Coordinated risk management for supply chain and government

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Abstract

This paper aims at studying the coordination of governmental actors, such as customs, and supply chain partners in order to mitigate risks. To do so the concepts of supply chain visibility and data pipeline are briefly revisited. Then the result of a survey, highlighting the risk coordination challenges, carried with customs and supply chain partners is presented. One of the main challenges identified is that business partners should incur the implementation costs of such systems while the benefits are not clear to them. To highlight the potential operational benefits gained through such systems for business partners, we consider counterfeiting risks and study how a coordinated risk management scheme between governmental actors and business partners leads to cost efficiency through less inspection costs and congestion-induced delay at ports.

Keywords: Supply chain risk management, Counterfeiting, Customs

Introduction

Modern corporations perform their activities across countries and even continents. The internationalization of their businesses activities is accommodated by the liberalization of international trade, and driven by the exploration of new markets and sourcing opportunities. The international transportation of goods using standardized loading units, the maritime containers, has helped to create a reinforcing loop of decreasing transport costs and increasing sourcing opportunities overseas (Levinson, 2006). However, multinational companies face additional risks due to international transactions, the sharing of information and knowledge with partners overseas, the launching of products in new markets, and the international transportation of goods.

At the same time, government agencies such as Customs are equally challenged to keep up with the globalization of business activities, and are confronted with new tasks in the area of security, and with new tools and technologies that all have a promise of better, more accurate and real time data. This drives both businesses and governmental agencies to call for a more visible supply chain: Supply chain visibility is consistently ranked as a top priority for multinational enterprises (Aberdeen Group, 2006). Visibility

is shown to improve supply chain performance, both in terms of efficiency and security (Bartlett et al., 2007 and Wagner and Bode, 2006).

Governmental agencies such as Customs, police, and quality inspection agencies have advocated the collateral benefits of their visibility requirements, i.e. the possibility of commercial organizations to make use of information for their own purposes as well as for compliance. For example, the security program Customs-Trade Partnership Against Terrorism, CTPAT, led by US Customs and border protection and focuses on security of private companies against terrorism. In particular, the claim is that commercial organizations can also benefit from visibility by enhancing their risk management procedures by using information (Bakshi and Gans, 2010).

In this paper, the concept of supply chain visibility is further elaborated. As part of EU founded FP7 CASSANDRA project, we study how a comprehensive risk assessment mechanism can be devised such that governmental agencies are enabled to piggyback on business data in order to mitigate risks. The central idea evolves around building a data pipeline, which is fed by business data and used by governmental agencies.

In order to highlight the requirements and challenges faced by Customs and business parties, a survey study is conducted on both sides. One of the main challenges identified is how business partners might benefit from such system. In order to gain insights on this issue, an analysis on a particular risk, namely counterfeiting, is done in more details. Counterfeiting risk is perceived both by customs and property right owners in international supply chains as being highly relevant. The analysis as done in this paper sheds light on how Customs and business partners can collaborate through either investment in Customs facilities or supply chain visibility such that the channel through which counterfeiters dilute the legitimate supply chains is hampered and at the same time business partners benefit from less operational hassles such as congestion-induced delays at ports. In this manner, the counterfeiting case illustrates a collaborative scheme between customs and business beyond the sharing of data.

The CASSANDRA project: Security through visibility
The CASSANDRA project aims to increase supply chain visibility to support both business operations and risk management, while also supporting security risk assessment by governmental agencies, especially Customs authorities. The project, started in June 2011 and running till May 2014, is funded by the European Commission and has a consortium of 27 organizations, including service providers in international supply chains, Customs authorities, IT providers, and research institutes.

The objective is to research whether cross-border Customs controls can be more efficient and effective by moving from traditional transaction-based audits to system-based supervision. An important prerequisite for the above mechanism is the introduction of a risk based approach and visibility through an associated integral data gathering process that is workable and beneficial for business, and acceptable to government agencies. By using a risk-based approach, Customs authorities are dealing cost-efficiently with the assessable flows, so that there is more opportunity to investigate and address more obscure container flows, thus improving the effectiveness of control. For this new supervision concept, Customs authorities can re-use information from business parties. First step is that they can piggy-back on the data that resides with the business organizations. Second step is that risk assessment for a business and authority perspective is aligned and Customs authorities can also piggy-back on the risk assessment that is already done by business parties.

A critical factor in a risk-based approach is the confidence that government should have about the source, reliability and information content and quality of data presented to them by business. At the same time, business parties call for a data sharing solution that fits their current business processes and IT architecture and it does not result in an increase of administrative burden and major investments. The business parties in the CASSANDRA consortium are willing to share more information with governmental agencies but they also expect to see benefits from this, e.g. trade facilitation through a green lane or a reduced number of physical inspections.

Data sharing through a pipeline concept
A data pipeline concept for data sharing in international trade was developed jointly by UK and Dutch Customs. It introduces the concept of a seamless, integrated, web-based data pipeline, designed to capture consignment, people and organization data as much as possible at the source of the information (Hesketh, 2009; 2010. This means that data will not be captured for example at the consignee but as mush upstream in the supply chain as necessary. Data capture starts with the first contact between buyer and seller, which is formalized in the international contract of sale. Information on a specific consignment and container is available at the Consignment Completion Point where the consignor stuffs the container. The container information is then updated as the container with the goods moves downstream the supply chain. The concept of the pipeline is that most of the data required by Customs will be known at the Consignment Completion Point already. At this point in time, businesses should aim to have a high quality data set available in the data pipeline, which can then be used for both export and import declarations and also lead to a reduction in administrative burden when organizing further international transport.

The data pipeline can be realized in different ways, depending on the information technology that is already available in the supply chain configuration. Large freight forwarding organizations have global IT systems which hold information from a large part of the supply chain, which means there is already a sort of pipeline in place. When more business parties work together in a supply chain, a data pipeline can be constructed by building interfaces between business organizations, or by sharing information or communicating through a neutral information platform. A data pipeline can also be constructed by linking two different port community systems. In all cases, it needs to be investigated which information from which source is available and whether additional information needs to be captured and shared. The data pipeline concept can be improved by using more innovative information technology concepts, such as linked open data and data crawling. All these different possibilities will be investigated in the CASSANDRA project.

Risk Assessment from a business perspective
Business parties perform risk assessment on the supply chain from their own business perspectives. Risk assessment is done from an operational perspective or a financial perspective. The level on which risk assessment is performed and the extent to which procedures are formally described, differs between organizations.

Businesses assess for operational risks where this is likely to affect their operational processes and through this employees' safety, company image, and levels of customer service. This risk assessment can be done either forward looking or backward looking. Forward looking when information is used to anticipate on exceptions and events that will affect the flow of the containers and to make sure that mitigation measures are in place and prepared to diminish possible negative effects. Backward looking risk

assessment means that historical information is used to build risk profiles on customers, types of cargo, trade lanes etc. These historical profiles will be used to periodically assess the company's business processes and service levels. First risk assessment is done at the intake of the initial transport order. Interviewed businesses have no formal procedure in place to assess risks at this point but depend heavily on the experience of the person taking the order. The assessment is usually focused on knowing the customer, dangerous goods and countries of (trans)shipment.

From a financial risk perspective, businesses typically look at their first tier supply chain partners. For new customers, all interviewed business parties, assess for financial risks, based on customer financial statements. External parties that provide so-called black list information are also used. New customers are usually followed up closely during their first orders until they reach a state where they are trusted parties. Businesses perform a similar risk assessment on companies that supply key assets and/or services. This is only done for first tier parties and not for subcontractors of these business parties, that might as well have access to key information and company assets. Organizations in the second tier are sometimes not even known to the interviewed freight forwarders. For example, in case of Free On Board trade, where the consignee is the freight forwarder's customer, the freight forwarder might not know the consignor.

Businesses already collect supply chain information for operational control and risk assessment. For operational control, data that is captured has to support operations and trigger events when exceptions occur. The typical data elements that are captured and the exceptions and events that are managed, depend on the role and the responsibilities of the business party in the supply chain. For a typical freight forwarding business, the information that is captured is mostly related to the cargo carrying units, e.g. a sea container. For FCL shipments, this means that information is captured on the container level. For LCL business, this means that some information is also necessary on the consignment level, e.g. pallets and boxes. Consignment details are only of interest to a freight forwarding organization, if it is necessary to perform additional services like Customs declarations or re-packaging or when special handling is required, e.g. dangerous goods handling. For this information and the information quality, they rely on the consignor and consignee of the goods.

Data quality from the business perspective was discussed based on the aspects of completeness, timeliness, accuracy and consistency. Data completeness is sometimes checked by the information system, when forms need to be completed by employees or customers. The extent to which forms can assess for accuracy is often limited, e.g. to check whether an address is an existing address, and for a large part, supply chain data cannot be checked on accuracy in this automated way. Data accuracy can also be an issue because information interfaces depend to certain extent on keying in of information by different persons. Consistency of information is sometimes checked, through cross-checking in the system, but this is not done to a large extent. Timeliness of information is sometimes an issues as well, and depends largely to cooperation with other supply chain partners. Interviewed parties reported that especially the timeliness of information is an aspect that can help them in improving their processes and service quality.

Risk Assessment from a Customs perspective
Customs authorities perform risk assessment as part of their responsibility to control import and export flows for tax, social, health, safety and security purposes. Controlling these flows is done by a combination of information analysis and physical inspections. With increasing international trade and its positive effects on national economies,

Customs authorities are looking for ways to control goods flows while at the same time promoting and facilitating import to and export from their country.

First, risk assessment is done by analyzing the information provided to Customs by different sources. The declaration that is directly used for security risk assessment on cargo entering the European Union by sea is the Entry Summary (ENS) declaration. This declaration needs to be filed by the ocean carrier at least 24 hours before vessel departure in the country of origin. The information requirements for this declaration, as described in Annex 30A of the CCIP (Community Customs Implementation Provisions), ask for data on the organizations involved in the supply chain (consignor, consignee and carrier), consignment related data (goods description, number and type of packages, commodity codes etc.), and on the means of transport crossing the border (vessel details, first place of arrival, countries of routing, etc.). The information from the ENS declaration is combined with the information from Customs authority's intelligence systems to support security threat identification, or identification of threats for society, safety and health. This first risk assessment advises Customs whether a physical inspection is needed.

The second stage of Customs risk assessment includes physical inspection of the goods. For this, the container is usually put on hold and inspected at the port of destination. Depending on the status of the importer, e.g. AEO, the container and goods might also be inspected at an inland location. The necessity of a physical inspection is not communicated to the freight forwarder or the importer prior to container arrival at port. Physical inspection of a container stops the logistical processes and as such results in delivery delays. Furthermore, because physical inspections are not known before container arrival at the port of destination it also disturbs the further arrangements for inland transportation.

Representatives from Customs authorities in the United Kingdom and the Netherlands have indicated that the quality of the information in the ENS declaration is not always high because under current regulation there is more focus on 'fitting the form' instead of capturing the information on organizations, consignment and vessel from the highest quality information source (Hesketh, 2009; Hesketh, 2010). Because of this lack of data quality, the outcomes of the first stage of security risk assessment are not sufficiently secure and reliable.

Aligning business and Customs risk assessment
Typically, business and Customs authorities focus on different supply chain risks and as such performing the actual risk assessment can be difficult to align. While security programs, such as AEO programs, focus on knowing the organizations in a supply chain and auditing their internal processes and capabilities to control the supply chain and its risks, the pipeline concept, as developed further in the CASSANDRA project, focuses on capturing high quality information that is beneficial for both business and Customs risk assessment.

The quality of information can, according to Lee et al. (2002) and Bharosa (2011), be described in a number of different dimensions. With respect to the topic of CASSANDRA and the content of this paper, the following information quality dimensions seem relevant:
1. *Accuracy*; extent to which the information represents the underlying reality;
2. *Timeliness*; the extent to which information is sufficiently up-to-date (most recent) and on time to enable the tasks it is used in;
3. *Believability* (or credibility of the information) and *Reputation* (characteristic of the source of the information);

4. *Relevance* concerns whether information is necessary and usable in supply chain functions;
5. *Completeness* concerns that information is not missing and contains all (breadth and depth) that is needed to be usable;
6. *Consistency* in data format and in value in all occurrences of the same information;
7. *Availability* and *accessibility*; mainly a quality characteristic of the system (organizational or technological) where the data resides;
8. *Correctness* of information concerns whether information is without error.

From a business perspective, especially the dimensions of timeliness, accuracy and correctness seem interesting. The quality dimension 'Relevance' is important in the sense that businesses are only interested in having high quality data for the elements needed in performing their specific role in the supply chain. Freight forwarders stated that they are not even willing to receive additional information, especially related to the consignment, as this could affect their liability. From a Customs perspective, and within the CASSANDRA project, the focus is mainly on accuracy and correctness of information, which is directly related to the believability and reputation of the source.

The responsibility of capturing high quality information on the supply chain rests mostly with the different business organizations, as they are the entities where the information is created and resides. The CASSANDRA vision includes capturing of high quality information by business parties and sharing this information, through an information pipeline, with other parties that can (re-)use the information for their own purposes, and for their own risk assessment. While aligning the actual risk assessment can be difficult, aligning the information needs for the risk assessment by business and Customs authority is easier, looking at data needs and quality dimensions.

Implementing data sharing in international trade
The CASSANDRA project includes a large demonstration where the data pipeline concept and the sharing of information between business and government entities can be tested in real-life international trade lanes, so called Living Labs. The demonstrations will be carried out on three international trade routes, between North West Europe and South-East Asia and North America, and between North Africa and South Europe.

Within each trade lane, different parties work together and different Customs authorities are involved. Because of this variance in supply chain configuration and also information technology landscape, different data pipelines will be created that can fit the actual supply chain while also demonstrating the flexibility of the concept. Different data sharing technologies and different dashboard will be developed, while also working on a common vision and data model to support the communication between these different solutions.

Data sharing between business and Customs will be implemented for at least two different Customs innovation concepts: 'Import source = Export source' and 'ENS multiple filing'. For 'Import source = Export source', the idea is that when a high quality information set is available, in a data pipeline, on the exporting side of the supply chain, this data set can be used for the export declaration, but at almost the same time also for the import declaration, because the export and import declaration for a large extent ask for the same data set to be delivered to Customs. The 'ENS multiple filing' concept includes the thought that the declaration information should always be delivered by the best possible information source. This means that not only the ocean carrier, but also multiple parties can be involved in filing the ENS, depending on the supply chain configuration.

In the CASSANDRA project, it will also be investigated how the effect of providing higher quality information to Customs authorities can actually result in trade facilitation, e.g. a reduced number of physical inspections and perhaps even a green lane. A green lane within CASSANDRA includes a notification, some days before vessel arrival in port of discharge, to the business parties on whether a container will be physically inspected or not. This means that for the containers profiting from this green lane, there will be no necessary delay in arranging for inland transportation.

A model for government-business risk coordination
World Trade Organization 2011 defines counterfeiting as "Unauthorized representation of a registered trademark carried on goods identical to or similar to goods for which the trademark is registered, with a view to deceiving the purchaser into believing that he/she is buying the original goods". The economic and social impact of counterfeiting activities is reported to be considerable. The Counterfeiting Intelligence Bureau (2011) estimates show that counterfeiting accounts for 5-7% of world trade, making it worth $600bn per annum. However, Customs seizure of counterfeit products entering US reached some 14841 seizures in 2009, worth $260m, which is just a small fraction of the total counterfeit traffic. Moreover, Stevensson and Bubsy, 2011 report that counterfeiting increases Law enforcement costs, reduces tax revenues, funds organized crimes and terrorism, undermines reputations, damages customer-confidence and it even kills (15% of pharmaceuticals imported to the US are counterfeits containing unapproved substances). Despites all the pressure from media, practitioners and public counterfeiting is basically ignored in operations management literature. In the sequel of this section, we develop models aiming at capturing various coordination mechanisms that can be adopted by governmental actors and trading firms in order to mitigate the risk of counterfeiting products entering the legitimate supply chains. As mentioned earlier, supply chain visibility might result in reduced counterfeiting risks. However, having a visible supply chain requires huge investment by business and trading organizations. The question that arises here is that whether the benefit obtained through counterfeiting risk reduction would even out the investment costs of business partners. Moreover, if business parties are considering reducing counterfeiting risks by investment in Customs inspection facilities, what are the obligations mandated on Customs in return of investment. This case is motivated by a recent investment of $200 million of British American Tobacco in Customs facilities for a period that ends in 2020. The main question in this respect is how Customs inspection rates should be aligned in return of this investment such that the increased inspection rates are not detrimental to trade and at the same time it makes it difficult for counterfeit products to enter legitimate supply chains.

A basic Model for government-business risk coordination to combat counterfeiting
The first stage of container risk assessment is performed based on analysis of container and transport data, and according to the analysis a risk factor x is assigned to the container. x basically represents the likelihood that the inspection process does not raise any alarm while the container carries counterfeit items. Thus $(1-x)$ signifies the discovery of counterfeit products. According to the output of the first assessment the system should decide whether to send the container for a physical inspection or release it. Apparently, the higher risk factors make it more likely that the container should undergo physical inspection. $P\{x\}$ denotes the percentage of containers with a risk factor x sent for physical inspection.

After physical inspection, Customs needs to decide whether to detain a container or release it. If a container is detained, then a notice is sent to the rights owner. The rights owner is given a limited period (10 days) to initiate court proceedings against the importer. Failing to do that, the suspect goods are released from detention.

We assume that the counterfeiter's affordability to penetrate in the legitimate channel is limited. This is denoted by γ_0 as a fraction of the total number of containers. Then the counterfeiter decides how frequent to attempt to enter contraband to the supply chain. This is denoted by a probability γ such that $0 \leq \gamma \leq \gamma 0$. If a container is caught then the counterfeiter incurs a penalty cost L_f. If a container escapes Customs inspections then counterfeiters gain a benefit that sums to L_e, Moreover when a genuine container releases from Customs inspections and enters the market it generates L_r unit of revenue for the rights owner. We define α_1 and α_2 as the residual risk factors of the physical inspection process. α_1 is defined as the residual error that leads to some counterfeiter product slipping through the inspection process without being detected. Similarly, α_2 is interpreted as the percentage of false detentions, meaning that that the container contains genuine products but the inspection fails to identify that. Similarly. Having defined these parameters, the expected benefit to the counterfeiter by targeting $\gamma(\text{x})$ percent of containers with risk factor x is as follows

$$\max_{\gamma \in [0,1]} \pi_c = (1-x)L_f + x\Big[(1-\mathbb{P}\{x\})\Big[\gamma(x)L_e + (1-\gamma(x))L_r\Big]$$

$$+\mathbb{P}\{x\}\Big[\gamma(x)\Big[(1-\alpha_1)L_f + \alpha_1 L_e\Big] + (1-\gamma(x))\Big[\alpha_2\mathbb{E}\{L_d\} + \mathbb{E}\{L_w\} + L_r\Big]\Big]\Big]$$

Then in order to determine rights owners equilibrium strategy, the Customs set $P\{x\}$ together with α_1 and α_2 such that the expected losses due to counterfeit products entering the legitimate supply chain is minimized. Thus the expected cost to the rights owner is

$$\min_{\mathbb{P}\{x|x\in[0,1]\},\alpha_1,\alpha_2} \pi_r = \max_{x \in [0, 1]} (1-x)L_f + x\Big[(1-\mathbb{P}\{x\})\Big[\gamma(x)L_e + (1-\gamma(x))L_r\Big]$$

$$+\mathbb{P}\{x\}\Big[\gamma(x)\Big[(1-\alpha_1)L_f + \alpha_1 L_e\Big] + (1-\gamma(x))\Big[\alpha_2\mathbb{E}\{L_d\} + \mathbb{E}\{L_w\} + L_r\Big]\Big]\Big]$$

Although the objective function pushes the Customs authority to set α_1 and α_2 as small as possible, the concern for the viability of both trading firms and Customs prevent it from simply setting $\alpha_1 = \alpha_2 = 0$. Specifically, Customs is willing to reduce residual errors as long as the inspection-induced congestion does not surpass a certain threshold given by the following

$$\text{\# of containers in physical inspection} + \text{\# of detained containers} \leq n_0$$

The effectiveness of physical inspection highly depends on the time and care with which it is conducted. For example the amount of time spent on analyzing the data associated with containers, interpreting X-ray images or physical inspection of containers play a vital role in identifying contraband. To model this inspection time we follow the same approach as Bakshi and Gans (2010), defining the inspection time as a natural logarithmic function of α_1 and α_2. Then using the basic results from queuing theory on M/G/1 queues we can derive the required performance measures. The expected number of containers either undergoing the inspection process or waiting to be processed is given according to

$$\text{\# of containers in physical inspection} = \lambda_0\mathbb{E}\{S\} + \lambda_0\frac{\mathbb{E}\{S^2\}}{2(1-\rho)}$$

Moreover, the expected arrival rate to the detention process can be calculated as follows

$$\theta_1 = (1 - \alpha_1) \int_0^1 \gamma(x)\mathbb{P}\{x\}dx + \alpha_2 \int_0^1 (1 - \gamma(x))\mathbb{P}\{x\}dx$$

Accordingly, we have

$$\text{\# of detained containers} = \theta_1\mathbb{E}\{D\}$$

where $E\{D\}$ denotes the expected detention time. Using this modeling approach we can characterize $P\{x\}$ as a function of cost parameters. A sample of $P\{x\}$ is depicted in Fig 1.
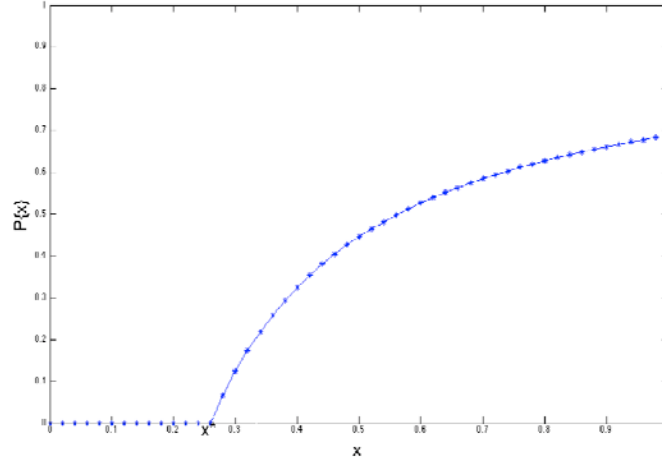

Fig 1. A sample instance of the function P{x}

A Principal-Agent Modeling
In this section we model the interaction between rights owner, Customs and counterfeiter as a multiplayer sequential game. We assume that the counterfeiter acts as the last player and sets the fraction of containers containing counterfeit items. Then incorporating the best response of the counterfeiter, the interaction between rights owner and Customs is thought as a Stackelberg game in which the rights owner acts as the leader and decides whether to invest in Customs inspection facilities or not.

   The Agent's Problem: The Customs' decision of accepting the right-owners proposal for an investment I is governed by Customs execution cost. Customs would accept the offer as long as the participation costs do not exceed the current cost of the system. In other words, if the current inspection and detention rates are denoted by θ_1^0 and θ_2^0 and they are asked to be increased to the levels θ_1^1 and θ_2^1 after investment, then the Customs participation constraint is

$$-\frac{I}{n} + c_1\theta_1^1 + c_2\theta_2^1 \leq c_1\theta_1^0 + c_2\theta_2^0$$

where n is the total number of containers to be processed by Customs. c_1 and c_2 denote Customs' physical inspection and detention costs per container.
The Principal's Problem: As before the principal tries to minimize the expected cost of counterfeit product entering the legitimate supply chain.

Investment on Supply Chain Visibility
   In the formulation of the basic model, g(x) is defined as the probability distribution function (pdf) of risk factor x. An immediate consequence of a visible supply chain is risk mitigation. Therefore it should be expected that in visible supply chain where the risk factor is distributed according to a pdf such as $g_v(x)$ we have $g_v(x) \leq g(x)$. Thus,

the question here is how the benefits of investments in supply chain visibility can be assessed. Trading firms and business partners would invest in supply chain visibility provided that the benefits gained would balance out the required investment. In other words

$$\underbrace{\text{delay cost} + \text{counterfeiting induced costs}}_{\text{before visibility}} \geq \text{investment} + \underbrace{\text{delay cost} + \text{counterfeiting induced costs}}_{\text{after visibility}}$$

where delay cost refers to the extra waiting and detention costs and counterfeiting induced costs represents the portion of costs incurred by counterfeiting products slipping out of physical inspection process without being detected. Denoting the investment on supply chain visibility by I_v and letting superscript v to denote the cost parameters and decision variables after making the supply chain visible the above constraint can be stated as follows

$$\int_0^1 x \mathbb{P}\{x\} \big[\gamma(x)\alpha_1 L_e + (1 - \gamma(x))\big[\alpha_2 \mathbb{E}\{L_d\} + \mathbb{E}\{L_w\}\big]\big] dx$$

$$\geq I_v + \int_0^1 x \mathbb{P}_v\{x\} \big[\gamma(x)\alpha_1^v L_e + (1 - \gamma(x))\big[\alpha_2^v \mathbb{E}\{L_d^v\} + \mathbb{E}\{L_w^v\}\big]\big] dx$$

Conclusion and Future research directions

In this paper, we have reported on ongoing initiatives between governmental agencies and businesses to achieve supply chain visibility and facilitate international trade. In particular, governmental agencies are provided with supply chain data to enhance their security assessments. The rationale is that such enhanced assessments allow for the creation of "green lanes" in which governmental interventions are reduced considerably and where supply chain planning can be done in a reliable way. Moreover, this paper reflects on collaborative arrangements between government and business, which go beyond data sharing. As counterfeit products are a major concern both for customs and property right owners in supply chains, we have taken an example in this domain. By means of a stylized model, we demonstrate how government and business can coordinate their actions to mitigate the effectiveness of an adversary, i.e. an organization that aims at infiltrating legitimate supply chain with counterfeit product. Future research is aimed at a further understanding of how governments and business can coordinate their efforts in facilitating legitimate trade while reducing opportunities for illegitimate activities. We believe and have started to demonstrate that supply chain visibility is an important enabler in doing so.

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