Cabotagestudien

A Study on the Movement of International Vehicles in Denmark

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HENRIK STERNBERG, ANDREAS HOLMBERG, GUSTAF LINDQVIST & GÜNTER PROCKL

REPORT

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Cabotagestudien:
A study on the movements of international vehicles in Denmark

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Executive summary

This is a preliminary report of the initial Danish findings from the Scandinavian study "Cabotagestudien". The final conclusions will be presented in a Scandinavian report, planned to be published in the autumn of 2014.

An open European market for goods and services, including transport services, stimulates trade, global competitiveness and economic growth. At the same time, concerns about domestic job security and the environment have sparked debate. This report should be considered a first modest contribution to a mainly unexplored area in the past. Cabotagestudien consists of a walkthrough of previous research on road freight transport deregulation, a data collection of the movements of international trucks in Scandinavia, method validation and statistical comparison Parts of the data collection presented in this report are based on an innovative app for truck counting that registers vehicle movements with the assistance of 8 000 volunteers. Given the novelty of the methods employed and the lack of statistics, the results must be interpreted by keeping in mind the underlying assumptions of this report.

Our dataset offers three main indications:

1) Cabotage is promoted by policy makers as a way to improve fill rate. Our data as well as the involvement of cabotage hauliers in the study, suggest that some hauliers base their business model on domestic haulage with foreign vehicles, so called "big cabotage". Given that Denmark has some of Europe's highest driver wages, cabotage as a business model is a logical consequence. As a business model it is still very limited in Denmark, but from a Danish perspective it is questionable if it improves fill rates. Previous research suggests that deregulation mainly improves cost efficiency, with only minor effects on technical efficiency.
2) Our data gives no indications of any legal infringements of the cabotage rules, meaning that none of the observations indicate any trucks making a fourth trip after an international trip. Since Denmark is a small country with frequent Danish policy controls, there are few incentives and high risks for hauliers to take part in illegal cabotage.
3) The data collected can be used to complement the Eurostat cabotage statistics. After correcting for bias, our data suggest that major portions of new member states' cabotage operations in Denmark are not included in Eurostat 2012. We suggest an alternative picture based in part on Eurostat and in part on the actual vehicle movements, giving a minimum cabotage penetration in Denmark of 4.6%, with the data providing room for a significantly larger percentage.

Further elaborations on these indications as well as additional data and calculations will be published in the final report on the Scandinavian Cabotagestudien.

Dansk resumé

Dette er en foreløbig rapport af de første danske resultater fra den skandinaviske undersøgelse "Cabotagestudien". De endelige konklusioner vil blive præsenteret i en Skandinavisk rapport, der forventes at blive offentliggjort i efteråret 2014.

Et åbent Europæisk marked for varer og tjenesteydelser, herunder transportydelser, stimulerer handel, global konkurrenceevne og økonomisk vækst. Samtidig har bekymringer for national jobsikkerhed og miljøet udløst debat. Denne rapport skal betragtes som et første beskedent bidrag til et overvejende uudforsket område af tidligere studier. Cabotagestudien består af en gennemgang af tidligere forskning i deregulering af vejgodstransport, en dataindsamling af internationale lastbilers bevægelser i Skandinavien, metodevalidering og statistisk sammenligning. Dele af dataindsamlingen præsenteret i denne rapport er baseret på en innovativ mobil app til lastbilsoptælling, som registrerer køretøjers bevægelser, med hjælp fra 8 000 frivillige. Fordi de anvendte metoder er helt nye og mangler statistisk præcision skal resultaterne fortolkes ved at holde disse underliggende antagelser i rapporten for øje.
Vores datasæt rummer tre centrale indikationer:

1. Cabotage fremmes af politiske beslutningstagere som en måde at forbedre fyldningsgrader. Vores data samt inddragelsen af vognmænd i undersøgelsen tyder på, at nogle vognmænd baserer deres forretningsmodel på indenlandsk godstransport med udenlandske køretøjer, såkaldt "big cabotage". I lyset af at Danmark har nogle af Europas højeste chaufførlønninger er cabotage som en forretningsmodel en logisk konsekvens. Som forretningsmodel er det stadig meget begrænset udbredt i Danmark, men fra et dansk perspektiv er det tvivlsomt, om det reelt forbedrer fyldningsgraderne. Tidligere forskning tyder på, at deregulering hovedsageligt forbedrer omkostningseffektivitet, med kun har en mindre effekt på teknisk effektivitet.
2. Vores data viser ingen tegn på juridiske overtrædelser af cabotage reglerne, det vil sige at ingen af observationerne viser tegn på, at lastbiler kører en fjerde tur efter en international tur. Da Danmark er et lille land med hyppige danske politikontroller er der få incitamenter og høj risiko for vognmændene at deltage i ulovlig cabotage.
3. De indsamlede data kan bruges til at supplere Eurostats cabotage statistikker. Efter korrigering for bias tyder vores data på, at store dele af nye medlemslandes cabotage aktiviteter i Danmark ikke indgår i Eurostat 2012. Vi foreslår et alternativt billede delvist baseret på Eurostat og dels på køretøjernes faktiske bevægelser, hvilket giver en minimum cabotage penetration i Danmark på 4,6% - med data, der giver plads til en betydeligt større procentdel.

Yderligere uddybning af disse indikationer samt yderligere data og beregninger vil blive offentliggjort i den endelige rapport om det skandinaviske ”Cabotagestudien”.

About the authors

Dr Henrik Sternberg's research interests are freight transport operations, international transport networks, supply chain information sharing and efficiency. His research has been published by a number of scientific supply chain management, logistics and computer science journals, such as the *Journal of Business Logistics*, the *International Journal of Logistics* and *Computers in Industry*. Currently Dr Sternberg holds a position as postdoctoral researcher at Lund University, Faculty of Engineering, Division of Packaging Logistics. Henrik defended his doctoral thesis "Waste in road transport operations – using information sharing to increase efficiency" in 2011 at Chalmers University of Technology.

Andreas Holmberg, PhD Candidate, Lund University, has a Master's Degree in Industrial Engineering with a focus on mathematical modelling and supply chain management. His research focuses on physical distribution, transport network design and supply chain collaboration. Andreas has been the lead researcher in the Closer Starfish project, which investigated the potential for horizontal collaboration between suppliers and retailers in the Swedish grocery market.

Gustaf Lindquist, Lund University, is a mathematician (MSc) and research assistant. He has over 10 years of experience in developing advanced analysis for Geographical Information Systems (GIS) as well as extensive experience in working with smartphone data. Currently Gustaf is a consultant for Apple, San Francisco, US.

Dr. Günter Prockl, Copenhagen Business School, is Associate Professor. He is teaching and researching in Supply Chain Management and different areas related to the management of Logistics Services and their providers. Previously Dr. Prockl acted as chair for Logistics and Transportation Management in Germany and worked for Fraunhofer Institute. Günter has published numerous book chapters, academic journal publications and research reports and is a specialist on, among other areas, the impact on productivity and cost by the European road transport legislation.

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Contents

Background

Why carry out a study on international trucks in Denmark?

10 million Europeans work in the transport industry and transportation is the basis for trade enabling societal wealth. Europe is currently deregulating the domestic road freight transport markets and the European Commission has outlined the benefits, such as increased efficiency, reduced environmental impact and reduced administration from the deregulation (European Commission, 2011, European Commission, 2014). It is a well-known fact that cost effective transportation enables economic growth (for example, Woodcock et al., 2007, Mačiulis et al., 2009), as does the reduced administration as a result of deregulation. The positive environmental claim, however, has been questioned due to, for example, potential modal shift (Visser and Francke, 2010, Ministerie van Infrastructuur en Milieu, 2013) and an increased transport demand as a result of decreased transport cost (Sternberg, 2013). In addition to environmental concerns, studies show unintended social effects on truck drivers as a result of the deregulation (Hilal, 2008).

Despite the strong impact on both society and industry, as well as the major political debates and media attention given to the matter, European freight deregulation has received rather little research attention. This is in contrast to the amount of literature that has addressed the American road freight deregulation through the Motor Carrier Act of 1980 (e.g. Corsi, 2005). Logistics and in particular transportation have a large environmental and societal impact (Wu and Dunn, 1994) and the societal costs of freight transportation are rarely internalised, causing concern among policy makers (Runhaar and Heijden, 2005, Stern, 2008).

Given both the lack of studies on the European road freight transport deregulation (hereafter referred to as "the deregulation"), and the financial, environmental and social importance of freight transportation, this study provides some insights into the European road freight transport deregulation in the case of Denmark. Some of the questions this report will try to contribute to are: What is the extent of cabotage in Denmark? What are the current effects of the deregulation?

The purpose of this report is to provide a picture of foreign trucks on Danish roads. Our aim is to present objective data, which can be viewed as a complement to existing statistics, and can be used for research and analysis.

This preliminary report presents initial findings mainly relating to Denmark. The final findings from the study, entitled "Cabotagestudien", will be presented in a Scandinavian report scheduled to be released in the autumn of 2014. We would like to emphasise that this study is, despite massive volunteer support, still a small-scale initiative with small resources placing limitations on the analysis. The report is organised as follows: The remainder of this section explains the current state of deregulation and the rules governing foreign hauliers' activities in Denmark. The second section provides an overview of existing knowledge which is followed by an elucidation of the methodology on which the research is based. Then the results from the data collection and analysis are presented. Finally, the implications of the analysis are discussed.

State of deregulation and brief overview of applicable rules – June 2014

The international traffic between EU countries is completely deregulated, whereas the domestic freight transport markets are still regulated, currently through Regulation (EC) 1072/2009 (2009). The Regulation states: "Hauliers who are holders of Community licences provided for in this Regulation and hauliers authorised to operate certain categories of international haulage service should be permitted to carry out national transport services within a Member State on a temporary basis in conformity with this Regulation, without having a registered office or other establishment therein".

The word *cabotage* originates from the sea domain and according to most dictionaries, applies to transport between two locations within a country, carried out by a foreign carrier. A foreign haulier carrying out national transports is generally referred to as cabotage. "Temporary" in the Regulation is defined as three cabotage transports in another country within one week, upon the completion of an international trip. Notably, the Regulation's definition of temporary cabotage does not exclude systematic cabotage, which means that in practice a foreign haulier can spend 365 days in another EU country, as long as the haulier ensures having an international trip every week. Schramm (2012) suggests the conceptual definition of "big cabotage", meaning that large-scale international hauliers with a critical mass of international trips, can act as domestic hauliers and continually rotate their trucks between two countries with three domestic trips in each of the countries.

Some road transports between two domestic locations are not cabotage, but *combined transports*. Combined transport is promoted within the European Union (EU) through the Combined Transport Directive (Council Directive 92/106/EEC, hereafter referred to as "the CT Directive"). The CT Directive seeks to promote combined transport operations through liberalisation of road cabotage, the elimination of authorisation procedures for combined transport operations, as well as financial support through fiscal incentives for certain combined transport operations. In order to be eligible for the provisions within the CT Directive, the movement of goods must meet a number of criteria, including:

1. Goods must be moved in a load unit which is more than 20' (6m) long; and
2. Goods must be moved by rail or inland waterway or maritime transport, where this section exceeds 100 km as the crow flies; and
3. Goods must be moved by road transport on the initial and/or final leg of the journey either:
    - between the point where the goods are loaded and/or unloaded and the nearest suitable rail loading station; or
    - within a radius of 150 km as the crow flies, from the inland waterway port or seaport of loading or unloading.

The CT Directive is supported by other EU policies, such as the Weights and Dimensions Directive (Council Directive 96/53/EC) which currently provides for Member States to permit movement of heavier intermodal load units by road when used in combined transport operations (European Union, 2014).

The Danish transport market

Several of the world's largest and most famous transport companies are Danish and Denmark has a long tradition of international freight transportation. With relatively high salary levels (European Commission, 2014), Danish hauliers and transport workers are, together with other western and northern European trade and interest organisations voicing concerns over their future existence. Recent research confirms their concern. For example, Kummer et al. (2014) showed that over a decade, half of the Austrian truck fleet had flagged out. According to Eurostat (2014b), the Danish domestic freight market was 12 292 million tonne-kilometres (mtkm) in 2012, as shown in Table 1. The same year the total amount of cabotage transports was 343 mtkm (Eurostat, 2014a). The total market national market was 12 635[1] mtkm and the share of cabotage transports was 2.7%. However, all domestic freight transports carried out in Denmark do not have access to international vehicles, but instead have specific vehicle combinations that do not render themselves useful for the international transport of goods. This means in practice that they cannot be granted the right to carry out cabotage within the framework of the current regulations (e.g. agriculture bulk transports).

In Table 1 the national transports in 2012 are displayed by product category and are marked with a "Yes" in the column "Cabotage Feasible" if it is feasible for the category to be handled out by international drivers within the current regulations. The total national market that is exposed to

[1] This figure includes domestic national transports carried out by Danish registered vehicles (12 292 mtkm) and by international vehicles – cabotage (343 mtkm). As we have seen from several other figures (e.g. 2.6%: http://itd.dk/en/InternationalItem.aspx?NewsID=3669), there seems to be a lack of consensus on the figures.

international drivers is thus only 6 737.7[2] mtkm. When comparing the cabotage with the exposed national freight market the share is instead *estimated* to a minimum of 5.1% based on current statistics.

Table 1. National freight market in Denmark divided into product category and if the category can be transported by cabotage transports.[3]

Product Category	Amount mtkm	Cabotage Feasible
Food, feed, beverages, tobacco	2 656.7	Yes
General cargo, mixed goods	1 963.0	Yes
Agriculture, forestry and fishery products	1 868.2	No
Gravel, stone, sand, clay, salt, asphalt	1 444.6	No
Building materials, minerals	1 017.0	No
Gasoline and other petroleum products	520.6	No
Soil and waste	472.1	No
Metal products	390.7	Yes
Processed wood, paper, and paper products	386.9	Yes
Unknown type of goods (e.g. in containers)	371.2	Yes
Chemical products, fertilizers, plastics, rubber	254.4	No
Machinery, appliances, electrical appliances, etc.	179.3	Yes
Vehicles and associated parts	161.6	Yes
Ores, iron, and other metal	152.4	No
Letters and parcels	142.0	No
Furniture and other manufactured goods	102.4	Yes
Empty containers and swap bodies	89.0	Yes
Textiles and clothing	53.6	Yes
Moving goods	40.4	Yes
Charcoal	25.9	No
Total	12 291.9	6 394.7

Every year the ITD (Danish road transport trade organisation) counts vehicles passing the main Danish border crossings (Figure 1). The counting is carried out using hired assistants and done in a systematic manner. Padborg dominates as the road freight centre of Denmark.

[2] 6 394.7 + 343 = 6 737.7

[3] The "Cabotage Feasibility" has been assessed by trade organization experts. In the assessment, we decided to include rather than exclude, so the actual figure of the "cabotage feasible" market is likely to be considerably lower.

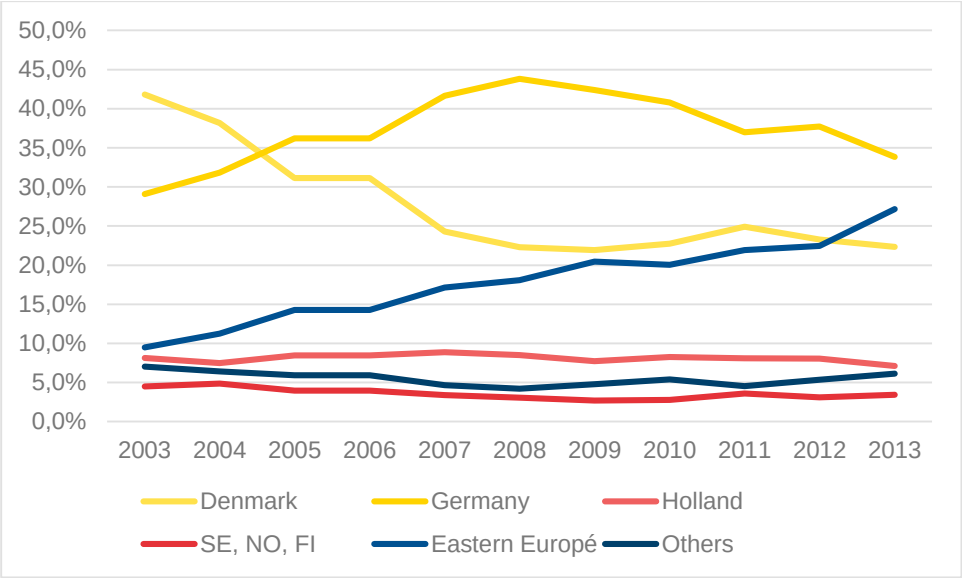

Figure 1. Market share in Denmark by country of registered vehicles going in to Denmark (source: http://itd.dk/Default.aspx?ID=593).

Given the importance of the Danish transport industry for the national economy, cabotage transportation in Denmark sparked political debate resulting in action. The Danish police have received considerable resources for controlling heavy goods vehicles, making Denmark well-known for extensive controls. The latest statistics from the Danish police indicate illegal cabotage at 0.5% (Bröndum, 2014).

Existing knowledge in the field

This section offers a broad summary and discussion of the existing knowledge in the area of the report. Before presenting the existing research on transport regulation, a brief primer on various views on efficiency and logistics trade-offs is provided.

Efficiency

The lack of a common definition of a system's efficiency, both in general and in specific scientific fields (Shaw, 2009), often makes it difficult to understand communication using *efficiency*. Generally efficiency relates to the input used in a process transforming it into output in order for the system's goal to be achieved.

When looking into transportation, considering *externalities* becomes very important. "Externalities are an economic concept that refers to activities of a group that have unintended consequences, positive or negative, on other groups and most importantly that those consequences, particularly if they are negative, are not assumed by those causing them. The impacts are therefore 'externalised'" (Rodrigue et al., 2013, p.260). The European Commission report, "Towards Fair and Efficient Pricing in Transport" (European Commission, 1995), is one sample of many papers and investigations, all recommending transport policies that enable internalisation, such as "polluter pays" regulations and infrastructure charges (Hultkrantz et al., 1997). Road freight transportation in particular is associated with externalities, but in many transport setups, no other option is viable. Hence, the European Commission states in the "Roadmap to a Single European Transport Area – Towards competitive and resource efficient transport system" (2011): "In longer distances, options for road decarbonisation are more limited, and freight multimodality has to become economically attractive for shippers. Efficient co-modality is needed. The EU needs specially developed freight corridors optimised in terms of energy use and emissions, minimising environmental impacts, but also attractive for their reliability, limited congestion and low operating and administrative costs."

Before we start the walkthrough of existing knowledge relating to deregulation, we would like to outline how freight transport networks are planned. A central factor is *cost*. Freight transport demand is induced. This means that it is not a service consumed without a relation to geographic utility (Hesse and Rodrigue, 2004) and has economic gain of the geographic utility being greater than the cost of the transport. As will be argued in the next section, deregulation strongly decreases cost. In the short-term that only means gains for the shipper through reduced transport costs, but in a longer perspective, transport costs are a major factor influencing decision making when locating factories, warehouses, distribution centres, etc. The network planning is always a trade-off between warehousing and transport costs. Decreasing transport costs means that in the long-term it becomes more profitable to centralise warehouse structures, cut inventory and transport goods more frequently and over longer distances (Lumsden, 2006, Simchi-Levi et al., 2007). The incentives for advanced planning to increase the fill rate of heavy-goods vehicles decreases as freight rates decline. On the contrary, higher inventory costs enable higher fill rates and/or larger transport units. At the core of corporate economic models for network planning is a total cost minimisation under given service levels.

Motor Carrier Act of 1980 (MCA)

The Motor Carrier Regulatory Reform and Modernization Act (more commonly known as the Motor Carrier Act of 1980 (MCA) is a United States federal law which deregulated the trucking industry. In short, before the deregulation of road haulage in the United States, each state regulated the traffic licenses and hauliers were only allowed to traffic those distances they were licensed for. In addition, bureaus controlled price levels, e.g., through checking if prices were, quote: "reasonable". Notably, the learnings from the Motor Carrier Act of 1980, seem to be kept out of the discussion/debate on the European deregulation. One of the reasons for this, could be that the previous US structure involved bureaus controlling price levels.

The deregulation following the MCA resulted in several effects. First off, strong reductions of shipping costs, that have remained low after the initial adjustment to deregulation (Kling, 1990, Ying and Keeler, 1991). Service quality improved or remained constant – small communities experienced minor cost decrease, whereas dense areas faced major cost cuts. Several new firms entered the Full Truck Load (FTL) segment, whereas numerous firms in the Less than truckload (LTL) went bankrupt, without being replaced by other firms on the market, leading to fewer and larger firms (Kling, 1990).

The major technical efficiency gain was achieved by private fleets (operated by a shipper for the purpose of transporting that shipper's goods) being dissolved, enabling hauliers to move goods from more shippers and more efficiently balance their assignments. Centralization of transport planning is typically associated with higher fill rates (Cruijssen et al., 2007, Cruijssen et al., 2010).

A major effect of the US deregulation was that the transport geography changed. Trucking replaced rail as the main mode of transportation. In 1980, 70% of US freight expenditure were paid to road hauliers, whereas it was 87% in 2004, despite significant price reductions through the deregulation. As expected, an increased centralization of warehouses took place.

Several researchers have addressed effects on worker conditions,– unionized carriers went out of business (Belzer, 2000). Driver salaries fell by 21% between 1973 and 1995, with deregulation accounting for roughly one third of the decrease and de-unionization for another third (Belman and Monaco, 2001). Belzer (2000) outlines drivers as the big losers of the deregulation in his book "Sweatshops on wheels". Researchers have proposed different effects of the effects on driving safety from the regulations. We have found no significant evidence of increasing accidents, but between the hauliers there exist significant difference – in terms of safety and accidents, unionized hauliers clearly have less accidents than non-unionized (Corsi et al., 2012). In the aftermath of the heated debate in the end of the 70ies in the US, Unions and trade organizations were wrong about service decline, but right about deteriorating drivers' conditions.

In North America, the U.S., Canada and Mexico have signed an agreement called North America Free Trade Agreement (NAFTA) which facilitates cross-border movement of goods and services between the countries (NAFTA, 2014). The agreement has efficiently facilitated cross-border movement between Canada and the U.S., thanks to similar safety regulations (Webster, 2010). However, the border to Mexico has remained closed due to pressure from safety and labour organisations in the U.S. Therefore, a new accord was signed in 2011 opening up the US-Mexican border for Mexican trucks (Black, 2011), tough with strict restrictions and control mechanisms:

"*Mexican trucks must comply with all Federal Motor Vehicle Safety Standards and have monitoring systems to track hours on the road, the Transportation Department said. Also, truck drivers must take drug tests that are analyzed in the U.S., hand over complete driving records and prove their English-language skills … Mexican trucks will be allowed to carry loads to a U.S. destination and bring cargo back to Mexico. They won't be able to deliver goods between two U.S. cities. U.S. trucks will be allowed to circulate in Mexico under the same guidelines.*"

In order to ensure that no domestic runs are carried out and to track compliance with US hours-of-service laws, the Mexican trucks are enforced to carry electronic recorders (Williamson, 2011).

Road freight deregulation in Europe

In the beginning of the 1990s, some of the first logistics researchers to address European deregulation were the Americans, Cooper et al. (1990), with a conceptual outline of "Europe 1992: Benefits and Challenges for International Transportation". Pfohl (1993) followed with a study on the logistics implications of the unified European market and found that the decreasing costs from low-level road hauliers would enable a centralisation of companies' manufacturing and distribution sites. From a German perspective, Pfohl also predicted that logistics managers would increasingly want to rely on outsourcing logistics and in particular outsourcing transport operations.

From other scientific fields, transport deregulation has gained significant interest from law and political sciences, studying how national authorities have met the deregulation (for example, Heritier, 1997). Several economic policy researchers have praised the deregulation. Boylaud and Nicoletti (2001, p.244) state: "The available empirical evidence suggests that liberalisation has promoted efficiency and consumer welfare in the countries that have implemented reforms". Lafontaine and Malaguzzi Valeri (2009) analysed data series of international transportation and cabotage. They found that the increase of tonne-kms was due to increased tonnes transported, not an increased transport length, implying positive trade effects. That fill rates have remained somewhat constant over time is supported by minor investigations. One such study is the longitudinal Swedish-Norwegian border fill rate study by Ramböll (Wall, 2013), that show a very low decrease in fill rate between 1989 and 2013 (measured 1989, 1994, 1999, 2004 and 2013).

Hilal (2008) investigated, from a sociological perspective, the worsening social conditions (also referred to as "social dumping") of European truck drivers. She explains how unscrupulous companies use legal vacuums occurring when deregulation is operational faster than national police forces can carry out inspections. According to Hilal, the intensified use of subcontracting leads to dodging of national tax laws and labour and welfare regulations, with worsens working conditions.

The competitive international long-haul segment is characterised by low operating margins. Fuel prices do have an effect on competitiveness of international hauliers, as shown by the case of the UK (McKinnon, 2007). Kummer et al. (2014) carried out a longitudinal study in Austria, showing the dynamics of transport services and the ease of both flagging out and the extent of heavy goods vehicles (HGVs) being flagged out. They found that over a period of 10 years, 50% of the Austrian vehicles had been flagged out to East Europe. The price differences between a Western/Northern European (EU15) haulier and an Eastern European (from now on referred to as new member states) one is typically around 20-40%, depending on the type of haulage and countries compared (European Commission, 2013, Kummer et al., 2014). The cost difference is to a large extent an effect of lower wages, but also due to lower fixed costs, for example vehicle tax and inspection costs.

Changing the structure of transportation inevitably has large effects on the environment. Previous studies show both positive environmental impacts from cabotage (Visser and Francke, 2010) and negative ones (Ministerie van Infrastructuur en Milieu, 2013, Sternberg, 2013). All three studies were small-scale and conducted using different data and different calculation methods. The data of Sternberg (2013) also raised concerns that a large number of international vehicles did not show signs of leaving Sweden[4].

[4] The first round of data collection for Cabotagestudien was carried out in the spring of 2013. The second round, 6 months later, revealed that a very large number of trucks that moved only domestically, were no longer present in the country, whereas the international trucks largely remained. These findings will be elaborated in the Swedish report published in the autumn.

Methodology – overview

As confirmed by (Lafontaine and Malaguzzi Valeri, 2009), only a few scientific articles have addressed the European freight deregulation. Hence, we have applied a combination of methodologies in order to investigate international truck movements in Scandinavia. Firstly, we developed an innovative smartphone app for collecting a large dataset. Secondly, we validated the dataset against the actual GPS positions (in some cases complemented with consignment notes). Thirdly, we investigated various documents (literature, legal cases, consignment notes, news articles, etc.) and carried out a field trip in Denmark. In addition, an expert workshop was carried out, to discuss legal interpretations and potential errors in the data. The final piece of work carried out (a calculation model to analyse business models of international hauliers) was not completed at the time of this report. During the whole time, we have maintained a fruitful dialog with various Danish interest organisations.

Position reporting of foreign vehicles – Cabotagestudien app

Politicians, authorities and researchers all rely on Eurostat to retrieve statistics on road freight transportation. In the Eurostat data, some countries statistics are non-disclosed and some European countries lack routines for collecting haulage data (Eurostat, 2013). We have applied "empirical crowdsourcing", that is, using volunteers to collect position data of foreign vehicles, in order to complement the Eurostat data with additional insights.

Engaging volunteers in observation

Early studies on collecting GPS data have shown that, with technology, volunteers are typically positive to participating in research projects (Murakami and Wagner, 1999). Previous studies on truck drivers carrying out self-observation (for example, Klaus et al., 2008, Sternberg, 2011)[5] have shown that truck drivers to some extent are motivated to participate in research programmes, in particular when given incentives. In addition to the potential for collecting large amounts of empirical data that might otherwise be hard to come by, early experiments on using smartphone apps with drivers by Sternberg (2011) indicated that some quality problems of the collected data need to be taken into account.

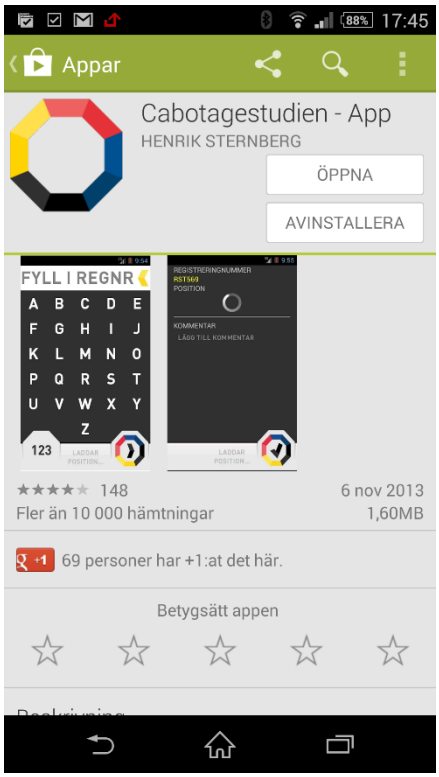

Figure 2: Screenshot from Google Play

Given this background, an initial version of Cabotagestudien was carried out in Sweden in the spring of 2013. A simple app for Android and iOS was made freely available and promoted using social media. The user entered the licence plate number of the observed vehicle and submitted the position, using the phone's GPS coordinates. During the first round of Cabotagestudien, the platform and quality assurance tools were continuously developed. There was great interest for the study in Denmark, and a large number of Danish volunteers used the Swedish app. Hence when the Scandinavian Cabotagestudien started, a critical mass of users was ready to use the Danish version of the app, the Facebook page and website.

Data were collected from 8 October to 9 November 2013. The data collection method itself rendered considerable media attention, which further boosted the number of users. In addition to drivers acting out of fear of losing their jobs in the light of deregulation, we believe the visualisation component of

[5] Further contributions on the driver observation methodology are currently under review in *Transportation Journal*.

the project played an important role. The users could continuously monitor the results of the project on the project homepage: http://dk.cabotagestudien.com/da/steder/#/plates/ . Continuous news and updates were given on the Danish Facebook page, monitored by assistants of the Copenhagen Business School. In addition, the *Lastbil magasin* (Danish trucking magazine) offered free subscriptions as a prize to the most productive Danish volunteers. The most productive Danish volunteer, "Truckerbobo", reported 2 669 truck positions over the data collection period. The top list (http://www.cabotagestudien.com/sv/topplista/) was published in the app to give recognition to the top contributing volunteers.

Ethics and privacy

The app contained warning texts, strongly advising against using it while driving. In the information material as well as continuously in social forums, volunteers were informed and reminded to respect the privacy of foreign drivers and individual companies. In a deregulated market, shippers' transport purchasing policies are governed by the strategy of the company. The Cabotagestudien team's advice to domestic drivers concerning job security and safety has always been to encourage informed consumption, that is, using their power as end consumers rather than stigmatising foreign truck drivers who in many cases already live under harsh social conditions.

During the field trip (see Scandinavian field trip section) the Cabotagestudien team met with over 100 foreign drivers. The app's functionality was demonstrated to several groups of drivers and they were told how their privacy and the licence plates of their trucks were to remain confidential.

Error sources in the data collection

Several sources of error needed to be taken into consideration. The following non-antagonistic errors were observed:

- Technical errors: These occur when, for example, the smartphone sends erroneous GPS coordinates (or no coordinates at all, making it look like an observation was made at 0'0 [outside the coast of Africa]).
- Double typing: Some double submissions were made. These were filtered out.
- Erroneous typing: This is an apparent weakness in the study, since there is no guarantee that the user has not entered the licence plate of a personal car, trailer or a fictive licence plate. A few users reported their errors. Since licence plates with only one observation are unlikely to have spent more than a maximum of one day in a Scandinavian country, they were not of interest for the purpose of the study anyway.

Several app users in Denmark carried out impossible observations (e.g. a truck being at two different locations within an implausible time interval) or simply reported foreign trucks they had previously seen, in order to either criticise the app or to try to "over use" it to increase the presence of foreign vehicles in the statistics. Early on, the Cabotagestudien team decided not to carry out any real-time blocking of such antagonistic usage of the app, since that would potentially lead to a kind of "arms race" between the data verification functions and the antagonistic users. 4% of the Danish observations were discarded because of quality issues, as will be explained in the analysis section.

Drivers have a bias in their reporting and tend to report new member states trucks more frequently than EU15 ones. As the results section will show, the expert was right and this error source is accounted for. Some larger hauliers are known to apply rigid internal control measures to prevent illegal cabotage, hypothetically creating a company reporting bias, i.e., drivers are aware and focus on observing small or medium-sized haulier vehicles. The limitations of the current dataset does not support or reject the existence of such bias.

The final source of error, one that we have not been able to adjust for, is fake licence plates. Swedish observers (and the authors during their field trip) took several pictures of truck drivers trying to hide their licence plates, trucks driving without licence plates, etc., and sent them to the team. No such pictures were taken or sent from Denmark (or Norway) during the time of the study (8 Oct. to 9 Nov.

2013). As will be explained in forthcoming reports, surprisingly large differences between the Scandinavian countries have been observed.

Error sources in the preliminary data analysis

Transportation researchers around the world are currently experimenting with various types of smartphone-based approaches to data collection (Bohte and Maat, 2009). Collecting smartphone data for transportation research is a novel, but is fast developing as an approach for collecting large datasets in a cost efficient manner. As with other probabilistic methods, the analysis of geographic movement patterns is by default very prone to errors (Bierlaire et al., 2013). The poor quality of GPS data collected from smartphones precludes the use of state-of-the-art map matching methods (ibid.), yet with complementary data on the actual characteristics of some trips, quality of the analysis can be greatly increased (Du and Aultman-Hall, 2007, Bohte and Maat, 2009). Despite additional descriptions and templates for matching GPS data to trip purpose, trips with many stops still represent a great challenge to analyse (Du and Aultman-Hall, 2007). In practice this means that the greatest challenge is distribution traffic with frequent stops.

When working with GPS datasets, several factors have to be assumed, despite the fact that they are not true for the whole population studied. Denmark is a very small country and foreign trucks can easily operate legal cabotage 365 days a year. For 43 out of the 100 most observed trucks, the team had access to perfect data (see next section – Validation trucks), confirming that trucks operating frequently in Denmark without being observed in Sweden, Norway or Finland, regularly make trips to Germany.

The Danish experts in the workshop noted that trucking under the combined transport regulation is relatively rare in Denmark and none of the three validation fleets carried out any combined transports. None of the trucks on which the team retrieved detailed data had carried out combined transports. Hence our analysis model of Denmark does not take combined transport explicitly into consideration. Another constraint is assumed efficient route planning, which means that hauliers are assumed to carry out their initial tour until a significant (100 degree) route change occurs in a period of 15 minutes.

Validation trucks

Twelve hauliers were requested to share data with Cabotagestudien. The data requested of companies were GPS logs and copies of consignment notes. In return, the companies were offered anonymity and a potential certificate that they had been externally scrutinised. Of the twelve hauliers, three agreed to share data. One haulier answered our request, but declined assisting with data, because they did not think their potential participation would be accepted by their customers. The remaining 8 never answered our request and we refrain from speculating why.

The validation set used this far for the preliminary analysis consisted of a dataset of GPS logs of 114 trucks, with 99 trucks having carried out both international transports and cabotage in Scandinavia during the period of the study.

Scandinavian field trip

During the first period of data collection in the spring of 2013, the users sent in many reports about the international trucks regarding parking pitches, alarming social conditions, violations of Swedish laws with replaced, covered or no plates at all, and so on. We started in Sweden on 27 October and travelled the roads through Norway and Denmark, before ending up in Sweden on 3 November. The purpose of the trip was to gain a better view of the international freight market in Scandinavia and establish contacts with foreign drivers to validate the analysis.

The conditions of the drivers' facilities very considerably. Most foreign drivers spend a majority of their time in Scandinavia relying on the shipping company's hygienic facilities that they can use when loading and/or unloading.

Polish drivers in general were very open and they seemed to have, in general, a positive attitude to their work and the salary they were paid. Typically they stay out for 4-5 weeks followed by 2 weeks at home. Most Bulgarian drivers were very hesitant to speak to the authors. The ones who did stated that they stay out for 3-4 months, followed by 2-4 weeks at home.

Figure 3. Panorama picture of the Padborg toll station, 2 Nov. 2013.

Through Facebook and Skype, we maintained contact with some of the drivers. We spent two days (a Friday and Saturday) in Padborg. At the toll station, the biggest challenge to driver conversations was the large number of drunk drivers.

Finally, one of the authors collected observational data without nationality bias, in order to collect supporting material for the calculations.

Remaining work

- Additional validation cases: For the final report, our ambition is to incorporate further validation cases.
- Legal cases: The Cabotagestudien team set out to study legal cases, but due to the lack of cases (finding only the court case of one international haulier), we discontinued this approach.
- Currently the University of St. Gallen in collaboration with Lund University are developing a microeconomic calculation model, to create addition insights on the Danish market. At the time of the writing of this report, the model is yet to be validated.

Results

This section presents the results from the data collection.

Volunteer data overview

A total of 172 261 observations were collected by approximately 8 000 Cabotagestudien app volunteer users (some users were anonymous). Out of the 172 261 observations, 38 0861 were made in Denmark. 436 observations were deleted because of, for example, erroneous coordinates or double entry. In total, 56 947 different licence plates were reported (the main part of them, only once). 12 596 licence plates were reported by at least two observers, corresponding to 110 076 observations. The remaining 60 697 valid sights were not used. The bulk of the observations were clearly made by truck drivers, with the data collection patterns corresponding to their regular routes. 2 109 users (543 in Denmark) contributed 10 or more observations. Figure 3 gives an overview of the coverage of the Danish observations.

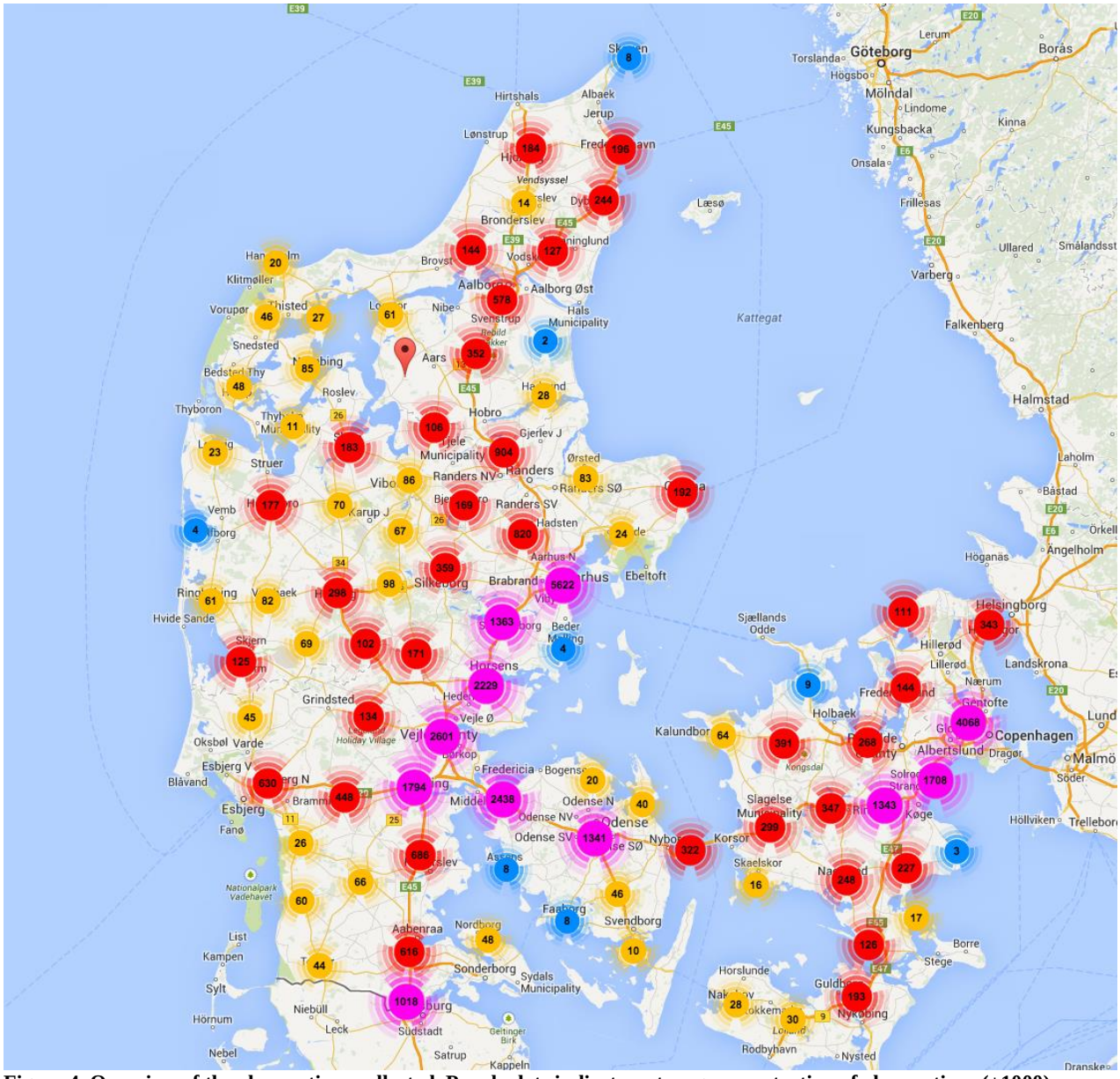

Figure 4. Overview of the observations collected. Purple dots indicate a strong concentration of observations (+1000).

Based on the observations, individual truck moving patterns could be established, see Figure 5 and Figure 6 for a samples:

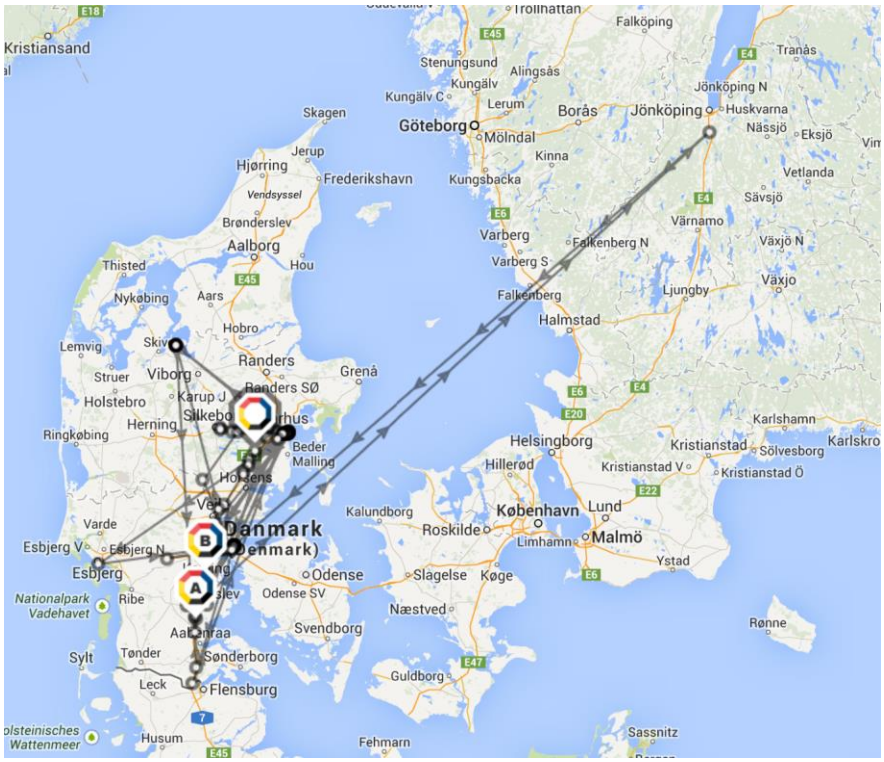

Figure 5. A sample moving pattern (http://www.cabotagestudien.com/sv/rapporteringar/#/plates/2031/I_____H/), based on 103 observations.

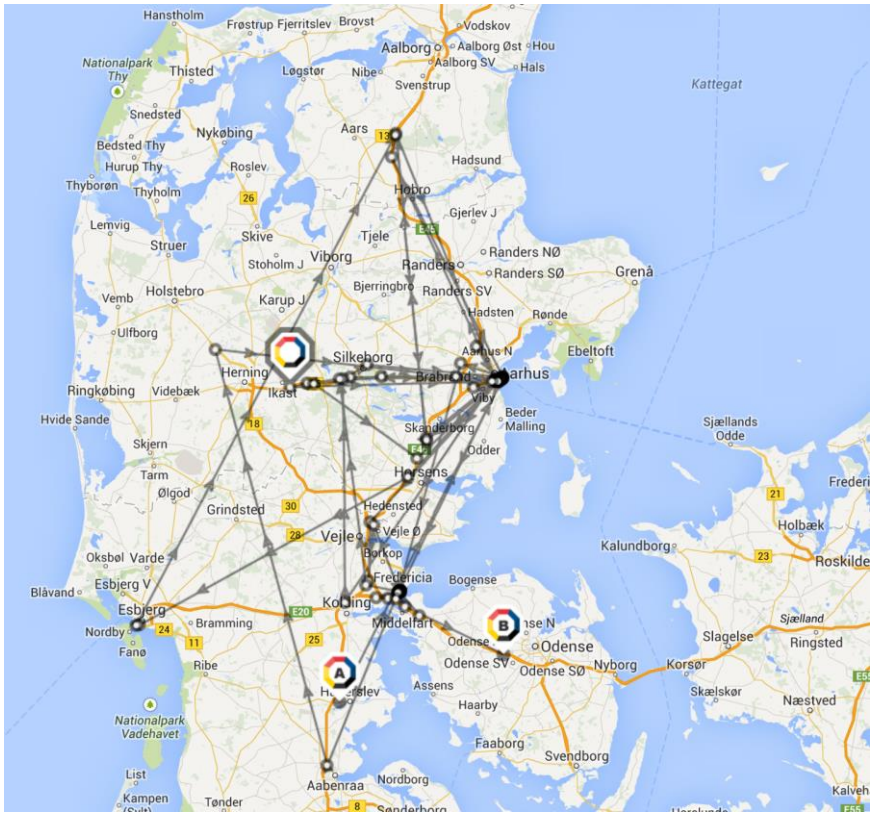

Figure 6. Another sample movement pattern (http://www.cabotagestudien.com/sv/rapporteringar/#/plates/145/I_____H/).

Observer bias – validation trucks

When the observers reported trucks, they could optionally enter nationality. The reported nationalities of the trucks displayed a strong bias towards reporting new member states trucks, as shown in **Error! Not a valid bookmark self-reference.**. Out of 3 373 trucks observed in Denmark, 762 were Polish, 462 Bulgarian and 409 German. No nationality was entered for 669 (20%) trucks.

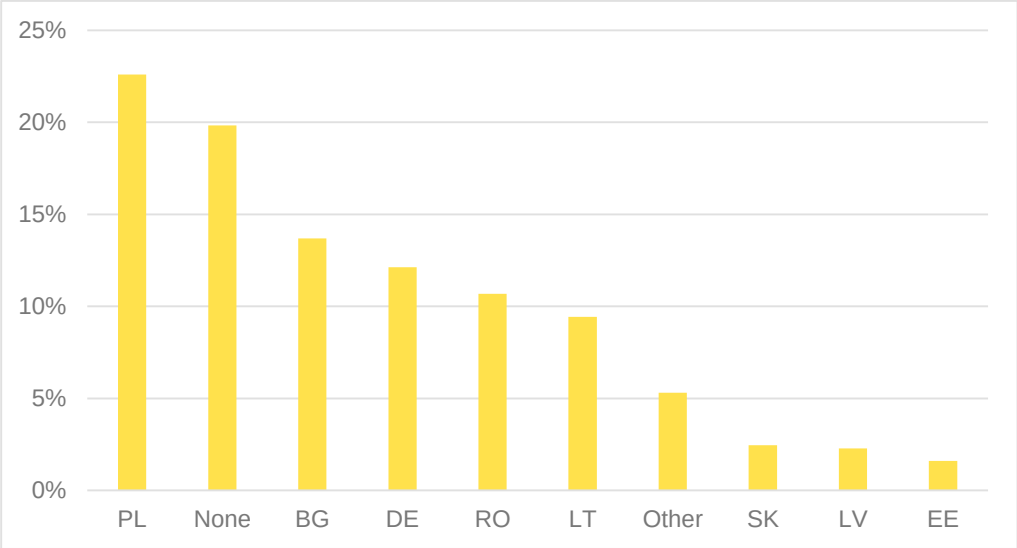

Figure 7. Percentages of truck nationalities observed by volunteers.

This observation bias has led to that the distribution between EU15 and new member states vehicles is somewhat false. Thanks to the validation case, the frequency of observations from the volunteers of EU15 and new member states'[6] vehicles respectively could be compared to the actual appearances. This showed that new member states vehicles were reported 1.31 times a day, whilst EU15 vehicles only were reported 0.79 times per day.

Validation trucks

The validation case consisted of a dataset of GPS logs belonging to 114 trucks, with 99 trucks having carried out both international transports and cabotage in Scandinavia during the period of the study. 45 were on the TOP100 list of most observed trucks.

The reports made from the volunteers in the study have been matched with the actual locations of the vehicles in the validation case. The difference between the reports and the actual appearance of the trucks in the validation case is taken into account when the estimation calculation of cabotage carried out by vehicles from the new member states. The difference in the frequency of reports of EU15 and new member states' vehicles from the volunteers was further elucidated when comparing the results of the volunteers with both the validation case and the reports of the authors. The volunteers have been more prone to report new member state vehicles than EU15 vehicles, which has led to a skew relation between the nationalities. Therefore, the bias calculations, used for calculating the estimation of new member states cabotage, have been separated for to compare reports and validation case from EU15-countries and new member states respectively.

One of the authors observed 199 trucks on the route from Fredrikshavn to Padborg and from Rödby to Copenhagen. In order to generate a small unbiased set, he would report all trucks encountered on parking lots where the team took their breaks. Since the authors' data collection was carried out Friday to Saturday, it does give a strong bias towards the trucks staying longer durations in Denmark. A comparison with the volunteer observations is illustrated in Figure 8.

[6] A difference is made between EU15-countries and the remaining member states, which from here on in the report will be referred to as the "new member states".

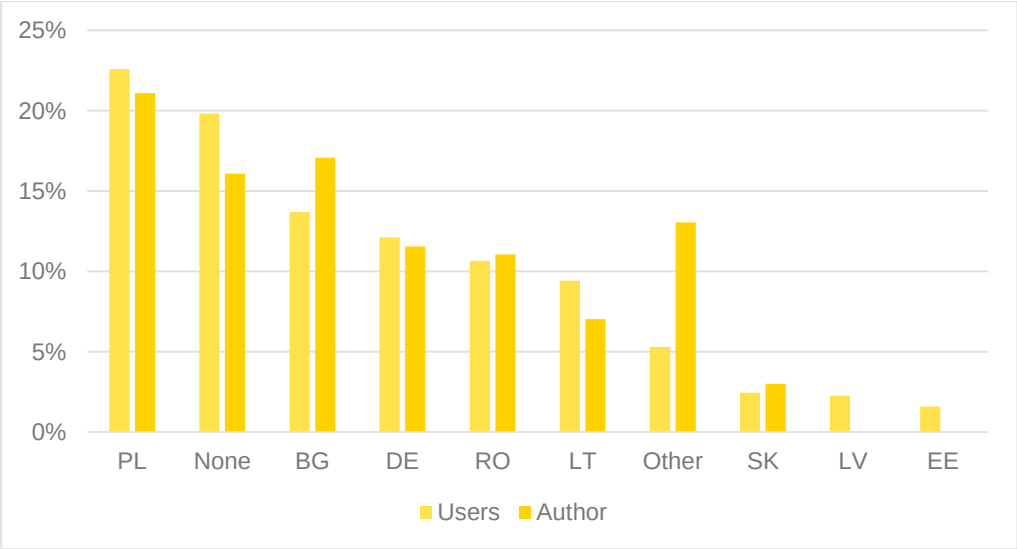

Figure 8. Percentages of truck nationalities observed by volunteers (left) and author (right)

The authors found that a large share of the trucks observed at the Padborg toll station had not been previously observed, indicating that many foreign trucks only enter Denmark at Padborg and shortly after leave the country.

Antagonistic observations

Comparisons of the volunteer sightings with the validation dataset showed a 96% match. A match was defined as being both a time match (max 10 minutes difference) and a position match (radius of 30 km), though more than 90% matched within 1 minute and 1 km. Hence, an additional 4% of the observation dataset was scrapped.

Indications – business and legal

As outlined in the methodology section, the trip analysis is based on assumptions that even though they hold true for a major part of dataset, are not valid for each trip. While still more validation data are necessary to ensure stronger validity, the preliminary findings are likely to apply.

The trips generated from our data show no indications of violations of the cabotage rules (i.e. no instance of a fourth domestic trip after an initial international trip), nor did the trips analysed from the validation sets[7]. The authors had access to complete legal documentation of one of the hauliers in the dataset. The haulier had received several fines for cabotage violations, all of them being due to documentation errors (e.g. the driver picked up the wrong consignments, failed to get a signature on a consignment note, etc.). This does not mean there is no illegal cabotage in Denmark, it only means our data does not support the existence of anything but administrative infringements. We have requested access to further copies of court documentation from three more international hauliers operating in Denmark, but have not received it so far.

In terms of business, the current dataset indicates that at least 150 and at most 200 foreign trucks operate with cabotage as a business model, which means that they are stationed in Denmark, continuously make 2-3 domestic trips, leave the country for shorter international hauls, and then return to run cabotage in Denmark.

Figure 9 illustrates the basics of the model used to analyse the number of tours carried out domestically.

[7] Our initial assumption that a haulier following the rules will have no issues sharing their data proved to be true.

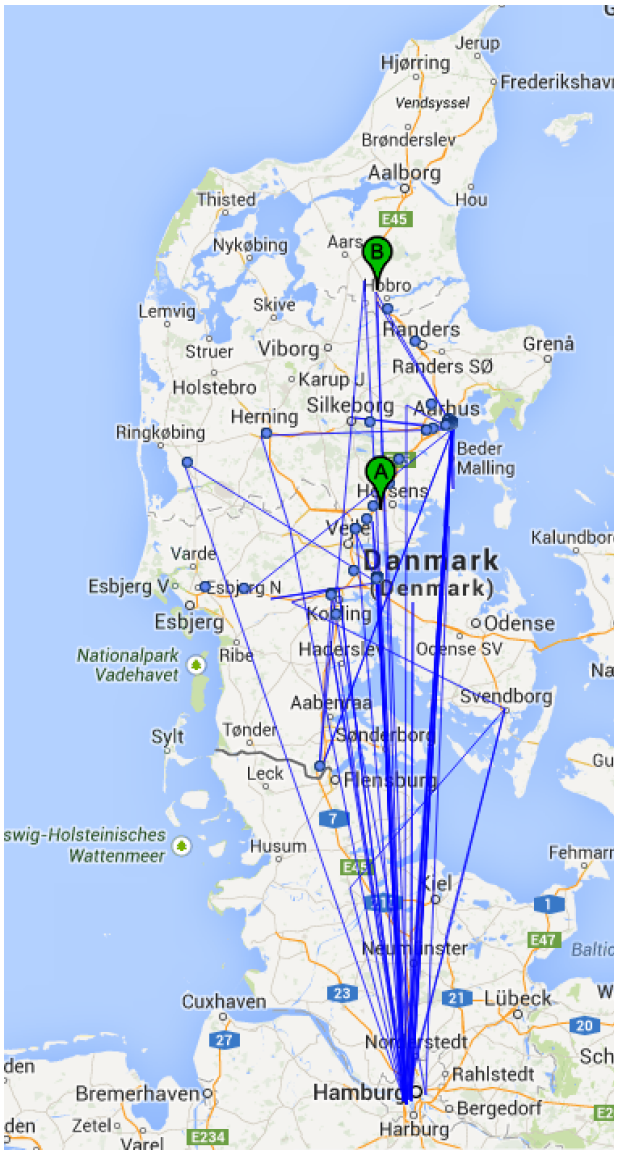

Figure 9. A Romanian truck, graphically illustrating the route analysis model.

Estimating cabotage in Denmark

The statistics on cabotage presented by Eurostat are based on reports submitted by the country where the vehicles are registered. However, the reports from the volunteers, the observations by the authors, and the statistics of vehicles crossing the border (ITD data) indicate that some reports from member states to Eurostat on cabotage are too low. *Based on the assumption* that the Eurostat statistics of cabotage transports carried out in Denmark by vehicles from countries in EU15 (B in the formulas below) are correct, it is possible to make an estimation of the magnitude of cabotage in Denmark by new member states vehicles. Drivers have the right to carrying out cabotage following an international trip. *A second assumption* is that all cabotage in Denmark is equally distributed over all international vehicles.

If the number of observations of EU15 vehicles (β) is put in relation to α, then it is possible to calculate an estimation of cabotage carried out by new member states vehicles in Demark. The number of sightings of EU15 and new member states vehicles are both biased and have a margin of error that needs to be taken into consideration. Also, since the latest statistics available from Eurostat on cabotage carried out in Denmark are from 2012, and the collected observations from the study are from 2013, the observed difference in border crossings (ITD border counting) is assumed as a baseline for projecting change between the years (θ). In mathematical terms this can be described by the formula below, based on common standard deviation calculations, resulting in a 95% confidence interval.

We have constructed a model in order to estimate the amount of cabotage carried out in Denmark based on the data collected in this study. This model is the result of some key assumptions made by the authors and will be presented and discussed in this section and in the discussion section.

The first key element is that we define the information on cabotage carried out by EU15 vehicles from Eurostat to be correct:

$$\mathrm{B} = Cabotage\ in\ Denmark\ by\ EU15 - vehicles\ (Eurostat)$$

Secondly, we define:

$$\text{Foreign transports} = \text{Cabotage transports} + \text{international transports}$$

This is separated for EU15 vehicles and new member state vehicles.

Thirdly, we assume that the observations[1] from volunteers represent how many transports they carry out. The observations are connected to the number of days they are in Denmark and this is thus seen as an indicator of how many tkm they travel. As mentioned in the *Antagonistic observations* section, the distribution of observations between EU15 and new member state vehicles is skewed when compared to the validation case, and this has therefore been taken into consideration by the factor c.

$$c = factor\ considering\ the\ antagonsitic\ behaviour\ of\ volunteers$$
$$Foregin\ transports = Volunteer\ observations \times c$$

Fourthly, since we cannot separate if the observations made are cabotage or international transports being carried out, we assume that the ratio between cabotage and international transports are the same disregarding if it concerns EU15 vehicles or new member state vehicles. This assumption is considered to be realistic or to be biased to underestimate new member states cabotage, since the new

[1] From here on *observations*, if nothing else is stated, refers to the observations made by the volunteers.

member states can offer cabotage transports at a lower rate, making them a primary choice on the spot market. This can be stated as:

$$\frac{Cabotage_{new\ meber\ states}}{International_{new\ meber\ states}} = \frac{Cabotage_{EU15}}{International_{EU15}}$$

Since the above ratio is assumed to be the same for new member states and EU15 countries, this implies that this ratio also is valid:

$$\frac{Cabotage_{new\ meber\ states}}{Observations_{new\ meber\ states}} = \frac{Cabotage_{EU15}}{Observations_{EU15}}$$

$$\beta = Observations_{EU15}$$

$$\gamma = Observations_{new\ meber\ states}$$

Lastly, since the latest available statistics from Eurostat on cabotage carried out in Denmark are from 2012 and the observations were made during 2013, we have a factor that takes this into consideration. We have chosen to take the observed difference in number of vehicles crossing the Danish borders by ITD (θ).

$$\theta = Change\ in\ international\ traffic\ in\ Denmark\ by\ EU15 - vehicles\ (ITD)$$

So consequently, assuming:
1) that Eurostat's statistics on EU15 cabotage (B) are valid, 2) that they have changed by factor θ, 3) that the ratios between cabotage and international transports are equal for either type of cabotage, 4) that the observations of both EU15 and new member state cabotage are related to the amount of cabotage carried out, then the following model can be concluded for cabotage by new member state vehicles:

$$Cabotage\ by\ new\ meber\ state\ vehicles\ in\ Denmark = \frac{\mathrm{B} \times \theta}{\beta \times c_\beta \times \pi_\beta} \times \gamma \times c_\gamma \times \pi_\gamma$$

where the function π represents the standard error of the difference between the observations and the validation case.

The *estimation* of total cabotage in Denmark is calculated as follows:

$$\alpha + \frac{\alpha * \theta}{\beta * \pm\sqrt{\frac{1}{n_\beta - 1} * \sum_{i=1}^{n_\beta}(\beta_i - \bar{\beta})^2 * \frac{(N_\beta - n_\beta)}{n_\beta * N_\beta}} * \frac{1.96}{\bar{\beta}}} *$$

$$\gamma * \pm\sqrt{\frac{1}{n_\gamma - 1} * \sum_{i=1}^{n_\gamma}(\gamma_i - \bar{\gamma})^2 * \frac{(N_\gamma - n_\gamma)}{n_\gamma * N_\gamma}} * \frac{1.96}{\bar{\gamma}}$$

Before adjusting for volunteer observation bias, the number of vehicle observations from the EU15 countries was 5 456 and from the new member state vehicles was 22 916. As included in the formula above, the data set has been divided and the bias has been calculated separately for the two figures. The bias for new member states observations is calculated to 14% whilst the standard error for EU15 observations is significantly higher, due to a smaller portion of the data set, at 38.5%. The calculated 95% confidence interval for β is 6 915±50% and for γ it is 17 441±50%

We have calculated the "one sample t-test" giving us a t-value (t) of the samples:

$$t_x = \frac{\bar{x}}{\frac{s_x}{\sqrt{n_x}}}$$
$$t_\beta = 5.085$$
$$t_\gamma = 13.968$$

The cabotage carried out with vehicles from EU15 countries was 251 mtkm in 2012 (Eurostat) and the new member states cabotage was 93 mtkm in 2012 (Eurostat). The change between the years (2012 to 2013) was a decrease of vehicles from EU15 by 7.2% and an increase of new member states vehicles by 20.9%. Taking these changes into consideration results in an *estimated* figure of 233 mtkm of cabotage in Denmark in 2013 by vehicles from EU15 countries, and of 112 mtkm by vehicles from new member states.

With these figures, an estimation of the total cabotage in Denmark can be calculated according to the formula above. This results in an estimation that new member states cabotage in Denmark should at least be 364 mtkm, but we want to highlight that this involves a high standard error factor. Also, this figure is based on configured statistics from 2012 (Eurostat) which could potentially make the actual figure either higher or lower. Given the above assumptions and our dataset, the calculated total cabotage should at least correspond to 597 mtkm. This would mean that the total cabotage carried out in Denmark accounts for at least 4.6 % of the total domestic market, if the Danish domestic statistics are correct. It must be stated again that this figure is an absolute minimum and our calculations, based on the given assumptions, support a larger cabotage share.

Concluding discussion and reflections

As mentioned in the background, the authors have encountered several different figures on the share of cabotage in the Danish transport market. The presented figure is 2.7% and is based on a national freight market of 12 292 mtkm (Eurostat) and carried out cabotage of 343 mtkm (Eurostat). We also presented the feasible cabotage market to 6 738 mtkm. However, this is based on the assumption that the statistics on cabotage carried out in Denmark by Eurostat is accurate. If the calculations of estimations made in the results chapter are used and compared to the feasible cabotage market, a calculated estimation of the cabotage share of the available freight market in Denmark should be at least 8.5%. However, we want to emphasize that this figure is based on multiple, nested assumptions with numerous potential errors in each step of the calculation process.

The Eurostat team consists of highly skilled, expert statisticians. Unfortunately, that does not help when some European countries entirely lack routines for collecting data and Eurostat lists some countries' cabotage operations as confidential. Given the feasible assumption that EU15 countries have sufficient routines for reporting cabotage operations and the large share of cabotage being carried out by trucks from the new member states, statistic cabotage penetration should be significantly higher. Currently, no one knows the actual figure.

Considering previous studies and the data at hand, we have no support of any resource efficiency increase from the use of cabotage – only increased cost efficiency. The current regulation, allowing three cabotage trips after the completion of an international trip, enables "big cabotage" (cabotage as a business model). In practice, the result of "big cabotage" is increased cost efficiency and a status-quo in terms of resource efficiency. In terms of cabotage as a means of increasing fill rate, we are missing detailed inside data from any of the large (500+ trucks) fleets operating cabotage in Denmark. Studying their use of cabotage might give indications of actual resource efficiency increase and we authors would be very happy if any large haulier would be open to sharing consignment and route information.

Most stakeholders and policy makers acknowledge that regulation creates unnecessary administration and wastes resources. One such inefficiency is that under the current regulation, a haulier first has to complete an international trip before the haulier can operate cabotage. Particularly in multi-stop operations, this will often lead to unnecessary empty-driving, since the haulier is not allowed to pick up goods until the international trip is completed. We believe it would be interesting to develop a model to test whether a time-based cabotage limit rather than a trip-based limit could potentially result in both increased cost and resource efficiency.

Looking at the experiences from the North American trucking deregulation, it is clear that the shippers are the big winners and that the drivers, regardless of company, are the big losers from the deregulation. Research shows that deregulation itself is not a driver of accidents, but de-unionization is. In a deregulation, unionized hauliers will have severe difficulties being competitive against non-unionized hauliers. The Scandinavian countries apply a structure of national union agreements, which prevent Scandinavian truck driver wages from decreasing. At the same time, salary levels in some new member states might be relatively stable, since liberal labor immigration rules in some of the states enable access to a large pool of non-EU citizens prepared to work for lower wage levels. We propose for future investigations to look into if these factors actually maintain the existing large cost gap.

Considering the current major cost difference between Danish and new member states' hauliers, cabotage as a business model is likely to grow, as the industry adapts to take advantage of the potential cost savings that can be achieved through combining international transports with cabotage trips. Facing further liberalization, shipper preferences will play a decisive role. On the question of whether it matters if a Romanian or Danish truck picks up containers, the CEO of a haulier operating cabotage in Denmark says: "If they [the shippers] want Danish trucks and Danish drivers, they will of course

get that, but currently they don't care." The same manager says: "The shippers will not pay me for Danish trucks and drivers. If I stop operating these container transports, then someone else will operate cabotage and haul them in Denmark." These pragmatic statements highlight both the complexity and flexibility of the market players. It is a fact that the hauliers adapt fast and trucks can easily be registered in another country, as illustrated by the case of Austria (Kummer et al., 2014). The major price differences create a situation where the winning hauliers manage to hire and retain the most competent low wage drivers. Seen from a societal perspective, do we want the actors to compete with resource efficiency or contract the cheapest possible driver?

If cost efficiency is the main objective, flagging out vehicles from EU15 to new member states should be considered a positive development. Generally, the further the drivers are coming from, the longer durations they have to spend in their trucks away from their home. Ongoing studies by the Norwegian institutes Fafo Institute for Labour and Social Research and Institute of Transport Economics are likely to contribute with more insights into both social and safety aspects of the ongoing deregulation.

The author's most surprising realization was the big difference between the Scandinavian countries, which we will elaborate on in the final Scandinavian report. Hence, we want to highlight that the Danish findings apply for Denmark *only*.

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