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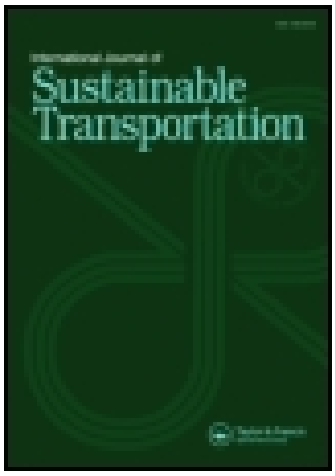

International Journal of Sustainable Transportation
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ujst20

Road Pricing and Port Hinterland Competitiveness: An Application to the Hamburg - Le Havre Range

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Accepted author version posted online: 12 Aug 2014.

Road pricing and port hinterland competitiveness: An application to the Hamburg – Le Havre range

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Abstract

Road pricing is drawing ever greater attention, not only as a means for funding infrastructure investment, but also as a way of eliminating negative externalities associated with land-based transport. The goal is to improve the environmental sustainability of such transport while maintaining its economic viability. As road transport continues to be the most prominent mode of hinterland transportation to and from seaports, road pricing may be assumed to impact on the competitiveness of those ports. This paper examines the extent to which this is the case by taking a micro-research approach. It analyses how road pricing affects the cost functions of the various actors in the logistics chain and considers the potential impact of different setups and modalities in neighbouring regions and countries.

KEYWORDS: sustainable transport choice, road pricing, port competitiveness, cost structure

1. INTRODUCTION

In 2003, Germany abandoned the Eurovignette system and replaced it with a kilometre charge for trucks, a scheme known as LKW-Maut. Under the new scheme, truck drivers are obliged to pay a toll based on the distance travelled on German motorways, and the number of truck axles and the emission category of the vehicle concerned. The introduction of the LKW Maut accelerated the transition of the fleet to more environmental friendly Euro-5 and Euro-6 engines[*].

To accommodate for such variabilisation, the European Council and Parliament revised the Eurovignette Directive 2011/76/EU, amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures. The new directive should allow for greater variability in tariffs, in order that due account could be taken of, among other things, environmental factors and congestion frequency for the purpose of making road transport more environmentally sustainable.

Meanwhile, the introduction of road pricing as a more flexible alternative to the Eurovignette is under consideration by other European governments, including the Flemish regional government. Road pricing can also guide Flemish transport decision makers towards more sustainable transport choices. Under an agreement with the Walloon and Brussels Capital regions, the Eurovignette would be replaced with freight road pricing for trucks weighing upward of 3.5 tonnes. The system would apply to the

[*] See http://www.bag.bund.de/DE/Navigation/Verkehrsaufgaben/Statistik/Mautstatistik/mautstatistik.html

current Belgian Eurovignette network, which encompasses the main motorway network, as well as to some major secondary roads. The primary goal is to make heavy freight vehicles that use the Belgian road infrastructure pay for the wear and damage caused to that infrastructure, based on the number of kilometres travelled.

If so desired, kilometre pricing may also take into account other external effects of transportation. By differentiating the levy on the basis of vehicle type, place and time, it should be possible to diminish negative environmental impacts, abate congestion and reduce the number of accidents. This may be achieved through the mechanism represented in Figure 1.

Without a charge, market equilibrium is reached at price p_1 where demand equals marginal private cost (MPC), and where the quantity requested equals q_1. Introducing a kilometre charge for freight transport will initially lead to a cost increase for road transport and a reduction in the volume of freight transport demand. A levy that fully internalises the external costs is the crossing point of marginal social cost (MSC) with the demand function. At that crossing, at a price p_2, a transport volume q_2 will be demanded. The levy will then amount to h. The magnitude of the price increase and demand decrease will depend on the price elasticity of demand. The more elastic demand, the stronger the reduction in transport demand, as it becomes easier for the shipper of the goods to find an alternative to the expensive option of road transport. Of course, these broadly envisaged goals of road pricing can only be achieved if not only freight transport, but all modes of transport are subject to an accurate internalisation of external effects. This paper is

however more limited in scope, not just for practical reasons, but also in order to capture the prevailing political mind-set in respect of transport policy for the coming years. Moreover, there is no denying that road transport, despite mitigation efforts, remains the biggest polluter.

Review of the relevant literature shows that road pricing has attracted much attention in recent years (McKinnon, 2006a/b; Holguin-Veras et al., 2006; Bråthen, S., & Odeck, J., 2009; Swan & Belzer, 2010 and 2013). Many research papers have focused on the price sensitivity of road freight transport (for a thorough review of the scientific literature on road tonne/vehicle kilometre price elasticities, see de Jong *et al.*, 2010). Fewer have tackled the question of road pricing in the context of port hinterland transportation and port competitiveness. Of immediate interest to the present contribution are those studies that look specifically at the competitive impact of road pricing: Bundesamt für Güterverkehr (2005), De Ceuster *et al.* (2009), Denktas *et al.* (2009), Gusbin *et al.* (2009), Gustafsson *et al.* (2006), Kleist and Doll (2005), Kummer and Einbock (2003), Kveiborg (2005), Schuler and Reisch (2009) Steininger (2002) and Streimelweger (2003). Strikingly, the various research findings lead to very divergent conclusions, sometimes within the context of a single study. The observations, then, would appear to be highly scenario and case-dependent. Hence the relevance of a separate study on the Flemish case, which constituted the main rationale for undertaking the present research.

The main question to be addressed in the present paper is whether Flemish seaports should expect negative competitive effects from the introduction of road pricing in

Belgium. There is a fear that if road pricing is introduced in Belgium only, the Flemish seaports will suffer a competitive disadvantage. The issue at hand has become particularly pressing since Belgium's neighbour the Netherlands, home to the important competing port of Rotterdam, abandoned the idea it entertained until about a year ago also to introduce road pricing.

Insight is first and foremost required into the impact the local introduction in Belgium of a road pricing scheme might have on the cost of the total transport route. Therefore, section 2 outlines the methodology used to calculate cost impact. Section 3 focuses on the data, while section 4 introduces selected routes and the notion of truck nationality. Section 5 considers the impact of the Belgian road charge on the total transport cost over the entire route. It looks at the extent to which the impact varies according to distance, truck type, load level, time of the day, etc. This chain cost increase will lead to short, medium and long-term behavioural changes on both the demand and the supply side, as shown in section 6. Not only will such behavioural responses affect activities within the transport and logistics industry; they may also cause spill-over effects in the economy at large, as illustrated in Figure 2 and elaborated on in section 7. The magnitude of these effects would depend in part on a number of sector-specific characteristics, but it would be largely determined by the earmarking of the kilometre charge revenues. Section 8 concludes with some observations and lessons on the impact of kilometre charging.

2. COST CALCULATION METHOD

Transport companies take decisions based on their knowledge of cost structures. For practical applications, such as the introduction of a kilometre charge, it may suffice to subdivide the cost of a transport operation into time and distance-related cost. The time cost is allocated to a transport operation on the basis of time elapsed, while the distance-related cost is allocated according to distance. This approach is frequently used and widely accepted (Blauwens *et al.*, 2010), and will also be the methodology applied in the present paper.

The time cost reflects the time elapsed. This type of cost may be incurred even when a vehicle is not moving, e.g. during loading or unloading or due to congestion e.g. Time cost is not affected by the journey as such, but merely by the number of hours travelled. Examples of time cost components are driver wages and annual vehicle insurance premiums (Blauwens *et al.*, 2010).

A distance-related cost is incurred on top of the time cost. This cost is related to kilometres driven with vehicles and by drivers of the company. It is allocated to individual transport operations based on the distance covered. Examples of distance-related costcomponents are fuel consumption, maintenance related to distance covered, and, as the case may be, kilometre remunerations to staff (Blauwens *et al.*, 2010).

The division into time and distance-related cost is clear-cut. Specific allocations may sometimes lead to problems of interpretation, but these can typically be resolved (see Blauwens *et al.*, 2010).

For each vehicle in the company, the time cost can be expressed as an amount per hour, the hour coefficient u[†]. The distance-related costt can be expressed as an amount per kilometre, the kilometre coefficient d.

The cost of a transport operation with a specific vehicle can then be calculated by multiplying the kilometre coefficient d with the distance D that needs to be covered (expressed in kilometres), and adding to that the multiplication of the time coefficient u and the time U (expressed in hours) that the vehicle spends on the transport operation, including loading, unloading and waiting.

Hence, the total cost of a transport operation may be expressed as follows:

$$TK = u.U + d.D + z \qquad (1)$$

where z stands for other or specific costs (e.g. tolled tunnel, bridge, etc.) (Blauwens *et al.*, 2010).

This basic formula allows one to differentiate between an hour coefficient and/or a kilometre coefficient. Given that the kilometre charge to be introduced in Belgium will replace the Eurovignette and will result in a reduction of transport tax to the European

[†] For the purpose of this study, the variability of the value of time, *u*, is ignored.

minimum[‡], the hour coefficient needs to be modified and the kilometre coefficient divided into two components. This exercise results in the following revised formula:

$$TK = u'.U + d_1 D_1 + d_2.D_2 + z \quad (2)$$

Here, depending on the scenarios[§], u' is the hour coefficient corrected for the abolition of the Eurovignette and for the transport tax reduction in Belgium to the European minimum (see columns Table 1 – shaded cells correspond to the status quo before the introduction of road pricing). The distance-related cost is subdivided into $d_1.D_1$ en $d_2.D_2$ where D_1 stands for the distance driven outside Belgium under kilometre coefficient d_1, and D_2 represents the distance driven in Belgium with d_2 as a kilometre coefficient, including the tariff per kilometre for the Belgian kilometre charge.

The percentage change in total transport cost was calculated from the increased transport cost (i.e. by subtracting Eq. 2 from Eq. 1) divided by the transport cost before the introduction of road pricing. This yields the following mathematical formulas

$$\text{- national trajectory}: \frac{(u' - u).U + (d_2 - d_1).D}{u.U + d_1.D} \quad (3)$$

$$\text{- international trajectory}: \frac{(u' - u).U + (d_2 - d_1).D_2}{u.U + d_1.D} \quad (4)$$

3. DATA USED

[‡] The Eurovignette Directive (2011) states "Member States may not set vehicle tax rates any lower than the minimum rates set out in the Directive." (European Commission, 2011)

[§] See further.

If one considers a sufficiently long period of time, one can estimate, for an individual transport company, the time (hour) coefficient u and the distance (kilometre) coefficient d on the basis of that company's accounting data[**]. For calculation purposes, following Blauwens *et al*. (2010), it is assumed that a tractor and semi-trailer combination with a loading weight of 24-28t pays € 1250,00 for a Eurovignette and € 628,00 in transport tax. The Eurovignette represents approximately two-thirds of cost component 4 (see Table 1). In addition, the current transport tax is assumed to amount to the European minimum.

In the present study, use was made of Blauwens *et al*. (2010), who compiled data from a sample of companies for a truck combination of 24-28t loading capacity (). Since the data go back to 2004, indexes dating from March 2011[††] were used per cost element (base: 31 December 2003) (see Table 1)[‡‡]. For these base indexes, no distinction is made between national and international transport, nor are the country of origin and destination taken into account. The hour coefficient vary depending on whether a Eurovignette is required or not, as well as on the extent to which accompanying measures are taken alongside the

[**] The accounting data have been collected from five Belgian companies, under a confidentiality agreement. Each company controled a high number of vehicles. The data have been considered representative for the Belgian road transport sector.

[††] The Institute of Road Transport & Logistics Belgium calculates the monthly cost and cost evolution for national and international transport (with specific data for transport to Germany, France, Italy and Spain). This study shows the average evolution of the main cost and the total cost back in the form of indices and is a recognized government instrument in negotiating any freight price revisions (cost indices and their three-month moving average to be published in the Bulletin) (www.itlb.be >studies).

[‡‡] To know the indexed cost, one must apply the following formula: (base cost x new index)/100. An example illustrates: (3.34 x 121.95)/100 = 4.07. Identical calculations are conducted for other cost elements. Correcting for the Eurovignette, which accounts approximately two-thirds of the cost element 4 results in a cost value of 0.30 (0.99 – 0.69); correcting for transport tax and including accompanying measures leads to a cost element of 0.69 (0.99-0.30)(see alternative V) . Regarding alternative IV, the minimum traffic load roughly corresponds to the current traffic load. The cost element is assumed not to change in comparison with business as usual or alternative I.

introduction of the kilometre charge (see scenarios I-V). For the Belgian setting, two alternatives are considered: first a reduction of transport tax to the European minimum (see scenarios II and IV), and second an accompanying measure compensating for the transport tax on the other (see scenarios III and V). For the cost element 'interest and depreciation', a similar percentage increase is applied to the fixed and variable parts[§§]. Tables 1 and 2 result in different hour and distance coefficients.

A professional route planning system was used to determine the time U (expressed in hours), the distance (expressed in kilometres) and other or specific costs (e.g. tolled tunnel, bridge, etc.).

Introducing a kilometre charge will inevitably increase the kilometre coefficient. Flanders may, in a joint decision with Wallonia and Brussels, introduce such a kilometre charge without distinction of time and place. Or one may decide on a kilometre charge that varies according to peak and off-peak travel times. A number of alternatives are therefore considered:

- a charge in line with German LKW-Maut: € 0.15
- a peak tariff: € 0.20
- an off-peak tariff: € 0.10

[§§] Blauwens *et al*. (2010, p. 92) state that a distinction must be made between fixed (flat rate) and variable depreciation due to distance travelled. Fixed depreciation is an element in the time costs, an automatic result of keeping vehicles in service, while variable depreciation must be included in distance costs.

- a very low tariff: € 0.05

4. ROUTE AND TRUCK NATIONALITY SELECTION

For calculating the impact of a kilometre charge on the cost per vehicle kilometre, a number of scenarios are considered that take account of the following factors:

- Company location in Belgium or abroad: this is relevant in view of possible changes to the relevant fiscal regimes in order to compensate for the kilometre charge.
- National or international transport: when part of the trip is performed abroad, a Eurovignette may still be required (Denmark, Luxembourg, The Netherlands and Sweden)
- Trip length
- Time of day: peak or off-peak

The combination of company location and type of transport results in ten possibilities, four of which are calculated, as shown in Table 3.

Starting from this typology, a number of routes are selected for domestic and cross-border freight transport, as represented in Table 4. Due account is taken of the principal origin and destination countries in third-party international freight traffic on Belgian roads, namely France, Germany and The Netherlands.

For transport operations within Belgium, a company faces a kilometre charge but does not need a Eurovignette. Moreover, the company will receive compensation. A Eurovignette is however still required for trips to, from or through Denmark, Luxembourg, The Netherlands and Sweden, For the latter countries, two scenarios are considered: one in which transport tax is reduced to the European minimum and one in which transport tax is fully compensated for. Situations where no Eurovignette is required correspond to alternatives II and III in Table 1. If the company operates trucks on routes through countries with a Eurovignette, alternatives IV and V apply. In each case, the applicable scenario is compared with the current situation (with transport tax and Eurovignette), as represented by alternative I.

5. ROAD TRANSPORT PRICE IMPACT

In this section, the impact of introducing road pricing is measured.

5.1 Belgian Truck On Belgian Territory

Table 5 shows the resulting percentage change in total transport cost in the case where a Eurovignette is no longer required. Table 6 represents a situation where a Eurovignette is mandatory. Both tables also include the alternatives with minimum transport tax and accompanying measure.

Introducing a kilometre charge in Flanders or Belgium, either at the current average German Maut unit rate of € 0.15 or in the form of a congestion-bound tariff (€ 0.10 and € 0.20) per vehicle kilometre, implies that the total cost of a transport operation on a

Belgian route increases, at least in the absence of an accompanying measure. On the Zeebruges-to-Liège or the Antwerp-to-Liège connections, introducing a kilometre charge of € 0.15 leads to a cost increase of about 15%. Introducing a tax of € 0.05 leads to an increase of 4.5%, which is notably lower, but still substantial (see Table 5).

The impact of reducing the transport tax to the European minimum is negligible, as the current transport tax rate is already very close to that minimum. For trucks where no Eurovignette is required, there is an additional, albeit small, cost advantage.

5.2 International Transport

For international transport, the absolute increase in total transport cost is a function of distance covered on Belgian roads, while the relative increase depends on the share that the number of domestic kilometres represents in the total number of kilometres per trip. The longer the total trip, the lower the effect on the costs of a kilometre charge. On this basis, one may conclude that, for a number of important international freight flows towards and from Flemish ports, over longer distances, the impact of introducing a kilometre charge is relatively limited. Nevertheless, the effect can vary considerably depending on the route.

As shown in Table 7, for trucks without a Eurovignette and facing minimum transport tax, and performing a southbound international trip, a tariff of € 0.15 on the Antwerp-to-Lyon route induces a cost increase of 1.82%, while for trips between Zeebruges and Lyon the corresponding increase is only 0.20%. For the Antwerp-to-Lille route, the cost

increase amounts to 13.04%. The percentage change in total transport cost for other international trips is shown in Table 8.

The competitive position of foreign ports is negatively affected by more expensive transit traffic on account of the introduction of a kilometre charge. A kilometre charge of € 0.15 makes the trip from Rotterdam to Lyon 3.48% more expensive (see Table 9), while Antwerp to Lyon becomes 3.19% more expensive (see Table 7), and Zeebruges to Lyon just 0.90% (see Table 7).

Note: or a transport company from another country with similar cost structure
For trips between Belgium and Poland, the calculations were repeated for respectively a Belgian and a Polish truck (see Table 10). The hour coefficient for the Polish truck amounts to € 19.26 per hour, as the driver's wage is assumed to be half that of the driver of the Belgian truck. Consequently, without a kilometre charge, the trip from Antwerp to Warsaw costs € 1,383.48 for a Polish truck compared to € 1,686.64 for a Belgian truck. Table 10 indicates by which percentage cost increases with the introduction of kilometre pricing. Even though the relative effect is clearly larger for a Polish truck, in absolute terms, that truck will still be able to cover the distance at a lower cost than that incurred by a Belgian truck.

6. SECTOR REACTION PATTERNS

The magnitude of the cost impact depends among other things on the response by goods shippers to changes in road transport prices. It is often assumed that road transport is

relatively insensitive to price changes. A recent study by de Jong *et al.* (2010), however, suggests that some qualification is called for. Price elasticities depend not only on the type of price change, but also on the way the transport activity is measured. The study by de Jong *et al*. (2010) starts from an overview of research into price elasticities and provides bandwidths[***] of price elasticities for three types of price changes, viz. changes in fuel prices, changes in vehicle kilometre prices and changes in tonne kilometres. In addition, the authors derive a set of elasticity values for the European context (see Table 11)[†††]. This set is internally consistent and may be regarded to represent '*our best-guess long distance road price elasticity values over all commodities*' (de Jong *et al*., 2010). According to the same study, road transport vehicle kilometres decreases by 0.9% if the price per vehicle kilometre increases by 1%.

When applied to the results of part 3, we find that, for the most important Belgian routes, introducing road pricing impacts quite clearly on the number of vehicle kilometres performed. On entirely domestic trips, a charge of € 0.15 per km results in a decline in vehicle kilometres by about 15% (see Table 6).

For international transport routes, the situation is slightly more complex, as the impact of the kilometre charge in Belgium on the cost of a vehicle on an international trip fluctuates strongly with the total distance of the trip and the countries travelled through. For a trip

[***] Differences in geographical regions, better availability of non-road modes, etc. explain the variances in the estimates of price elasticities.

[†††] From the estimates of Beuthe et al. (2001) and de Jong et al (2010), it becomes clear that the price elasticities in Belgium are high (same reasoning as in previous footnote).

from Antwerp to Lyon, for instance, a charge of € 0.15 results in a drop in vehicle kilometres of about 2% (see Table 7).

According to de Jong *et al.* (2010, p. 227), the changes in the number of vehicle kilometres induced by a kilometre charge are the consequence of three factors, each of which accounts for approximately a third of the overall effect.

- Transport demand changes (-0.3)
- Modal shifts, e.g. towards rail and inland navigation (-0.3)
- Changes in transport efficiency (-0.3).

This distinction is important. After the introduction of the LKW Maut in Austria (2004) and Germany (2005), it seemed that the resulting changes in transport demand were more significant than the modal shifts induced (de Jong et al., 2010, p. 227).

Introducing a kilometre charge will no doubt lead to behavioural responses among road transport companies: they may try to pass on the levy to their customers or seek to compensate for the cost increase by improvements in operational efficiency. Table 12 provides an overview of possible short, medium and long-term responses.

The road transport sector operates at relatively small profit margins. Hence, there is a strong likelihood that, in the short run, the cost associated with a kilometre charge will be passed on to the customer. Similar patterns have been observed in comparable sectors,

including in air transport following the introduction of fuel surcharges. On the other hand, strong competition in road transport may mean that companies decide not to pass on the associated cost in its entirety. Clearly the competitive position of individual companies will be key here. Companies in a strong position may be expected to pass on all or part of the extra cost to the customer. Whatever proportion is not passed on will have to be borne by the operator. In the short run, this implies relinquishing profit, but in the medium run, increasing cost will invariably lead to logistics improvements, in and outside the road transport company. Moreover, there is every likelihood that a thorough rationalisation of the industry will, in the medium to long term, lead to mergers and acquisitions. This implies scale increases at company level, which may in turn generate efficiency gains, as has been observed in recent years in the container shipping industry.

In the longer term, the cost increase induced by the introduction of a kilometre charge may imply slower overall transport growth. Any shifts towards other transport modes may be assumed only to materialise in the longer run, if only because this would require new direct access points to the rail and inland navigation networks. These shifts will, moreover, only occur in niche freight flows, particularly those involving low-value goods that can barely afford the kilometre charge. A considerable portion of such flows, not least bulk, is already transported by other modes than road transport.

7. IMPACT ON THE ECONOMY

A kilometre charge for trucks in Belgium would generate a number of direct effects, most of which would be noticeable in the immediate future. These effects might cause a

number of additional, indirect impacts, thereby starting a dynamic process, the results of which will only become noticeable and measurable after longer periods of time. The overall impact will depend on the magnitude of the kilometre charge on the one hand and on how government decides to spend the net revenues generated through the charge on the other.

At this stage, there is no instrument that allows a detailed assessment of how a kilometre charge will impact on the various sectors that make up the Flemish economy. We can, however, single out possible evolutions in the port industry, which is key to the Flemish economy as a whole.

In line with de Jong et al. (2010), we assume the average price elasticity of vehicle kilometre to be -0.9. This elasticity can be applied to freight flows on international routes that are of relevance to the Flemish ports. On the route between Antwerp and Lyon, for instance, introducing a uniform kilometre charge of € 0.15 on Belgian territory would lead to a cost increase for road transport of 1.82% for a Belgian truck without Eurovignette and facing minimum transport tax (lower part of Table 7). Assuming that the cost increase is passed on fully in the freight price, and taking into account an elasticity of -0.9 (see Table 11), the corresponding reduction in vehicle kilometre will amount to 1.82% x 0.9 = 1.64%. The route between Zeebruges and Lyon includes fewer kilometres on Belgian roads, resulting in a cost increase of 0.2% (table 7) and a subsequent demand decrease of 0.18% (or 0.2% x 0.9). If the kilometre charge is lower than € 0.15 per kilometre, the expected demand reduction is evidently much lower.

A similar reasoning applies to transit traffic. Earlier, it was calculated that an average route between Rotterdam and Lyon at a tariff of € 0.15 implies a cost increase of 3% (see table 9). Starting from the same price elasticity, the anticipated reduction in freight kilometres is 2.7% (or 3% x 0.9). However, on the route between Rotterdam and Lille (F.), the cost impact is much greater. The same tariff induces a cost increase of 11% and an ensuing estimated decline in demand of 9.9%. The crucial explanatory variable here is the balance between the number of kilometres driven in Belgium, and the total number of kilometres on the route concerned. On long distance connections, the drop in vehicle kilometres is relatively small, since the new kilometre charge affects only a limited section of the total route.

The percentage effect of a transport assignment performed entirely within Belgium will be substantially greater. This is due to the additional cost incurred over the entire length of the route. Take the example of a route between the port of Zeebruges and a steel works in Liège. The estimated cost increase associated with a new kilometre charge set at € 0.15 per kilometre is 15.35% (see Table 5). Applying the same price elasticity of -0.9 points to a significant impact on the transport demand.

This decrease in the number of vehicle kilometres does not imply that the number of tonnes transported to the ports will decline equally strongly. One-third of the decrease in vehicle kilometres is due to a drop in demand, and therefore corresponds to a reduction in port traffic. Another third is due to modal shifts, which does not prevent the goods from

arriving at the port. The final third is due to greater operational efficiency and improvements to the logistics and distribution chain, whereby the same tonnages results in fewer transport movements (de Jong *et al.*, 2010).

Moreover, the relative competitive position of the Flemish ports may also be affected by measures taken in neighbouring countries. The excise duty increase on diesel, which is under consideration in the Netherlands, for example, will make traffic to and from the port of Rotterdam more expensive, as some trucks are bound to buy fuel in the Netherlands. One may assume that ways will be sought to get around this, for instance by buying fuel in neighbouring countries with cheaper fuel.

A crucially important aspect is, of course, how revenues of a kilometre charge are spent. Kilometre charges yield substantial sums of money, including from foreign trucks. If one were to spend all these resources on cost reduction measures in Belgian ports, clearly the latter could become more competitive. If one were to spend the funds on reducing the cost of rail transport between Belgium and foreign ports, on the other hand, Belgium's ports would stand to suffer quite substantially. Let us assume that part of the tax revenue is spent on ways of reducing fixed costs for Belgian trucks. Belgian trucks would thus be compensated for the charge, e.g. through the abolition of the Eurovignette. To account for such compensation, a lower hour coefficient is applied to Belgian trucks (see alternatives Table 1). But even with such an accompanying measure, considerable revenues remain, not least the payments by foreign trucks using Belgian roads. For those remaining

revenues, we assume an expenditure that implies neither an advantage nor a disadvantage to Belgium's ports[‡‡‡].

Thus far, we have assumed spending to be neutral[§§§]. In practice, however, this is a very pessimistic assumption. In reality, even spending of new revenues on a reduction of wage costs will boost a country's economic activity.

The impact of introducing road pricing would, all in all, be relatively limited, in terms of both transport cost and the economy as a whole. The road transport sector will either try to compensate for the charge by greater operational efficiency or by passing the cost on to customers or suppliers.

Obviously this analysis will need to be reconsidered if and when other countries, such as the Netherlands, France or Italy, also decide to introduce a kilometre charge. From that moment, the total cost of international transport will be altered quite profoundly, with consequences for transport demand.

8. CONCLUSION

In Flanders, along with the Walloon and Brussels Capital regions, the Eurovignette would be replaced with freight road pricing for trucks weighing upward of 3.5 tonnes. The present paper provides an answer to the following question whether there is a danger that

[‡‡‡] For trucks operating in countries where the Eurovignette remains in force, the original hour coefficient is retained.

[§§§] Under a revenue-neutral scheme, the current transport taxes would be cut by the amount raised by kilometre charge pricing so that the average (Flemish) user pays as much as before.

the Flemish seaports are negatively affected by the introduction of road pricing by the Flemish government with Brussels and Wallonia?

To answer this question, we have calculated the impact of road pricing on the total cost of transport along a number of national and international routes that are key to the success of the Flemish seaports. At the same time, the impact of a new Belgian kilometre charge was calculated on routes to and from Rotterdam.

For an important route such as Antwerp to Lyon, introducing road pricing at € 0.15 per kilometre boils down to a 1.82% cost increase (see lower part of Table 7) in the case of Belgian vehicles, without Eurovignette and facing minimum transport tax. For a Dutch operator, the cost increase amounts to 3.19% (see upper part of Table 7). At a lower tariff, cost increases are smaller.

A cost increase of this magnitude may seem relatively important. However, the increase obviously applies only to the road section of the transport chain, which in the examples reviewed also includes a maritime section. Calculating the total chain cost will dilute the impact of a cost increase in consequence of a kilometre charge. And ultimately it is the total cost that is important for the choice of the logistics channel.

Southbound transit traffic from Rotterdam will become more expensive. In that sense, Rotterdam's competitive position will be negatively affected, vis-à-vis not only the Flemish ports, but also ports in France, Britain and possibly the Mediterranean.

One may from the conducted calculations and analysis reasonably assume that the competitive position of Flemish ports will not be adversely affected by the introduction of a kilometre charge, even if transport, save for some exceptions, becomes more expensive. For transport services performed by Belgian trucks, the eventual cost increase will, under certain conditions, be more modest than for transport services performed by foreign trucks. The impact on international transport dilutes as the distance of the route becomes bigger and the proportion travelled on Belgian roads decreases. In the case of maritime transport, the effect dilutes even further.

The effects of road pricing to enter the competitiveness of the Flemish maritime ports and the Flemish logistics sector are clear. The Flemish seaports experience little or no impact on competitiveness, partly due to the fact that transit flows via road transport to and from Rotterdam become more expensive. The Flemish logistics sector is indeed facing a short-term increase in costs and a decrease in the number of vehicle kilometers.

However, this also leads to increases in efficiency within the road transport sector. In the middle-long run, road pricing will lead systematically to logistics improvements, in and outside the road transport company and guide those companies towards more sustainable transport choices. In the long run, any shifts towards other transport modes would occur. This fits within the European vision written down in the recent White Paper. To encourage this shift, among others additional direct connections to the rail and inland navigation network will be needed. These shifts will only feature for a small part of the

current freight flows, especially with low-value goods that can hardly bear the kilometre charge. A big part of these flows, mainly bulk, now already use other modes than road transport.

More research in the concrete middle-run and long-run effects may be desirable, especially for the specific commodities and trades impacted on the Belgian territory. Doing so would be complementary to the work presented in this paper, and deepen out the specific impacts. In particular, it would be good if for those specific trades, tailor-made elasticities could be calculated. That would require a separate exercise, applying for instance discrete choice analysis.

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Table 1: Hour cost for a 24-28t truck combination (2004 and March 1, 2011 prices)

Scenarios			I	II	III	IV	V
			With Eurovignette and transport tax	Without Eurovignette, with minimum transport tax	Without Eurovignette and with accompanying measure	With Eurovignette, with minimum transport tax	With Eurovignette and with accompanying measure
Cost element	Euro per hour, 2004	Index 2011	Euro per hour, 2011	Euro per hour, 2011	Euro per hour, 2011	Euro per hour, 2011	Euro per hour, 2011
1. Interest and depreciation (fixed part)	3.34	121.95	4.07	4.07	4.07	4.07	4.07
2. Insurance	1.79	102.66	1.84	1.84	1.84	1.84	1.84
3. Driver wage,	16.37	122.27	20.02	20.02	20.02	20.02	20.02

including all charges							
4. Transport tax and other retributions	0.67	147.8	0.99	0,3 (*)		0.99	0.69
5. Other costs (administration etc.)	2.01	116.59	2.34	2.34	2.34	2.34	2.34
TOTAL: hour coefficient u	24.18		29.26	28.57	28.27	29.26	28.96

Table 2: Distance-related cost for a 24-28t truck combination (2004 and 1 March 2011 prices)

Cost element	Euro per km, 2004	Index	Euro per km, 2011
1. Interest and depreciation (variable part)	0.04	121.95	0.05
2. Fuel	0.22	179.68	0.4
3. Tyres	0.01	134.27	0.01
4. Maintenance, repair	0.03	133.63	0.04
TOTAL (kilometre coefficient d)	0.3		0.5

Table 3: Combinations of type of company and type of trip

	Transport company registered in	Origin	Destination	Partly ride on Belgian territory
1	**Belgium**	**Belgium**	**Belgium**	**Complete**
2	Abroad	Belgium	Belgium	Complete (cabotage)
3	**Belgium**	**Abroad**	**Belgium**	**Partially**
4	Abroad	Abroad	Belgium	Partially
5	**Belgium**	**Belgium**	**Abroad**	**Partially**
6	Abroad	Belgium	Abroad	Partially
7	Belgium	Abroad	Abroad	Partially (transit)
8	**Abroad**	**Abroad**	**Abroad**	**Partially (transit)**
9	Belgium	Abroad	Abroad	Not applicable (cabotage)
10	Abroad	Abroad	Abroad	Not applicable

Table 4: Routes used in the cost calculation scenarios

CROSS-BORDER TRANSPORT	
From or to each of the Flemish ports	
Antwerp	Amsterdam, Basel, Goes (Nl.), Hamburg (+ further Scandinavia), Lyon (+ south), Lille, Rotterdam, Ruhr (Duisburg), Warschau and Vienna
Ghent	Goes (Nl.) and Paris
Ostend	Lille
Zeebruges	Goes (Nl.), Lyon (+ south), Ruhr (Duisburg)
Transit traffic	
Rotterdam	Lyon (plus south), Lille, Basel, Warschau and Wenen
Duisburg	London and Southampton
NATIONAL TRANSPORT	
Ghent	Antwerp, Mons, Liège and Zeebruges
Antwerp	Mons, Charleroi, Ghent and Zeebruges

Table 5: Percentage change in total transport cost for Belgian transport in case no Eurovignette is needed

	without Eurovignette, with minimum transport tax hour coefficient: 28.57				without Eurovignette and with accompanying measure hour coefficient: 28.27			
Kilometre pricing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp - Mons	20.76%	15.30%	9.84%	4.39%	20.29%	14.84%	9.38%	3.92%
Antwerp - Charleroi	20.70%	15.26%	9.81%	4.37%	20.23%	14.79%	9.34%	3.90%
Antwerp - Liège	21.29%	15.71%	10.12%	4.54%	20.84%	15.25%	9.67%	4.09%
Bruges - Liège	21.72%	16.03%	10.35%	4.67%	21.28%	15.59%	9.91%	4.22%
Ghent - Antwerp	21.10%	15.56%	10.02%	4.49%	20.64%	15.10%	9.57%	4.03%
Ghent - Mons (E40/E19)	21.37%	15.77%	10.17%	4.56%	20.92%	15.32%	9.72%	4.11%
Ghent - Liège	21.52%	15.88%	10.25%	4.61%	21.08%	15.44%	9.80%	4.16%
Ghent - Zeebruges	18.18%	13.33%	8.48%	3.63%	17.65%	12.80%	7.95%	3.11%
Hasselt - Brussels	20.45%	15.07%	9.68%	4.30%	19.98%	14.59%	9.21%	3.82%
Zeebruges - Antwerp	17.12%	12.58%	8.04%	3.51%	16.67%	12.13%	7.60%	3.06%
Zeebruges - Mons	20.82%	15.35%	9.88%	4.40%	20.35%	14.88%	9.41%	3.94%
Zeebruges - Mons	20.82%	15.35%	9.88%	4.41%	20.36%	14.89%	9.41%	3.94%

Table 6: Percentage change in total transport cost for Belgian transport cost in case a Eurovignette is needed

	with Eurovignette, with minimum transport tax hour coefficient: 29.26				with Eurovignette and with accompanying measure hour coefficient: 28.96			
Kilometre pricing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp – Mons	21.83%	16.37%	10.92%	5.46%	21.36%	15.91%	10.45%	4.99%
Antwerp – Charleroi	21.77%	16.33%	10.89%	5.44%	21.31%	15.86%	10.42%	4.98%
Antwerp – Liège	22.33%	16.75%	11.17%	5.58%	21.88%	16.30%	10.71%	5.13%
Bruges – Liège	22.74%	17.05%	11.37%	5.68%	22.29%	16.61%	10.93%	5.24%
Ghent – Antwerp	22.15%	16.61%	11.08%	5.54%	21.69%	16.16%	10.62%	5.08%
Ghent – Mons (E40/E19)	22.41%	16.80%	11.20%	5.60%	21.96%	16.35%	10.75%	5.15%
Ghent – Liège	22.55%	16.91%	11.28%	5.64%	22.10%	16.47%	10.83%	5.19%
Ghent – Zeebruges	19.39%	14.55%	9.70%	4.85%	18.87%	14.02%	9.17%	4.32%
Hasselt – Brussels	21.54%	16.15%	10.77%	5.38%	21.07%	15.68%	10.30%	4.91%
Zeebruges – Antwerp	18.15%	13.61%	9.07%	4.54%	17.70%	13.16%	8.63%	4.09%
Zeebruges – Mons	21.89%	16.41%	10.94%	5.47%	21.42%	15.95%	10.48%	5.01%
Zeebruges – Liège	21.89%	16.42%	10.95%	5.47%	21.43%	15.95%	10.48%	5.01%

Table 7: Percentage change in total transport cost for southward international trips

	Truck with Eurovignette							
	Belg. transport company accompanying measure				Dutch transport company or Belg. transport company - min. transport tax			
Kilometre pricing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp-Lyon	3.66%	2.59%	1.53%	0.47%	4.25%	3.19%	2.12%	1.06%
Antwerp-Lille	18.33%	13.64%	8.94%	4.24%	18.79%	14.10%	9.40%	4.70%
Ghent-Paris	4.00%	2.90%	1.80%	0.70%	4.40%	3.30%	2.20%	1.10%
Ostend-Lille	17.39%	13.04%	8.70%	4.35%	17.31%	12.98%	8.66%	4.33%
Zeebruges-Lyon	0.63%	0.33%	0.03%	-0.27%	1.20%	0.90%	0.60%	0.30%

	Truck without Eurovignette							
	Belg. Transport company accompanying measure				Belg. transport company minimum transport tax			
Kilometerheffing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp-Lyon	2.29%	1.23%	0.17%	-0.89%	2.89%	1.82%	0.76%	-0.30%
Antwerp-Lille	17.28%	12.58%	7.88%	3.18%	17.74%	13.04%	8.34%	3.64%
Ghent-Paris	3.08%	1.98%	0.88%	-0.22%	3.48%	2.38%	1.28%	0.18%
Ostende-Lille	17.58%	13.19%	8.79%	4.40%	17.50%	13.12%	8.75%	4.37%
Zeebruges-Lyon	-0.08%	-0.38%	-0.68%	-0.98%	0.50%	0.20%	-0.11%	-0.41%

Table 8: Percentage change in total transport cost for other international trips

	Truck with Eurovignette							
	Belg. transport company accompanying measure				Dutch transport company or Belg. transport company - min. transport tax			
Kilometre pricing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp - Goes (Nl.)	8.74%	6.44%	4.13%	1.83%	9.22%	6.91%	4.61%	2.30%
Antwerp-Amsterdam	5.61%	4.09%	2.57%	1.06%	6.08%	4.56%	3.04%	1.52%
Antwerp-Basel	7.48%	5.50%	3.52%	1.54%	7.92%	5.94%	3.96%	1.98%
Antwerp-Duisburg	7.10%	5.22%	3.33%	1.45%	7.53%	5.64%	3.76%	1.88%
Antwerp-Hamburg	1.72%	1.19%	0.66%	0.13%	2.13%	1.59%	1.06%	0.53%
Antwerp-Rotterdam	8.37%	6.16%	3.94%	1.73%	8.86%	6.65%	4.43%	2.22%
Antwerp-Warschau	0.19%	0.01%	-0.17%	-0.36%	0.73%	0.55%	0.36%	0.18%
Antwerp-Vienna	0.84%	0.50%	0.16%	-0.18%	1.36%	1.02%	0.68%	0.34%
Ghent - Goes (Nl)	2.65%	1.89%	1.13%	0.37%	3.04%	2.28%	1.52%	0.76%
Zeebruges - Goes (Nl.)	2.14%	1.48%	0.83%	0.18%	2.61%	1.96%	1.31%	0.65%
Zeebruges-Duisburg	11.96%	8.86%	5.76%	2.66%	12.40%	9.30%	6.20%	3.10%

Table 9: Percentage change in total transport cost for transit trips

	Truck with Eurovignette							
	Belg. transport company accompanying measure				Dutch transport company (*) or Belg. transport company - min. transport tax			
Kilometre pricing	€ 0.20	€ 0.15	€ 0.10	€ 0.05	€ 0.20	€ 0.15	€ 0.10	€ 0.05
Rotterdam-Lyon	4.06%	2.90%	1.74%	0.58%	4.64%	3.48%	2.32%	1.16%
Rotterdam-Lille	13.84%	10.26%	6.69%	3.11%	14.31%	10.73%	7.15%	3.58%
Rotterdam-Paris	6.10%	4.46%	2.82%	1.19%	6.55%	4.91%	3.27%	1.64%
Rotterdam-Vienna	2.05%	1.39%	0.73%	0.06%	2.66%	1.99%	1.33%	0.66%
Rotterdam-Basel	4.86%	3.49%	2.11%	0.74%	5.49%	4.12%	2.75%	1.37%
Duisburg-Southampton	2.97%	2.09%	1.22%	0.34%	3.50%	2.63%	1.75%	0.88%
Duisburg-London	5.09%	3.73%	2.37%	1.01%	5.43%	4.07%	2.72%	1.36%
(*) Or a transport company from another country but with similar cost structure								

Table 10: Percentage change in total transport cost for international trips with Polish driver.

Truck with Eurovignette					
International route		€ 0.20	€ 0.15	€ 0.10	€ 0.05
Antwerp - Warschau	Polish driver	0.89%	0.67%	0.44%	0.22%
	Belgian driver with min. transport taks	0.19%	0.01%	- 0.17%	- 0.36%
	Belgian driver with accompanying measure	0.19%	0.01%	- 0.17%	- 0.36%

Table 11: Road freight transport price elasticities

Price changes	Impact on		
	Fuel consumption	Vehicle kilometers	Ton kilometres
Fuel price	-0,3	-0,2	-0,1
Price vehicle kilometre		-0,9	-0,6
Price tonkilometre			-1,0

Table 12: Behavioural changes to road pricing

Short run	Middle run	Long run
- Passing on distance-related costs to customers - Avoiding Belgian territory - Shifting to the lower-level network - Saving in other variable cost elements (maintenance etc.) - Delaying investment - Divesting or outsourcing part of the transport package - Accepting (temporary) cost increases and lower profit levels - Having less empty trips and higher loading levels	- Productivity increase - Structural reduction of cost increase per kilometre (e.g. fleet updating by acquiring more energy-friendly vehicles - Searching for additional efficiency improvements (e.g. via strategic co-operation agreements, mergers and acquisitions) - Divesting part of the transport package to other transporters - Introducing vehicles of less than 3.5 tonnes	- Shifting from road transport to other modes - Reducing transport-intensive goods - Reorganising distribution networks and warehousing locations; increasing lot size; searching for economies of scale; decreasing transport distance between point of production and market area

Source: Rijkswaterstaat, 2003

Figure 1: Kilometre charging impact

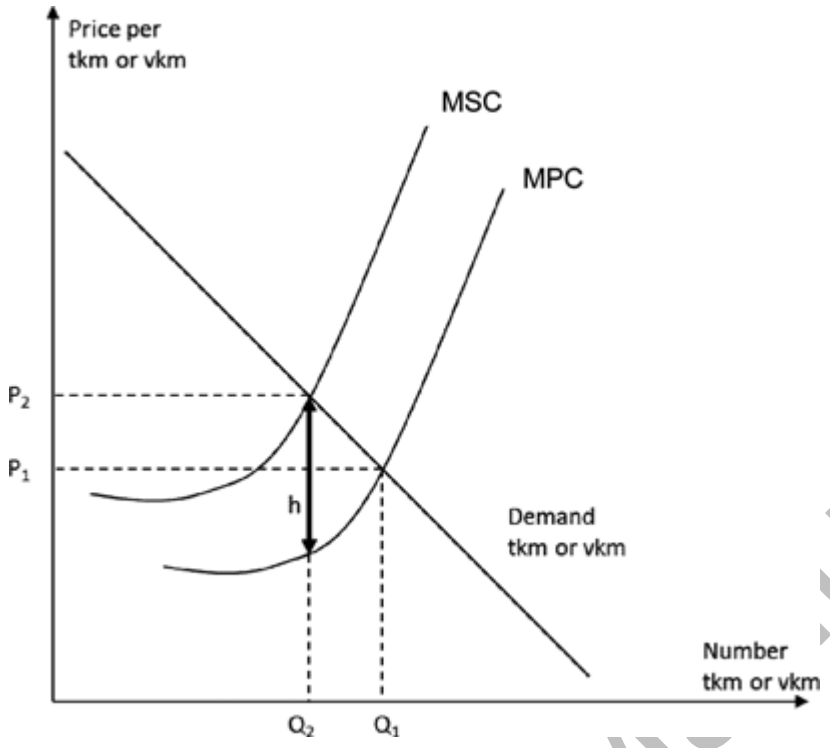

Figure 2: Kilometre charging conceptual framework