we have summarised regional employment and development figures for logistics employment in a descriptive table. Both the map and the table are longitudinally constructed, allowing a detailed comparison per region over time.

3.1.2. Indirect effects: co-agglomeration index

Spatial concentration of sectors can be measured by various indicators, including the location quotient, its derivation horizontal cluster location quotient, the locational Gini coefficient, the Herfindahl-Hirschman index, and Moran's I indicators (Andreoli et al., 2010, p. 81; Fransen, 2020, p. 81). Input-output analysis is designed for analysing intermediate industry deliveries, but it provides little spatial detail. A study on the employment effects of logistics on high-tech manufacturing in South Korea (Kim et al., 2021) shows this limitation. Here, we instead apply the Ellison-Glaeser Index (EGI) for co-agglomeration, which is calculated as the spatial occurrence of 2-digit sector pairs relative to a random co-agglomeration, in the municipalities of the ESE-corridor introduced below. The logistics subsectors, the public sector, and primary sectors (agriculture, forestry, fishing) are excluded from the results since these are not relevant to our analysis of co-agglomeration in the supply chain. The advantage of EGI is that it allows for the interpretation of the observed sector pairs as either potential outcomes of supply chain relations (positive co-agglomeration), relations reflecting natural advantage (e.g., availability of a waterway or natural resources), or spatial incompatibility (negative co-agglomeration), while it eliminates the random location effect. The aggregated company microdata for municipal spatial units provides a higher level of detail than that of the study in the U.S. by Ellison et al. (2010), which aggregates to state and county levels. For brevity, we present bar charts of the ten sectors with the highest and lowest co-agglomeration scores in the corridor for 2000, 2011 and 2017, filtered for sectors known to exhibit location behaviour sensitive to first-nature (not man-made) advantages (Ellison and Glaeser, 1999).

3.1.3. Agglomeration effects: shift-share analysis

In line with a study on the rise of mega DCs by Andreoli et al. (2010), we perform a shift-share analysis for 2000–2017. Whereas the authors use the U.S. state level, we use business microdata aggregated on the NUTS3 regional level. The analysis separates the regional share (advantages in the regional production system) from two other components of employment growth: the national growth share and industry mix (shift) effect. This is performed for the logistics sector itself, of two suggested productive sectors—agrifood and tech/manufacturing—and all remaining sectors combined. We interpret the regional share as an indicator for the total Marshallian agglomeration effects in these sectors, without calculating its components—labour pooling, input-output linkages, and knowledge spillovers—separately (Steijn et al., 2022). The higher the regional share component, the more competitive the region in a sector compared to the other regions. For this, we assume the natural advantage of the separate regions in the case study corridor to be comparable. In the interpretation of the resulting shift-share graphs, we closely examine regions introducing policies favouring DC developments.

The multifaceted view generated by the three applied methods enables us to test our hypothesis of employment effects as claimed and expected by policymakers and researchers.

3.2. Dutch East-Southeast freight corridor

We apply our empirical analysis to the East-Southeast (ESE) freight corridor in the Netherlands, encompassing the busiest goods transport routes in Northwest Europe, between the port of Rotterdam and the German Ruhr area, as well as many DC developments. These conditions make the corridor suitable for analysis in terms of the issues introduced above. The ESE-corridor spans ten NUTS3 regions which we take as a proxy for the corridor, including 150 NUTS4 municipalities. This approach provides the opportunity to distinguish regional policy regimes targeting DC development.[6] The entire ESE-corridor has seen stimulation of the logistics sector through national as well as regional/local policies (Kuipers et al., 2018; Nefs and Daamen, 2022; Raimbault et al., 2016; Raspe, 2012; Rli, 2016; Witte, 2014), including port and

[4] An open-access version of this treated data is available on a repository (DOI: https://doi.org/10.4121/19361018.v1). The dataset contains three layers: the ESE-corridor area, the business estates (based on public information compiled in the Ibis data), and the buildings. For the purpose of this paper, the authors used an enriched version, where the forementioned LISA employment data are joined to each building. Similarly, this information cannot be disclosed for individual buildings. Reproducibility of the analysis, however, is guaranteed by publishing the data treatment scripts on this paper's repository (DOI:https://doi.org/10.4121/21438021)

[5] The 5-digit SBI codes included in the logistics sector, as well as the treatment of missing data, are explained in detail in the technical appendix on the repository (DOI:https://doi.org/10.4121/21438021)

[6] See https://ec.europa.eu/eurostat/web/nuts/background for definitions. While NUTS3 (COROP) region level is not an administrative level in the Dutch governance system, it reflects the (labour) market regions quite well, making it a frequently used scale for spatial-economic research. Spatial-economic policy is for a great deal made by local governments (NUTS4), which often collaborate on NUTS3 level.

hinterland infrastructure investments as well as VAT and labour legislation favourable to DCs.[7] At the provincial and municipal levels, stimulation measures were adopted, and land was supplied to strengthen hinterland logistics clusters such as Greenport Venlo in the east and Port of Moerdijk in the west of the corridor (Panteia et al., 2019).

Fransen (2020) maps the region-specific compositions of the logistics sector in the ESE corridor between 2010 and 2018, finding an increased spatial concentration with regional specialisation in logistics in most regions, measured as location quotient. This may be related to the national and regional policies in the corridor mentioned above. We observe in the microdata that the logistics building footprint in the corridor doubled between 2000 and 2020, while the average building size tripled. A study in the Noord-Brabant Province, in the centre of the ESE-corridor, shows that manufacturing firms are clustered, and many (but not all) are located near large transportation terminals and logistics clusters (Meijer, 2020).

Based on earlier research and policy (Kuipers et al., 2018; Rli, 2016), we focus on three types of regions in the corridor: the port region around Rotterdam traditionally stimulating the logistics sector, hinterland regions with policies favouring DC developments, and hinterland regions without such policies. We identify three regions with strong DC-favouring policies: West-Noord-Brabant, Midden-Noord-Brabant, and Noord-Limburg, which are the top three of the *Logistics Hotspot Ranking*. This ranking[8] was first introduced in 2005 and is based on six criteria, including the relevant policy measures of available logistics construction sites as well as cooperative government. These three regions show a relatively large increase in DCs and have inter-municipal economic development organisations focusing on logistics.[9] The arguments supporting DC development outlined in Section 2 can be clearly observed in the corridor, for example, by Logistics Capital Partners CEO announcing 1.000 jobs in Roosendaal (West-Noord-Brabant): “not only warehouse personnel, but also managers and specialised IT crew”.[10] Another example is an alderman in the Arnhem-Nijmegen region stating “With this new distribution centre and the employment growth of 800 to 1.000 jobs we show that Zevenaar is indeed a logistics hotspot”.[11] Research journalism has recently described several cases of this trend in the Netherlands (Investico et al., 2022; Joosten, 2020; Klumpenaar, 2022). A more systematic view on the argumentation regarding DC development by private and public sectors in the ESE-corridor is provided in recent studies (Nefs, 2022b; Nefs and Daamen, 2022).

4. Results

4.1. Direct effect: regional and local variations in employment growth concentration

Despite the image of a ubiquitous and rapid-growth sector, logistics footprint (Fig. 1) and employment growth for 2000–2020 are not spread evenly across the Dutch territory. Measured across the whole country between 2000 and 2017, the employment microdata show a sector increase of 10.6%, well under the national growth average of 14.2% over all industries; however, there is a significant logistical employment increase in most ESE-corridor[12] regions (Table 1). Furthermore, the data show a large increase in logistics footprint and sprawl, particularly in the ESE-corridor (Figs. 1 and 2). This changing spatial pattern is the result of land supply policies and business decisions, both of which occur on various scales and involve different mechanisms varying per DC size class.[13] In this paper we focus on the ESE-corridor, which is by its proximity to Belgium and Germany preferred for (X)XL national and European DCs, and on regions in the corridor stimulating this type of DC.

Fig. 2 shows the direct spatial employment effects in five areas in the ESE corridor, selected to demonstrate the highly varying logistics employment landscape across business estates in the time intervals between 2000, 2010, and 2020. The top two DC-favouring regions (Noord-Limburg and Midden-Noord-Brabant) show a strong increase in logistics employment concentration in XXL logistics sites, such as Trade Port Noord (Venlo)—with the highest density score in the Netherlands—and Vossenberg-West (Tilburg). Regions without DC stimulation policy show smaller changes in the spatial pattern. The Arnhem-Nijmegen region, for example, experiences smaller growth, whereas Zuidoost Zuid-Holland experiences a shift of employment concentration from older to newer areas around Dordrecht. Some areas even experience a logistics employment decline, such as the business estates of Den Bosch. These heterogeneously changing patterns are confirmed by the regional direct employment numbers provided in Table 1.

Table 1 shows the highest logistics employment growth occurs in the regions with a higher increase in logistics footprint, particularly those with logistics favouring policies. Although this may be a case of correlation rather than causation, it seems evident that adding logistics buildings would result in more jobs in that field. Contrary to some assumptions (Van Geffen et al., 2019), logistics employment and population growth do not correlate unequivocally since logistics employment peaks occur both in regions with low and high population growth. While the regions in the bottom part of Table 1 experience job growth along with population growth, Noord-Limburg experienced a dramatic 44,3% increase in logistics jobs with a doubling of the logistics building footprint and only a 2,8% population increase. On close examination, logistics employment concentrations shift away from population concentrations, particularly in regions with DC-favouring policies (Fig. 2).

Another notable variation concerns the jobs generated per warehouse footprint (space quote). Table 1 lists all logistics sector jobs in the region, including those registered at a DC as well as in offices. Over time, all regions experience a strong decline of approximately 25–50% in employment space quote. Both in 2000 and in 2017, the logistics-stimulating regions show the lowest quotes. This points to a trend of decreasing marginal returns: each added square meter of warehouse yields fewer jobs. We discuss this trend in the next section. Another relevant factor is the average building size: S- and M-sized logistics buildings typically have an employment space quote more than double that of XL and XXL buildings (Nefs, 2022a). In the 2000s and especially after 2010, more XL and XXL warehouses have been built.

In summary, the analysis points to a strong direct effect of DC development and favourable policies, a highly heterogeneous spatial pattern of logistics employment concentration in and across regions, and a decreasing effect of jobs generated per added square meter of the warehouse.

4.2. Indirect effect: weak spatial ties between logistics and other activities

Contrary to the hypothesised effect, Fig. 3 shows that logistics firms do not co-agglomerate strongly with other economic activities in the

[7] In the Netherlands, VAT on goods is delayed to the time of export from the DC. Compared to the more unionised Belgium, less restrictions on night shifts apply in Dutch DCs.

[8] The Logistics Hotspot Ranking, performed by approximately 35 industry experts, is published annually by Logistiek Magazine. https://digimagazine.logistiek.nl/vastgoed/zo_komt_de_logistieke_hotspot_2020_tot_stand (See top 3 data in the repository).

[9] REWIN, Midpoint Brabant and Brightlands/Greenport Venlo

[10] BN De Stem, July 8th 2018 (https://www.bndestem.nl/roosendaal/duizend-banen-in-nieuwe-distri-doos-in-roosendaal~af1e07bf/)

[11] 7Poort business park, November 2019 (https://www.7poort.nl/nieuws/symbolische-start-bouw-distributiecentrum-xxl-op-businesspark-7poort/)

[12] Some other sectors grow faster inside the corridor, including real estate, ICT, and energy.

[13] A body of literature deals with the spatial supply and demand issues of DCs (for example Onstein et al., 2019; Verhetsel et al., 2015)

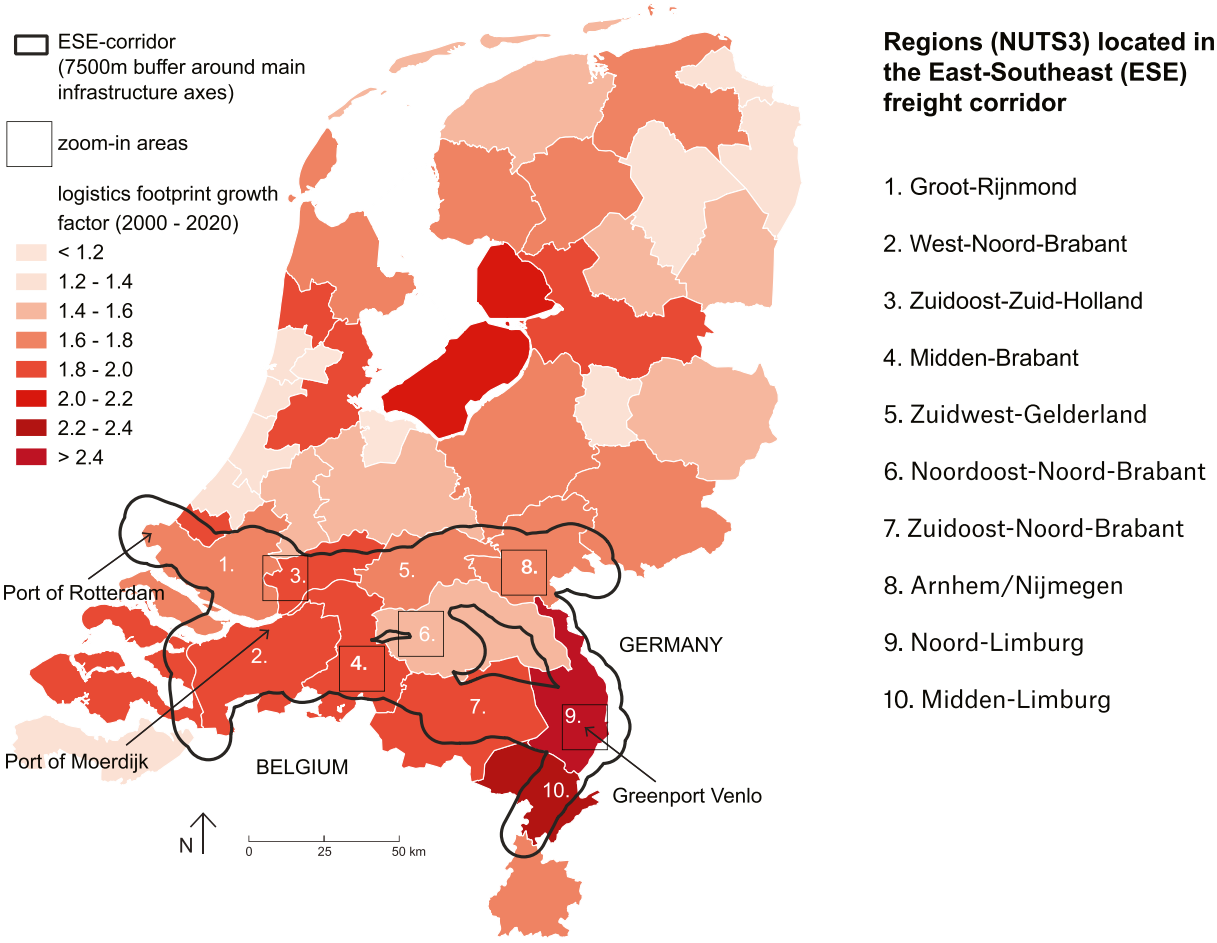

Fig. 1. Growth of the logistics building footprint in Dutch NUTS3 regions for 2000–2020. Most dynamic regions lie within the outlined East-Southeast freight corridor.

Table 1
Employment and warehouse growth in the ESE-corridor. Based on LISA data & Dutch Distribution Centres geodata.

Region	population growth	logistics employment (jobs)			logistics warehouse space (m2)			space quote** (jobs/m2)		
Corop	*2000–2017*	*2000*	*2017*	*growth*	*2000*	*2017*	*growth*	*2000*	*2017*	*growth*
Noord-Limburg*	2,8%	15.566	22.463	44,3%	1.878.869	3.857.767	105,30%	0,008	0,006	−29,7%
Midden-Noord-Brabant*	7,1%	23.728	31.717	33,7%	2.279.685	3.752.634	64,60%	0,01	0,008	−18,8%
Midden-Limburg	7,6%	9.316	12.095	29,8%	580.062	1.305.658	125,10%	0,016	0,009	−42,3%
West-Noord-Brabant*	6,1%	35.234	41.586	18,0%	3.414.983	5.748.339	68,30%	0,01	0,007	−29,9%
Zuidwest-Gelderland	7,0%	16.323	18.811	15,2%	1.269.787	2.030.930	59,90%	0,013	0,009	−27,9%
Zuidoost-Zuid-Holland	−1,9%	23.430	26.738	14,1%	830.653	1.314.341	58,20%	0,028	0,02	−27,9%
Arnhem/Nijmegen	5,7%	26.250	29.942	14,1%	1.551.682	2.331.437	50,30%	0,017	0,013	−24,1%
Groot-Rijnmond	6,5%	88.701	95.232	7,4%	4.872.473	7.125.875	46,20%	0,018	0,013	−26,6%
Zuidoost-Noord-Brabant	7,4%	37.540	39.993	6,5%	2.009.277	3.374.861	68,00%	0,019	0,012	−36,6%
Noordoost-Noord-Brabant	5,6%	38.079	39.763	4,4%	2.326.647	3.262.430	40,20%	0,016	0,012	−25,5%

* Top 3 logistics hotspot ranking regions.
** Including logistics sector jobs outside business estates (e.g. offices).

same municipality.[14] Most sectors show a EGI score of near zero, meaning that they have an essentially random spatial co-agglomeration with logistics. The top-ten co-agglomerating sectors experience a pull effect of logistics that is closer to random than the push effect experienced by the bottom ten, suggesting that logistics does not generally attract other businesses nearby. The two highest co-agglomeration scores (lotteries and casinos, insurance and pensions) are not related to the logistics sector. Recycling, agricultural services, lodging, and printing (e.g. packaging), however, can be considered to relate to logistics and especially VAL activities. Since the co-agglomeration score of waste and recycling can partly be attributed to first-nature drivers of location behaviour (i.e. the availability of natural infrastructure, resources and space), the employment spillovers in the supply chain are also only partly related to the occurrence of DCs (also found in agreement with Steijn et al., 2022). While logistics is increasingly clustered in the ESE-corridor, the results do not indicate increased co-agglomeration of other activities in the supply chain in this area. This outcome is

[14] As a comparison, the highest EGI co-agglomeration scores in the study by Ellison et al. (2010) are around 0.2, while the scores in our analysis do not reach 0.01.

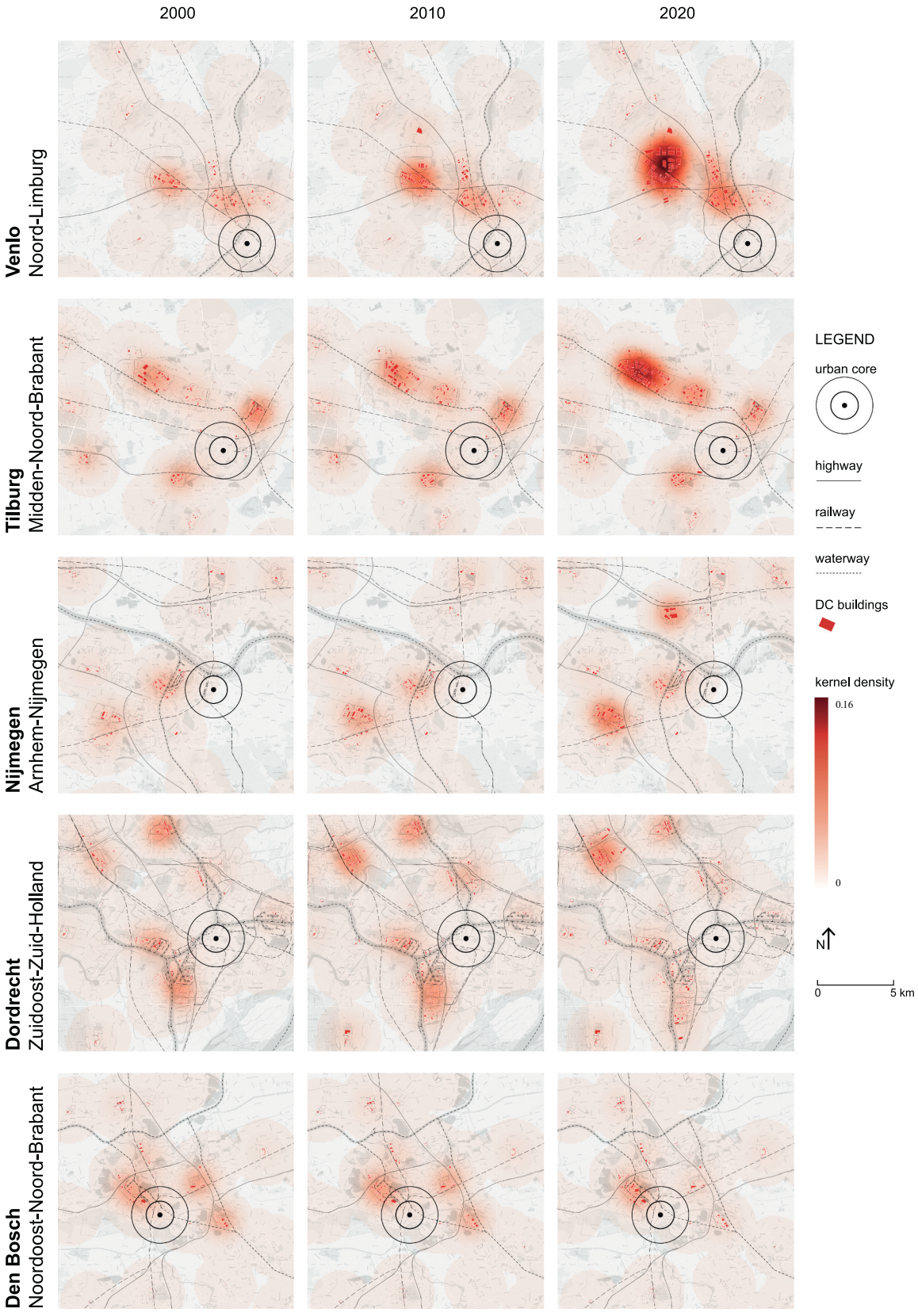

Fig. 2. Logistics employment density maps of business estates in the ESE corridor. The top layer shows the DCs. See the zoom-in squares of Fig. 1 for geographical reference. Based on LISA data & Dutch Distribution Centres geodata.

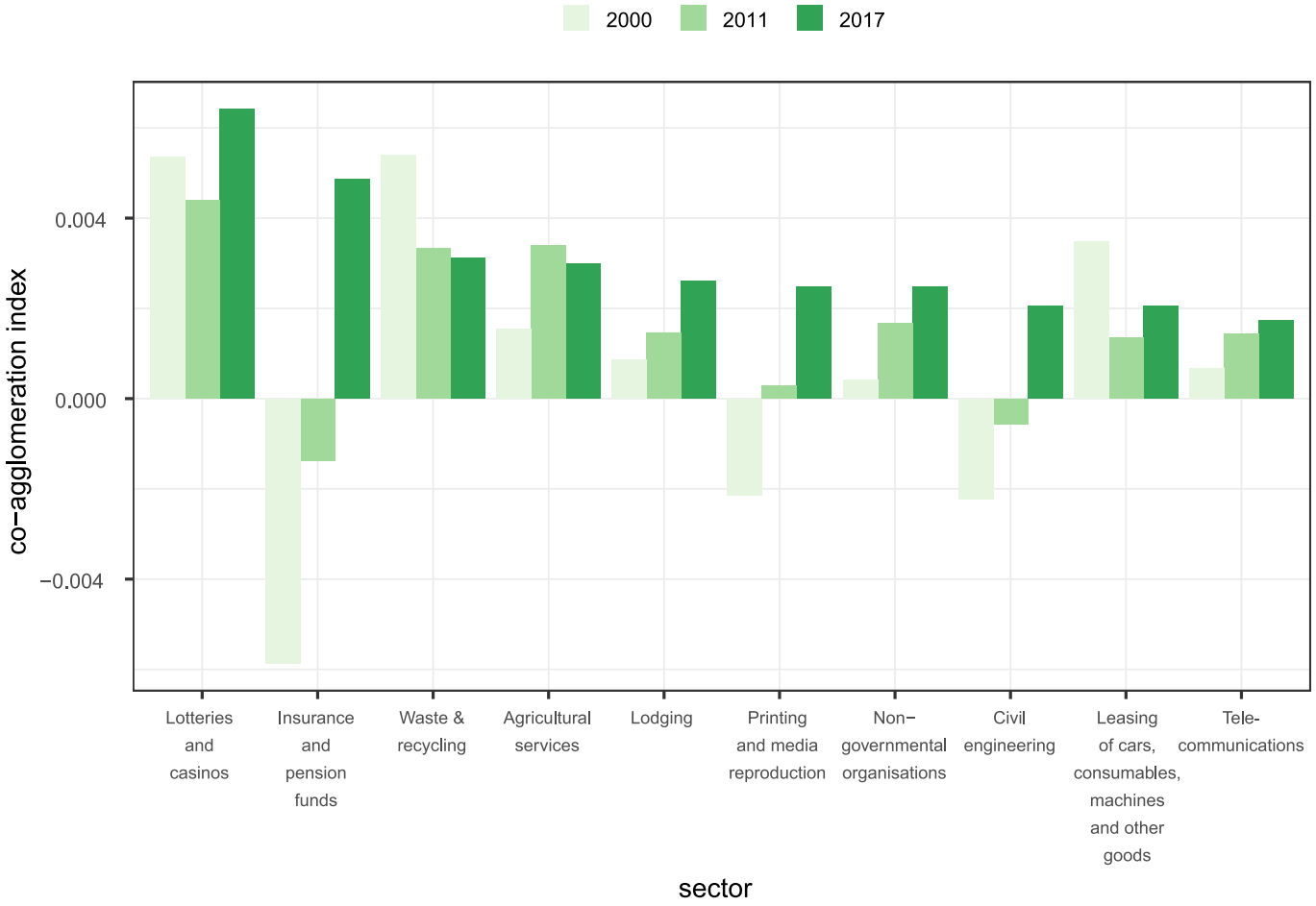

Fig. 3. Top-10 (positive) co-agglomeration scores between logistics and other economic activities in the ESE-corridor. Based on LISA data.

further supported by the ten least co-agglomerating sectors with respect to logistics (Fig. 4), including R&D and innovation. These sectors also include more high-tech forms of manufacturing, such as computers, opto-electrics, auto manufacturing, and pharmaceuticals, which are generally high-value-added industries and among the sectors often targeted by policy makers.

By comparing different periods, we find that both positive and negative co-agglomerating scores change considerably and do not show a consistent pattern of growth or decline. Some co-agglomeration patterns slowly strengthen (e.g. logistics and printing), some already weak ties weaken further (e.g. logistics and R&D), and most co-agglomeration pairs of logistics remain essentially random. In summary, these results do not support the policy reasoning that logistics activities attract value-added activities through supply chain relations at the local level.

4.3. Agglomeration-effect: strong yet monofunctional logistics ecosystem

The results of the shift-share analysis of the regions in the ESE-corridor are shown in Fig. 5. The darker tones in the bar charts represent the regional share, which we use to assess the regional agglomeration effects (or regional competitiveness) as explained above. This measure is the result of the regional employment growth minus the national and industry-related expectations. In the Netherlands, the considerable national employment growth raises expectations across all sectors. In practice, however, some sectors perform below average on the national level, as is the case for the logistics sector. In contrast with the national average, however, the regions in the ESE-corridor have experienced a strong growth in logistics employment, represented by a large regional share. This difference is greater in the three DC-favouring regions. The results, therefore, suggest that strategic positions in the transport network—a key characteristic of the corridor as a whole—as well as DC-favouring policies play an important role in establishing a competitive regional business climate, including specialised services and personnel. Noteworthy exceptions are the regions of Groot-Rijnmond and Zuidoost-Noord-Brabant, including the larger cities of Rotterdam and Eindhoven, which have a more diversified economy.

Contrary to our hypothesis, the observed agglomeration effects of the logistics sector do not correlate with increased regional competitiveness in the key sectors of agrifood and tech/manufacturing, which are often targeted in spatial-economic policies as well. Tech/manufacturing jobs and regional competitiveness declined in most regions of the corridor; this effect was less significant in Zuidoost-Noord-Brabant, which can be explained by the booming tech sector of the *Brainport* Eindhoven. In particular, the logistics-stimulating regions also experienced a decline in agrifood jobs and employment in the other sectors (e.g., services). Across the corridor, increased regional competitiveness of logistics correlates with a decline in competitiveness in the agrifood, tech/manufacturing, and other sectors.

4.4. Summary of employment effects

The threefold analysis shows that (i) a considerable direct logistics footprint and employment growth were realised in the corridor, more so in the regions with DC-favouring policy; (ii) co-agglomeration patterns of other sectors relative to logistics, promoted by policy makers and suggested by researchers, are weak (e.g. printing) or even negative (tech/manufacturing); and (iii) regions in the corridor, particularly those with DC-favouring policies, specialised quickly and developed

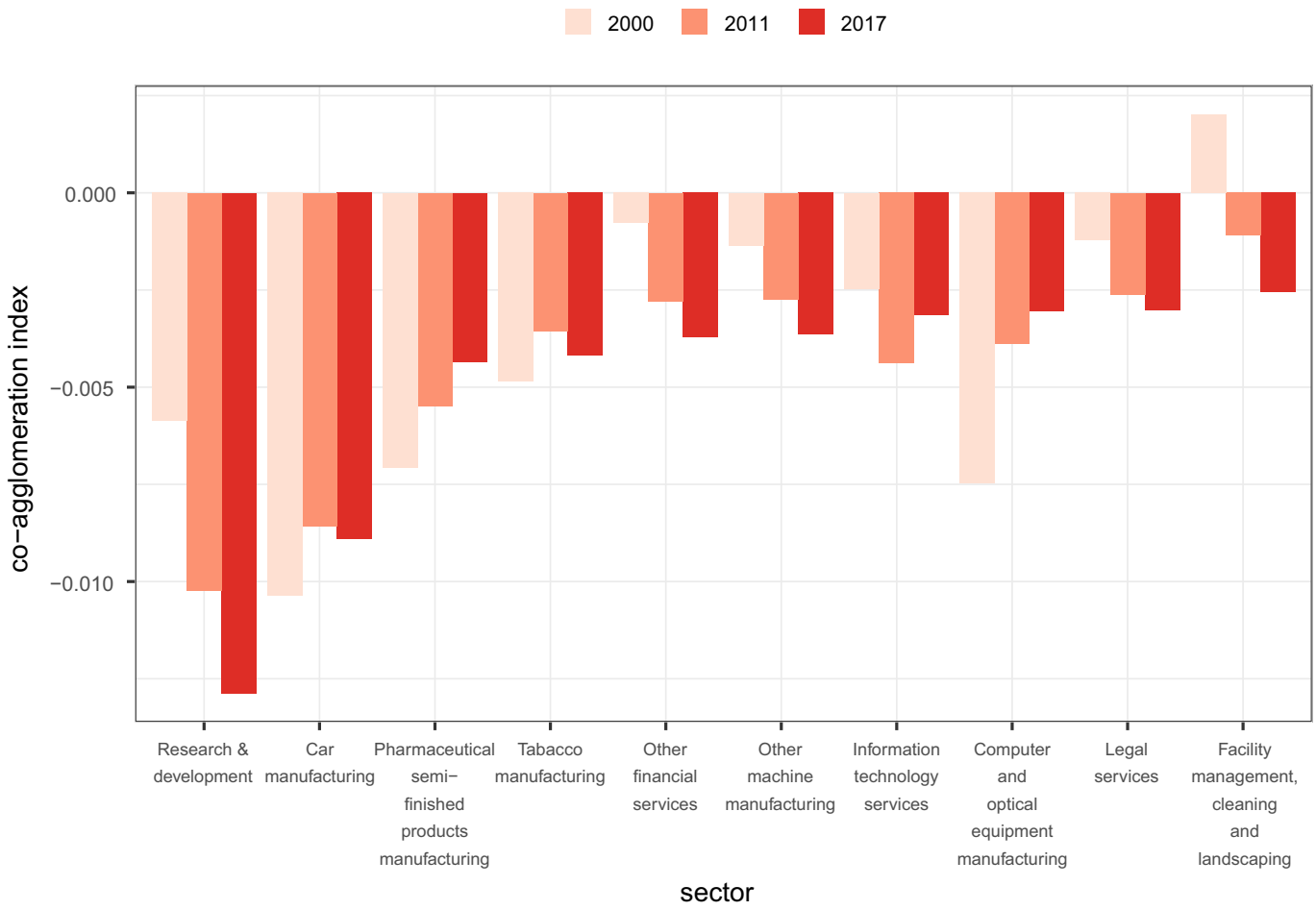

Fig. 4. Bottom-10 (negative) co-agglomeration scores between logistics and other economic activities in the ESE-corridor. Based on LISA data.

competitive logistics business ecosystems (agglomeration effects). However, these same regions underperformed in the other sectors of the economy, including those on which they focused, such as tech/manufacturing and agri-food.

The spatial variation within and among regions is significant. Direct employment creation in DCs occurs primarily in new XXL logistics business estates, which are increasingly located distant from population centres. On the regional scale, we observe both concentration and de-concentration of logistics activity, as identified earlier by Rivera et al. (2014) and Heitz et al. (2017), sometimes shifting from declining to emerging locations. The strong co-agglomeration effect of logistics with manufacturing, as described in the U.S. and in South Korea (Kim et al., 2021; Sheffi, 2012), was not observed throughout the ESE-corridor. The effect may not structurally occur in the Netherlands and possibly in other European countries. There are three plausible explanations for this: (1) such effects are increasingly being *outsourced* through the value chain to other regions or countries; (2) value-added logistics activities, such as manufacturing, services, and suppliers, could be increasingly *insourced* in the same XXL warehouses, where they cannot be accurately distinguished via the employment microdata at establishment firm level[15]; or (3) the stringent environmental zoning of business estates in Dutch planning practice restricts the potential co-agglomeration of manufacturing and logistics.[16] The analyses suggest in general a more modest effect than suggested in many logistics growth narratives.

5. Discussion of logistics development policy

Beyond the insights provided by the three separate analyses, an integrated view can extend the evaluation of the DC-favouring spatial-economic policy in relation to the regional employment effects. For this purpose, we recombine the data regarding the three employment benefits into a multidimensional diagram (Fig. 6) to show, for the regions with (red) and without (blue) favouring policies, changes in building footprint (horizontal axis) and specialisation (vertical axis). Both changes are assumed to be stimulated by policies. The sectoral employment growth (indexed) of each region is represented as the dot size. The cumulative shift-share graph on the right shows the performance of all regions with and without DC-favouring policy, which can be interpreted as discussed in Section 4.

The diagram shows that all regions in the ESE corridor experienced a growth in logistics footprint and employment, while eight out of ten increased logistics specialisation. The evolution is not homogeneous across regions, however. In the port region Groot-Rijnmond, the added footprint does not result in increasing specialisation and competitiveness, possibly due to the fact that the historical port region is now shifting towards a service economy, while its hinterland is catching up logistically (Manshanden et al., 2022; Rli, 2016). While West-Noord-Brabant achieved the largest DC footprint growth, the increase in specialisation and employment is moderate. In contrast, Midden-Noord-Brabant shows a higher impact with a considerably lower footprint growth. Midden-Limburg presents an interesting case of a region with

[15] The data categorise an entire company into one (sub)sector.
[16] The often-used maximum environmental planning category of 3.2 allows logistics but not industrial activities, for example.

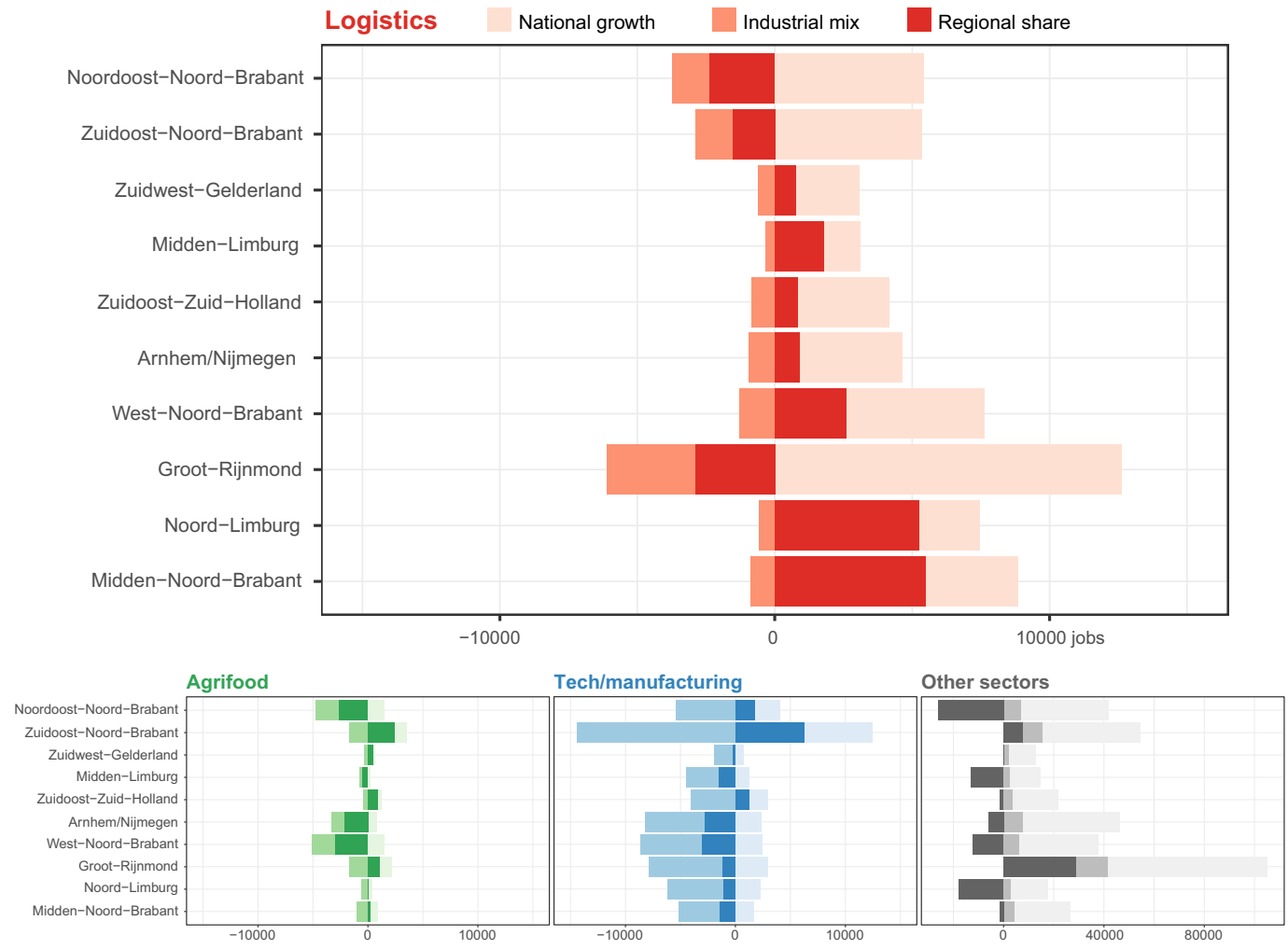

Fig. 5. Shift-share diagram of ESE-corridor regions ordered by absolute logistics employment growth for 2000–2017. The three smaller diagrams show the shift-share results for the same regions, in the same order, regarding agri-food, tech/manufacturing, and the other economic sectors. Based on LISA data.

rapid growth in specialisation and employment, without dedicated policy or extensive footprint growth. This could be explained by some DC developments, or redevelopments, in tandem with the decline of other sectors (Van Oort et al., 2015).

There is a clear difference between hinterland regions with and without DC-favouring policies in the ESE-corridor. The former experience higher levels of footprint growth, logistics specialisation, and favourable competitive positions. The shift-share graph demonstrates that most employment growth in DC-favouring regions can be characterised as regional competitiveness, while most growth in other regions relates to national employment growth. When combined with the detailed shift-share results of Fig. 5, in terms of the performance in other sectors, particularly the three DC-favouring regions face the risk of a spatial-economic lock-in. Under such a scenario, the regions become focused on logistics and have invested a great deal of land, policy efforts, and other means into the sector—arguably at the cost of developments in other sectors; it becomes increasingly hard to change this self-reinforcing dynamic, which has become hardwired in the spatial-economic conditions, such as land use and infrastructures, and available skills.

6. Conclusions on the employment effects of logistics development policies

In this paper, we analysed changing regional employment patterns of the logistics sector, in the case of the Dutch ESE-freight corridor between 2000 and 2020. The results demonstrate that some of the assumed benefits of DC developments can be spatially identified in the analysed corridor. Employment benefits of new DCs decrease over time, potentially due to automation and the use of migrant labour. Furthermore, the expected co-agglomeration of manufacturing and suppliers near DCs does not occur structurally. Finally, although DC-favouring regions have successfully developed competitive logistics business ecosystems, they may experience a sectoral lock-in: a self-reinforcing dynamic hardwired in their land use, infrastructures and skills. The spatial-economic policy narratives framing DCs as employment catalysts are thus of limited validity.

6.1. Policy implications

Our results caution against policy narratives that propose logistics developments as a one-size-fits-all solution or quick fix for regional employment growth. Detailed employment density maps show large spatial variations, in addition to numeric differences in specialisation, footprint, and jobs added in logistics. The fact that three regions in the corridor (West-Noord-Brabant, Midden-Noord-Brabant, and Noord-Limburg) dominate the top of the Logistics Hotspot ranking for almost 20 years suggests that the success of logistics clusters, similar to other economic clusters, can largely be attributed to regional advantages and path-dependence, which are not easily reproducible through policy implementation in other regions (compare see with earlier research by Delgado et al., 2010; Held, 1996; Taylor, 2010; Van Oort et al., 2015;

Fig. 6. Multidimensional diagram showing regional policies aimed at the growth of a sector applied to logistics in the ESE-corridor for 2000–2017. Based on LISA data & Dutch Distribution Centres geodata.

Van Oort et al., 2016; Van Oort and Bosma, 2013; Weterings et al., 2007). Also, non-spatial sectoral stimulation policies, such as the Dutch *Topsectors* policy (Raspe, 2012), are likely to generate localised benefits in the regions in which the sector is already strong. Therefore, policies that promote local logistics development run a risk of reinforcing spatial-economic lock-in in areas with logistics specialisations. Conversely, when logistics is not a local specialisation yet, our results suggest that these policies are not as effective as the narrative promises. Rather than focusing on policies of logistics specialisation, diversification into structurally related industries (by subcontracting relations, skill-relatedness or cooperation relations) may have higher potential for local employment development (Boschma and Frenken, 2009; Neffke and Henning, 2013).

In the supply of land for logistics developments, governments are advised to first assess and explore the role of logistics in the functioning of the regional economic ecosystem of consumptive and productive sectors. Depending on the context, logistics can be argued to usurp supply from labour and land markets at the expense of other (competitive) sectors or the foundational economy (sectors necessary for basic needs provision). Second, governments may adopt an integrated and more balanced view on the costs and benefits of the logistics development, taking into account other demands for space (housing, nature, SMEs, etc.). A societal cost-benefit analysis based on a broader set of metrics than solely employment, land revenue and tax income, is desirable. A better-informed land supply process can filter out investors that do not contribute significantly to local added value or job creation and maintenance.

6.2. Further research

We emphasise that more in-depth research is needed regarding the causal effects of specific logistics projects on the quantity and quality of work in the vicinity (Tabak, 2022). This should include the value-added activities inside XXL warehouses (e.g. assembly and service tasks currently invisible in the data) and the decreasing number of jobs per square meter of warehouse. The latter may be attributed to economies of scale and automation of logistics, for instance with regard to truck driving, forklifting and cargo-handling (Frey and Osborne, 2013, pp. 23, 41). Whether this would instead entail an increase in skilled workforce involved in logistics data handling and robotics and reduce low-skilled labour, is still uncertain. Lower-skilled labour involved in delivery platforms for example is growing (Chicchi et al., 2022). More research is also required with respect to triple-helix policies that link co-developing businesses, education and knowledge institutes to governmental programs, aiming for knowledge creation and spillovers in the field of automation and *smart logistics*.

Despite automation, there is still a growing demand for a low-skilled workforce in the Netherlands, which is increasingly supplied by labour migration from Eastern Europe (Bakker et al., 2019; BCI, 2019; Stec Group, 2020). Sector and media sources show an increase in logistics migrant labour totalling nearly 200.000 workers in 2021 in the Netherlands.[17] Working conditions and housing issues for migrant labour are thus other urgent topics for further research.

Credit author statement

Nefs: Conceptualization, Methodology, Software programming,

[17] https://www.groene.nl/artikel/opgepropt-in-het-vakantiepark; https://www.buitenkans.org/post/19-mei-huisvesting-van-arbeidsmigranten; www.brabant.nl/arbeidsmigratie; www.arbeidsmigratiewerkt.nl; https://noord-brabant.maps.arcgis.com/apps/MapTour/index.html?appid=48d4b33d0c7e46f487e86cb2516af254; https://www.limburger.nl/cnt/dmf20220507_94174882

Formal analysis, Investigation, Resources, Data Curation, Writing - original draft, Writing - review & editing, Visualization, Project management.

Van Haaren: Conceptualization, Methodology, Software programming, Formal analysis, Investigation, Data Curation, Writing - original draft, Writing - review & editing.

Van Oort: Conceptualization, Methodology, Resources, Writing - review & editing, Supervision.

Declaration of Competing Interest

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Data availability

A technical appendix, code files and (sample) data are available on the repository: https://doi.org/10.4121/21438021

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References

Adão, R., Kolesár, M., Morales, E., 2019. Shift-share designs: theory and inference*. Q. J. Econ. 134, 1949–2010. https://doi.org/10.1093/qje/qjz025.

Anderson, W.P., Chatterjee, L., Lakshmanan, T.R., 2003. E-commerce, transportation, and economic geography. Growth Chang. 34, 415–432. https://doi.org/10.1046/j.0017-4815.2003.00228.x.

Andreoli, D., Goodchild, A., Vitasek, K., 2010. The rise of mega distribution centers and the impact on logistical uncertainty. Transp. Lett. 2, 75–88. https://doi.org/10.3328/TL.2010.02.02.75-88.

Autor, D.H., 2015. Why are there still so many jobs? The history and future of workplace automation. J. Econ. Perspect. Am. Econ. Assoc. 3–30. https://doi.org/10.1257/jep.29.3.3.

Bak, R., 2021. Logistiek Vastgoed in Cijfers 2021 [Logistics Real Estate in Figures]. NVM Business, Nieuwegein.

Bakker, H., De Jong, O., Wester, M., Slaakweg, A., 2019. Onderzoek arbeidsvraag Wijkevoort. Ecorys, Rotterdam. https://doi.org/10.1515/9780822381815.

Barca, F., 2009. An Agenda for a Reformed Cohesion Policy: A Place-Based Approach to Meeting European Union Challenges and Expectations.

BCI, 2019. De kracht van Regionale Logistieke Ecosystemen in Nederland. Nijmegen.

Boschma, R., Frenken, K., 2009. The Spatial Evolution of Innovation Networks: A Proximity Perspective.

Castells, M., 1996. The Information Age: Economy, Society and Culture. Volume I - The rise of the network society, Blackwell, Oxford.

Chhetri, P., Butcher, T., Corbitt, B., 2014. Characterising spatial logistics employment clusters. Int. J. Phys. Distrib. Logist. Manag. 44, 221–241. https://doi.org/10.1108/IJPDLM-03-2012-0086.

Chicchi, F., Marrone, M., Casilli, A., 2022. Introduction. Digital labor and crisis of the wage labor system. Sociol. Lav 51–69. https://doi.org/10.3280/sl2022-163003oa.

Cidell, J., 2010. Concentration and decentralization: the new geography of freight distribution in US metropolitan areas. J. Transp. Geogr. 18, 363–371. https://doi.org/10.1016/j.jtrangeo.2009.06.017.

Coe, N., Hess, M., 2013. Economic and Social Upgrading in Global Logistics.

CRa, Rademacher, Vries, De, Stec Groep, 2019. (X)XL-verdozing [(X)XL Boxification]. CRa, The Hague.

Cronon, W., 1991. Nature's Metropolis: Chicago and the Great West. WW Norton & Co, Chicago.

Danyluk, M., 2019. Fungible space: competition and volatility in the global logistics network. Int. J. Urban Reg. Res. 43, 94–111. https://doi.org/10.1111/1468-2427.12675.

De Lara, J.D., 2013. Warehouse Work - Path to the Middle Class or Road to Economic Insecurity? Inland Empire.

Delgado, M., Porter, M.E., Stern, S., 2010. Clusters and entrepreneurship. J. Econ. Geogr. 10, 495–518. https://doi.org/10.1093/jeg/lbq010.

Dhyne, E., Kikkawa, A.K., Komatsu, T., Mogstad, M., Tintelnot, F., 2022. Foreign Demand Shocks to Production Networks: Firm Responses and Worker Impacts. Cambridge.

Diodato, D., Neffke, F., O'Clery, N., 2018. Why do industries coagglomerate? How Marshallian externalities differ by industry and have evolved over time. J. Urban Econ. 106, 1–26. https://doi.org/10.1016/j.jue.2018.05.002.

Ellison, G., Glaeser, E.L., 1999. The Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration? American Economic Association.

Ellison, G., Glaeser, E.L., Kerr, W.R., 2010. What causes industry agglomeration? Evidence from coagglomeration patterns. Am. Econ. Rev. 100, 1195–1213. https://doi.org/10.1257/aer.100.3.1195.

Emmons Allison, J., Herrera, J.S., Struna, J., Reese, E., 2018. The matrix of exploitation and temporary employment: Earnings inequality among Inland Southern California's blue-collar warehouse workers, 21, pp. 533–560. https://doi.org/10.1111/lands.12366.

EZK, 2019. Missies voor het Topsectoren- en Innovatiebeleid [Missions for the Topsectors and Innovation Policy]. Ministry of Economic Affairs and Climate Policy, The Hague.

Faggio, G., Silva, O., Strange, W.C., 2017. Heterogeneous agglomeration. Rev. Econ. Stat. 99, 80–94. https://doi.org/10.1162/REST_a_00604.

Florida, R., 2000. Competing in the Age of Talent: Quality of Place and the New Economy. A Report Prepared for the R. K. Mellon Foundation, Heinz Endowments, and Sustainable Pittsburgh.

Fransen, L., 2020. Logistics in the Regional Industry Space : Industry Dynamics along the Dutch Freight Transport Corridors. Erasmus University.

Frey, C.B., Osborne, M., 2013. The future of employment. In: Technology and Employment.

Gutelius, B., 2015. Disarticulating distribution: labor segmentation and subcontracting in global logistics. Geoforum 60, 53–61. https://doi.org/10.1016/j.geoforum.2015.01.009.

Heitz, A., Dablanc, L., Tavasszy, L.A., 2017. Logistics Sprawl in Monocentric and Polycentric Metropolitan Areas: The Cases of Paris, France, and the Randstad, the Netherlands. Region, 4, pp. 93–107. https://doi.org/10.18335/region.v4i1.158.

Heitz, A., Launay, P., Beziat, A., 2019. Heterogeneity of logistics facilities: an issue for a better understanding and planning of the location of logistics facilities. Eur. Transp. Res. Rev. 11 https://doi.org/10.1186/s12544-018-0341-5.

Held, J.R., 1996. Clusters as an economic development tool: beyond the pitfalls. Econ. Dev. Q. 10, 249–261. https://doi.org/10.1177/089124249601000305.

Hesse, M., 2004. Land for logistics: locational dynamics, real estate markets and political regulation of regional distribution. Tijdschr. Econ. Soc. Geogr. 95, 162–173. https://doi.org/10.1111/j.0040-747X.2004.t01-1-00298.x.

Hesse, M., 2020. Logistics: situating flows in a spatial context. Geogr. Compass 14, 1–15. https://doi.org/10.1111/gec3.12492.

Foundries - a guide for 21st century cities of making. In: Hill, A. (Ed.), 2020. TU Delft Open doi:10.4121 uuid:8bcd1748-3c04-4c2f-96cd-e763fe3b5b63.

Hoogstra, G.J., Van Dijk, J., Florax, R.J.G.M., 2017. Do jobs follow people or people follow jobs? A meta-analysis of Carlino–Mills studies. Spat. Econ. Anal. 12, 357–378. https://doi.org/10.1080/17421772.2017.1340663.

Husing, J., 2004. Logistics & Distribution: An Answer to Regional Upward Social Mobility. Los Angeles.

I&W, 2019. Goederenvervoeragenda - Agenda voor een robuust, efficiënt en duurzaam transportsysteem [Freight Transport Agenda]. Ministry of Infrastructure and Water Management, The Hague.

IenM, 2017. MIRT onderzoek goederenvervoercorridors Oost en Zuidoost - The Dutch Logistics Corridors. Ministry of Infrastructure and the Environment, The Hague.

Investico, Van, der Borst, B., Van Dijk, R., Nieuwenhuijzen, J., Ramaer, C., Saris, K., 2022. Gooien met grond. Groene Amsterdammer.

Jacobs, J., 1969. Economy of Cities. Random House, New York.

Joosten, T., 2020. Banen als schaamlap voor distributiecentra en (lucht)havens. Follow the Money, 6.

Kim, Y.J., Lee, S.G., Trimi, S., 2021. Industrial linkage and spillover effects of the logistics service industry: an input–output analysis. Serv. Bus. 15, 231–252. https://doi.org/10.1007/S11628-021-00440-1.

Kline, B.P., Moretti, E., 2013. Place based policies with unemployment. Am. Econ. Rev. 103, 238–243. https://doi.org/10.1257/aer.103.3.238.

Klumpenaar, S., 2022. Wie zich ergert aan de 'verdozing' van Nederland, kan het beste bij zichzelf beginnen. NRC.

Kuipers, B., van der Lugt, L., Jacobs, W., Streng, M., Jansen, M., van Haaren, J., 2018. Het Rotterdam Effect—De Impact van Mainport Rotterdam op de Nederlandse Economie [The Impact of Mainport Rotterdam on the Dutch Economy]. Erasmus Centre for Urban, Port and Transport Economics, Rotterdam.

Lafrogne-Joussier, R., Martin, J., Mejean, I., 2022. Supply shocks in supply chains: evidence from the early lockdown in China. IMF Econ. Rev. https://doi.org/10.1057/s41308-022-00166-8.

Manshanden, W.J.J., van Haaren, J., van Oort, F.G., 2022. Nijpend personeelstekort beperkt groeipotentieel Rotterdam, Economische verkenning [Economic exploration] Rotterdam 2022. Rotterdam.

Marshall, A., 1890. Principles of Economics, 8th ed. MacMillan, London. https://doi.org/10.1038/042362a0.

Marti, B.E., 1982. Shift-share analysis and port geography: a New England example. Marit. Policy Manag. 9, 241–250. https://doi.org/10.1080/03088838200000050.

Meijer, L., 2020. De motor van de maakindustrie in beeld [Visualizing the manufacturing machine].

Neffke, F., Henning, M., 2013. Skill relatedness and firm diversification. Strateg. Manag. J. 34, 297–316. https://doi.org/10.1002/smj.2014.

Nefs, M., 2022a. Dutch Distribution Centres 2021 Geodata. https://doi.org/10.4121/19361018.v1.

Nefs, M., 2022b. Beyond global gains and local pains - Spatial inequality of hinterland logistics. In: Aesop (Ed.), AESOP 2022 Tartu: Spatial Justice. Aesop, Tartu, pp. 249–256.

Nefs, M., Daamen, T., 2022. Behind the big box: understanding the planning-development dialectic of large distribution centres in Europe. Eur. Plan. Stud. 1–22 https://doi.org/10.1080/09654313.2022.2057792.
Nefs, M., Zonneveld, W., Gerretsen, P., 2022. The Dutch "Gateway to Europe" spatial policy narrative, 1980-2020: a systematic review. Plan. Perspect. 20 https://doi.org/10.1080/02665433.2022.2053879.
Neumark, D., Simpson, H., 2015. Place-based policies. In: Handbook of Regional and Urban Economics. Elsevier B.V, Bristol, pp. 1197–1287. https://doi.org/10.1016/B978-0-444-59531-7.00018-1.
Onstein, A.T.C., Tavasszy, L.A., Van Damme, D.A., 2019. Factors determining distribution structure decisions in logistics: a literature review and research agenda. Transp. Rev. 39, 243–260. https://doi.org/10.1080/01441647.2018.1459929.
Orenstein, D., 2019. Out of Stock: The Warehouse in the History of Capitalism. University of Chicago Press, Chicago.
Palazuelos, M., 2005. Clusters: myth or realistic ambition for policy-makers? Local Econ. 20, 131–140. https://doi.org/10.1080/13575270500053225.
Panteia, Osborne, A.T., Defacto, Topcorridors, 2019. Goederenvervoer- Corridors Oost en Zuidoost [Freight Corridors East and Southeast]. Topcorridors, The Hague.
Porter, M.E., 1998. Clusters and the new economics of competition. Harv. Bus. Rev. https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition.
Porter, M.E., 2000. Location, competition, and economic development: local clusters in a global economy. Econ. Dev. Q. 14, 15–34. https://doi.org/10.1177/089124240001400105.
Pred, A., 1977. City-Systems in Advanced Economies - Past Growth, Present Processes and Future Development Options.
Raimbault, N., 2021. Outer-suburban politics and the financialisation of the logistics real estate industry: the emergence of financialised coalitions in the Paris region. Urban Stud. https://doi.org/10.1177/00420980211014452, 004209802110144.
Raimbault, N., Jacobs, W., Van Dongen, F., 2016. Port regionalisation from a relational perspective: the rise of Venlo as Dutch international logistics hub. Tijdschr. Econ. Soc. Geogr. 107, 16–32. https://doi.org/10.1111/tesg.12134.
Raspe, O., 2012. De Ratio Van Ruimtelijk-Economisch Topsectorenbeleid [the Logic behind Spatial-Economic Topsector Policy].
Rivera, L., Sheffi, Y., Welsch, R., 2014. Logistics agglomeration in the US. Transp. Res. Part A Policy Pract. 59, 222–238. https://doi.org/10.1016/j.tra.2013.11.009.
Rli, 2016. Mainports Voorbij [Beyond Mainports]. Raad voor de Leefomgeving en Infrastructuur, The Hague.
Santos, M., 2006. A Natureza do Espaço. Técnica e tempo, razão e emoção., GEOgraphia. edusp, São Paulo. https://doi.org/10.22409/geographia1999.v1i1.a13370.
Sheffi, Y., 2012. Logistics Clusters: Delivering Value and Driving Growth. MIT Press, Cambridge, United States.
Sheffi, Y., 2013. Logistics-intensive clusters: Global Competitiveness and regional growth. In: Handbook of Global Logistics: Transportation in International Supply Chains, pp. 463–500. https://doi.org/10.1007/978-1-4419-6132-7_19 LK -. International Series in Operations Research & Management Science 0884-8289 TA - TT -. New York, NY: Springer New York : Springer. https://tudelft.on.worldcat.org/oclc/5661074120.
Soinio, J., Tanskanen, K., Finne, M., 2012. How logistics-service providers can develop value-added services for SMEs: a dyadic perspective. Int. J. Logist. Manag. 23, 31–49. https://doi.org/10.1108/09574091211226911.
Stec Group, 2020. Ruimtelijke Sturing op Knooppunten [Spatial Steering on Logistic Hubs]. Stec Groep, Arnhem.
Steijn, M.P.A., Koster, H.R.A., van Oort, F.G., 2022. The dynamics of industry agglomeration: evidence from 44 years of coagglomeration patterns. J. Urban Econ. 103456 https://doi.org/10.1016/j.jue.2022.103456.
Steinnes, D.N., 1982. Do "people follow jobs" or do "jobs follow people"? A causality issue in urban economics. Urban Stud. 19, 187–192. https://doi.org/10.1080/00420988220080311.
Stimson, R.J., Stough, R.R., Roberts, B.H., 2006. Regional economic development - Analysis and planning strategy. In: Journal of Chemical Information and Modeling, 2nd ed. Springer, Berlin Heidelberg.
Strale, M., 2020. Logistics sprawl in the Brussels metropolitan area: toward a socio-geographic typology. J. Transp. Geogr. 88 https://doi.org/10.1016/j.jtrangeo.2018.12.009.
Tabak, E., 2022. Boxes, Boom and Benefits?-Identifying Effects of XXL Distribution Centres on Regional Economies in the Netherlands. Erasmus University, Rotterdam.
Taylor, M., 2010. Clusters: a mesmerising mantra. Tijdschr. Econ. Soc. Geogr. 101, 276–286. https://doi.org/10.1111/j.1467-9663.2009.00583.x.
van Bergeijk, J., 2019. Binnen bij Bol.com. Querido Fosfor, Amsterdam, Antwerpen.
Van den Heuvel, F.P., de Langen, P.W., Van Donselaar, K.H., Fransoo, J.C., 2014. Proximity matters: synergies through co-location of logistics establishments. Int J Log Res Appl 17, 377–395. https://doi.org/10.1080/13675567.2013.870141.
van Geenhuizen, M., Nijkamp, P., 2005. Death of Distance and Agglomeration Forces of Firms in the Urban E-Economy - An Artificial Intelligence Approach Using Rough Set Analysis. Amsterdam.
Van Geffen, P., Ploem, H., De Kort, E., 2019. Logistiek in Beeld - toekomstige locatiedynamiek bij logistieke bedrijven.
Van Oort, F., Bosma, N., 2013. Agglomeration economies, inventors and entrepreneurs as engines of European regional economic development. Ann. Reg. Sci. 51, 213–244. https://doi.org/10.1007/s00168-012-0547-8.
Van Oort, F., Weterings, A., Nedelkoska, L., Neffke, F., 2015. Ruimte geven aan economische vernieuwing. Utrecht.
Van Oort, F., Weterings, A., Nedelkoska, L., 2016. Arbeidsmobiliteit, skill-gerelateerdheid en stedelijke innovatie. TPEdigitaal 10, 104–121.
Verhetsel, A., Kessels, R., Goos, P., Zijlstra, T., Blomme, N., Cant, J., 2015. Location of logistics companies: a stated preference study to disentangle the impact of accessibility. J. Transp. Geogr. 42, 110–121. https://doi.org/10.1016/j.jtrangeo.2014.12.002.
VROM, 1988. Vierde Nota Ruimtelijke Ordening—Deel D: Regeringsbeslissing [Fourth Memorandum of Spatial Planning—Part D: Governmental Decision]. Ministry of Spatial Planning, The Hague.
Ward, G.M., 2016. Ideal Site Selection of Fast Electrical Vehicle Charging Stations within Urban Environments. Tue, Eindhoven.
Warffemius, P.M.J., 2007. Modeling the Clustering of Distribution Centers around Amsterdam Airport Schiphol : Location Endowments, Economies of Agglomeration, Locked-in Logistics and Policy Implications.
Weterings, A., Van Oort, F., Raspe, O., Verburg, T., 2007. Clusters en economische groei. Den Haag, NAi Uitgevers.
Witte, P.A., 2014. The Corridor Chronicles.
WRR, 2020. Het betere werk [Better work]. The Hague.
Yuan, Q., 2019. Planning matters: institutional perspectives on warehousing development and mitigating its negative impacts. J. Am. Plan. Assoc. 85, 525–543. https://doi.org/10.1080/01944363.2019.1645614.
Yuan, Q., 2021. Location of warehouses and environmental justice. J. Plan. Educ. Res. 41, 282–293. https://doi.org/10.1177/0739456X18786392.