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Public policy intervention in freight transport costs: effects on printed media logistics in the Netherlands

Hens Runhaar[a,*], Rob van der Heijden[b,c]

[a]*Copernicus Institute for Sustainable Development and Innovation, Utrecht University, P.O. Box 80115, 3508 TC Utrecht, The Netherlands*
[b]*Nijmegen School of Management, Radboud University, Nijmegen, The Netherlands*
[c]*Delft University of Technology, Thomas van Aquinostraat 3, 6500 HK Nijmegen, The Netherlands*

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Abstract

Trends in contemporary logistics management have led to an increased transport-intensity of production and distribution activities. Transport costs are increasingly traded off against other logistical costs and seem to have lost importance in strategic decision-making. At the same time, in Europe, transport policy aims at regulating freight transport demand by manipulating its costs, for instance, via taxation. In addition, investment in infrastructure lags behind growth in transport, potentially resulting in increased congestion. This paper explores how effective manipulation of transport costs is in order to regulate freight transport demand in supply chains for books and newspapers.

Keywords: Transport costs; Logistics; Regulation; Printed media industry

1. Introduction

1.1. Background: the ambivalent role of freight transport

Freight transport is commonly considered an important condition for economic development and economic growth (e.g. Banister et al., 2000). Irrespective of these positive impacts on the total performance of societies and economies, it is no longer possible to discard the negative impacts of transport, in particular the production of substantial negative social and environmental effects, including air pollution, noise, congestion, and traffic accidents. In particular the strong growth of freight transport by road is considered problematic. Road transport has a dominant position in total freight transport (see Fig. 1) and the negative effects per unit of road transport (e.g. tonne kilometre) are relatively high (see Table 1; for comparisons of external costs of various modes of transport, see Annema and van Wee, 2000; Forkenbrock, 2001 or Proost et al., 2002).

The negative effects of transport are expected to increase in magnitude in the future, since a substantial growth in European freight transport is envisaged. For instance, long-term modelling studies have shown that between 1995 and 2020, freight transport on Dutch territory, expressed in tonne kilometres, will increase by 80% (AVV, 2000). It is likely that the negative effects associated with this growth in transport will by far outweigh the consequences of technological innovations such as more fuel-efficient engines or a better use of transport capacity.

1.2. The policy response

Many governments in Western Europe feel that the balance between the benefits and costs of transport is not optimal, which is supported by scientific research (see Fig. 2). Moreover, it is considered problematic that a large proportion of the negative effects of transport are passed on to society. It is mainly for these reasons that transport policy in Europe has shifted from an approach, in which

* Corresponding author. Tel.: +31 30 253 3050; fax: +31 30 253 2746.
E-mail addresses: h.runhaar@geog.uu.nl (H. Runhaar), r.vanderheijden@nsm.kun.nl (R. van der Heijden).
URLs: http://www.dgmwo.geog.uu.nl (H. Runhaar), http://cms.nsm.kun.nl (R. van der Heijden).

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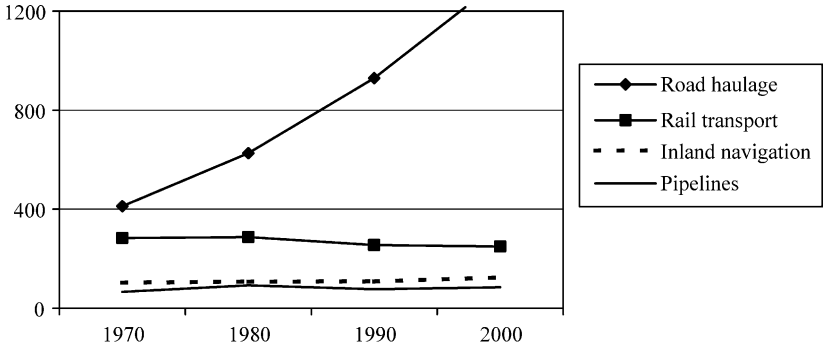


Source: EC, 1999: 45, supplemented with Eurostat data for 2000.

Fig. 1. Trends in freight transport in Europe (in milliard tonne km).

infrastructure was expanded in response to increasing traffic volumes, to an approach based on a mix of traffic and demand management measures (Banister et al., 1999). Nowadays, important policy goals include a reduction in the negative effects of freight transport (by technological and logistical innovations) and less congestion on the main transport axes, thus improving the accessibility of urban regions.

Public authorities do not have a large variety of instruments with which to directly intervene in freight transport. The most effective instruments for change are within the domain of the logistical management of production and distribution. Decisions in that context however are made by shippers and transport companies. Public authorities may only indirectly affect such decisions, predominantly through infrastructure and fiscal policies (other policy instruments (such as the assignment of locations that are not accessible by freight transport or only during specific time slots, other physical restraints, quality standards for vehicles, environmental regulations, and working time directives) either are part of such policies or have similar effects). Yet, contrary to earlier policies, most governments have become reluctant to expand road infrastructure networks at a large scale, mainly because of the high costs and the observation that it usually induces more transport and subsequently leads to more negative effects (e.g. Southerland, 2004). The consequence of this strategy is that, in all likelihood, (road) congestion problems will intensify. Alternatively, regulation of freight transport through taxation has become more popular among European governments. Various governments, for instance, have introduced new taxes on road freight transport (Switzerland, Austria) or are considering the introduction of such taxes (e.g. Germany, the Netherlands and the United Kingdom). In addition, the European Commission aims at a full internalisation of all external costs produced by transport (e.g. EC, 1998, 2001). In addition to this, several governments (among which the Dutch) have restructured (or plan to do so) general tax regimes by replacing fixed annual taxes by taxes directly related to the actual transport volume (including fuel duties and per-kilometre taxes).

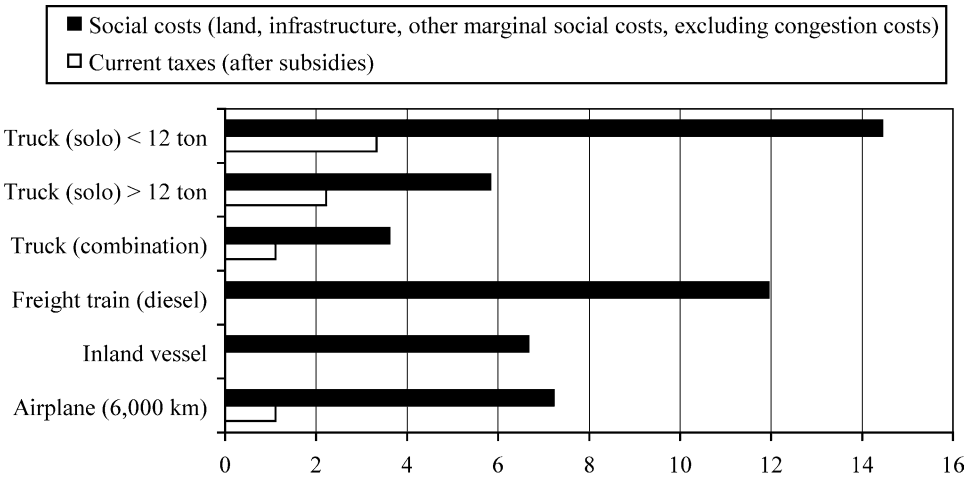
1.3. Research focus and structure of the article

This paper discusses whether direct intervention in transport costs for regulating freight transport demand is an effective instrument to cause significant changes in this sector. The costs shippers incur whilst distributing their goods namely are not only transport-based. Moreover, there is evidence that the share of transport costs in total delivered unit costs is decreasing, possibly creating reduced sensibility amongst stakeholders towards cost interventions. Given these considerations, this article assesses the (side) effects of public policies influencing transport costs. The analysis is largely based on the PhD dissertation of the first author (Runhaar, 2002). The paper has the following structure. Section 2 describes some conceptual aspects underlying the study and refers to the results of some related studies. Section 3 discusses the results of a stated adaptation survey that aimed at assessing the impact of higher transport costs. Section 4 contains some conclusions and reflections on the policy implications.

Table 1
Environmental pollution by mode of transportation in freight transport (2001)

	Road	Inland navigation	Rail transport
CO (g/tonne km)	0.90	0.13	0.02
VOS (g/tonne km)	0.22	0.05	0.00
NO_x (g/tonne km)	2.39	0.79	0.28
PM_{10} (g/tonne km)	0.14	0.04	0.00
SO_2 (g/tonne km)	0.02	0.05	0.02
CO_2 (g/tonne km)	256.13	49.66	12.58
CH_4 (g/tonne km)	0.01	0.00	0.00
N_2O (g/tonne km)	0.01	0.00	0.00

Source. Emissions and tonne kilometres (on Dutch territory): CBS, Statline (2003).



Source: AVV, 2000: 26.

Fig. 2. External costs and taxes paid in freight transport (in €-cent per tonne km).

2. Conceptual framework and related studies

2.1. Conceptual framework

Policy interventions that affect the level or structure of transport costs may cause a variety of effects. This paper focuses on the impact of policy interventions on logistical decisions that have an impact on transport demand (expressed in modal choice, vehicle movements, and vehicle kilometres). A useful framework that offers insight into such decisions is developed by McKinnon and Woodburn (1996). Based on empirical evidence, they distinguish between three categories of decisions that affect freight transport demand, namely:

- *the logistical structure:* the structure and spatial pattern of the production and distribution network, affecting the distances over which freight has to be transported as well as modal choice;
- *the scheduling of the product flow through the network:* including the flexibility or frequency with which orders are shipped, and customer service in terms of lead times and delivery reliability—these factors have an important impact on modal choice and on opportunities to consolidate shipments;
- *the management of transport operations:* the process in which individual shipments are converted into physical transport movements—this process has an important impact on the efficiency of freight transport (which can be expressed in the ratio of tonne- to vehicle-kilometres).

When discussing the role of transport costs, it has become common practice to define these costs broadly, as shippers typically bear a variety of costs when moving freight ('generalised transport costs'). Apart from expenditures on commercial carriers or own-account transport fleets (which are the 'direct' transport costs related to door-to-door transit costs) shippers face several sources of 'indirect' costs. For example, uncertainty regarding the reliability of arrivals due to congestion may generate or affect additional costs, including a potential loss in value of a product in transit, productivity losses, or lost sales if delays are unacceptable to customers (Kanafani, 1983). Consequently, to measure the effectiveness of direct cost intervention requires consideration of the trade-off made by shippers between various direct and indirect cost variables. In other words, are increased costs for transport compensated, for instance, by logistical reorganisation or by higher final prices.

2.2. Impact of increased transport costs: findings from other studies

Empirical evidence suggests that for shippers, on average, the relative importance of indirect costs vis-à-vis the direct transport costs has increased (for a shipper of low value bulk freight this obviously may be different). An important reason is that over recent decades, real carrier rates have shown a continuous fall (see Dings et al., 1999a; Cooper et al., 1998; McKinnon, 1998; NEI, 1999). These falling rates can be attributed to a strong growth in competition, scale effects (larger volumes of freight) and improved physical infrastructure networks. Moreover, the share of transport costs in total delivered unit costs has fallen (see Fig. 3), indicating that other logistical costs such as stock costs have become relatively more important. This can be attributed to an increasing awareness of firms of logistics costs, outsourcing of transport, professionalisation of the logistics discipline, and to increasing costs of logistics inputs other than transport (Bowersox et al., 1986; Hesse and Rodrigue, 2004; TUB, 2001).

Consequently, it can be observed that in general the importance shipping firms nowadays attach to direct transport costs is decreasing. Instead attention is typically focused on minimising the cost of producing and in particular storing products (Svensson, 2002). Empirical studies have

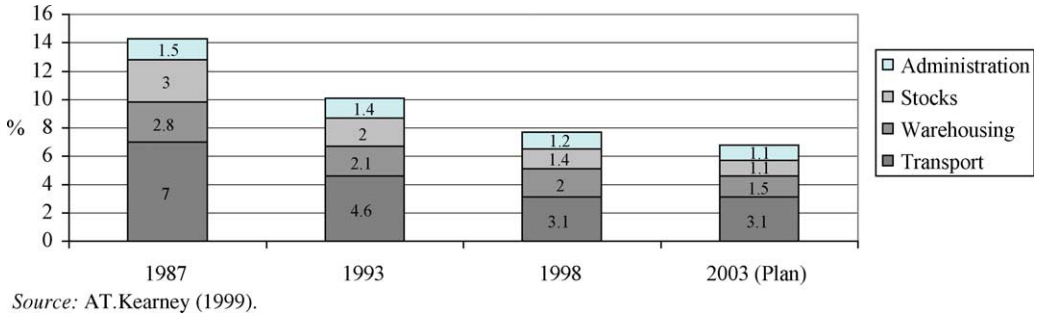


Fig. 3. Logistical costs as percentage of revenues for a typical European shipper.

shown that transport costs are hardly recognised when shippers make strategic decisions that have transport implications (McKinnon, 1998). Moreover, in order to minimise the costs of stock and production, logistical processes have often been restructured such that transport demand has increased (e.g. in the case of centralised or Just-in-Time production; McKinnon and Forster, 2000; NEI, 1999). Even more dominant is a change in required customer service level, i.e. requirements regarding order lead times and delivery reliability. These requirements have become increasingly important due to fiercer competition in this area (Muilerman, 2001).

Higher taxation of transport or longer transit times and reduced reliability of transport systems due to insufficient infrastructure provision are expected to lead to decisions to restructure logistics. Literature in transport economics and logistics management suggests that *direct* transport costs may have an impact on the following logistical components (for an overview see Runhaar, 2002):

- the geographical market area that is served by a production facility;
- the number of distribution centres and the number of stock points;
- locations of production and distribution centres;
- supplier choice (that is, locations or area of sourcing);
- stock levels and frequency of replenishment orders.

However, surveys that assessed the impact of (hypothesised) increases in direct transport costs reported adaptations mainly in the area of transport operations (McKinnon, 1998; Muilerman, 2001; Musso et al., 1999; van Schijndel and Dinwoodie, 2000). This may be due to the fact that these surveys were not explicit in the time horizon employed. Moreover, in terms of the applied methodologies: firms might find it difficult to overlook the implications for long-term decisions. Another major explanation could reside in differences in the level of the cost increase examined. There are strong indications that these will have to be rather large in order to induce logistical adaptations (Cooper et al., 1994).

The literature is less explicit about the effects of increased *indirect* transport costs due to longer transit times and/or reduced delivery reliability. Given the increased importance of customer service and logistical costs other than transport costs, it is, however, plausible that changes in transit times and delivery reliability will have a wider impact on logistical decisions than higher direct transport costs. The reason is that many production and distribution networks have recently been (re)designed to enable fast, flexible, and reliable delivery without having to keep large stocks. This is reflected in, among others, the production strategy (small runs, fast turnaround times, just-in-time manufacturing, and modularisation of products), the functional organisation (non-core activities are increasingly outsourced), and the distribution structures employed (for example, increased employment of cross docking). Evidently, these practices are only possible if freight transport services are also sufficiently fast, flexible and reliable.

Only a few empirical studies have been conducted in this area. Rao and Grenoble (1991), who focused on the impact of congestion on JIT manufacturing and stock management, found that the unpredictability of arrivals due to congestion potentially causes more logistical problems than increases in transit times alone. This is in line with the few other studies in this field (Fowkes et al., 1991; van Schijndel and Dinwoodie, 2000). The empirical studies however display different results. Rao and Grenoble (1991) mainly found adaptations in transport operations. The only observed impact on production and distribution regards changes in locations of facilities or in channel structures (unspecified). Van Schijndel and Dinwoodie also found mainly adaptations in transport operations, but this may be due to the fact that they conducted a survey among cargo transport operators. Some expected less frequent deliveries, which might indicate that they expected shippers to keep higher stocks. Yet the question is to what extent cargo transport operators have real insight into shippers' considerations and decisions. Finally, Muilerman (2001) examined the effects of increased congestion on the Dutch food and

parts services industries. In his study, logistics managers envisaged a decentralisation of distribution and services.

3. Assessing the impact of increased transport costs in supply chains for books and newspapers

3.1. Set-up of the analysis

In order to assess the impact of transport cost increases on logistical decision-making a study was undertaken in 2001–2002. Since detailed insight in shippers' decision making processes was required, the method of in-depth interviewing was chosen. The interviews were based on two hypothetical policy scenarios, namely:

- *fair and efficient pricing:* this scenario (1) assumes that all external social costs of transport will be passed on to carriers in line with the plans of the European Commission (direct cost increase);
- *significant increase in congestion:* this scenario (2) assumes that infrastructure renewal in the EU is insufficiently effective in accommodating the growth in (freight) traffic, resulting in a significant increase in congestion on infrastructure networks (indirect cost increase).

These policy scenarios were used to compare the effects of increases in direct and in indirect transport costs. However, taxation and congestion are factors that to some extent occur autonomously in both scenarios. The two scenarios therefore assumed a substantial, *extra* increase in either taxation or congestion. In the quantification of the two scenarios attention has been paid to the 'absorptive capacity' of carriers: the extent to which they are able to offset the negative effects of the two scenarios (Runhaar, 2002). Table 2 provides the details of the two scenarios. Here, the focus is on the impacts of the scenarios on the logistics behaviour of shippers.

Two specific supply chains were examined, namely those of books and newspapers. These supply chains include the following sectors: old paper collection and wholesale, paper production, paper wholesale, newspaper production and distribution, book publishing, printing and binding, and book distribution. These supply chains were selected since they reveal a wide variety of logistical organisations, they have the potential for reduced transport-intensity, they produce substantial traffic flows, and finally produce a wide variety of goods. The analysis was restricted to firms located in the Netherlands, since taxes, land and real estate costs, and other factors affecting logistical decisions tend to differ significantly from country to country (Mair et al., 1999). Obviously, the sectors examined are not necessarily representative. However, in the recent past, a few studies have been undertaken in such a way that they enable a comparison with this study.

The above scenarios were discussed with 41 (logistics) managers working for shipping firms in the indicated sector. Interviews were structured according to the stated adaptation technique. This technique is specifically designed for the analysis of (changes in) attitudes and behaviour of target groups in hypothetical situations. First an inventory was made of current (transport) activities, from which constraints faced by the respondents are deduced. In this way, biases on the part of the interviewee were reduced (Faivre d'Arcier et al., 1998). The survey encompassed a time span of 10 years from the moment it was conducted (2001), which was still tangible for the interviewees. Before describing some of the results, the empirical sector under study is briefly introduced.

3.2. Production and distribution of books and newspapers: a brief introduction

Book and newspaper supply chains will be characterised by means of the three logistical dimensions that were discussed before: logistical structure, scheduling of product flows, and the management of transport operations.

Figs. 4 and 5 depict typical *logistical structures* for book and newspaper production. They show that in terms of geographical areas of sourcing and sales, firms differ substantially. The *scheduling of product flows* also is rather heterogeneous. Low-value products with a regular demand such as cellulose, old paper, newsprint, and other

Table 2
Scenario details

	Road haulage	Inland navigation	Rail transport	Air-freight	Deep sea shipping	Short sea shipping
Scenario 1: 'Fair and efficient pricing'						
Assumed change in carrier rates by 2010 (%)	+50	+40	+50	+25	+50	+40
Scenario 2: 'Significant increase in congestion'						
Assumed change in transit times by 2010 (%)	+30	+25	−5	+20	+7.5	+7.5
Assumed change in arrival reliability by 2010	10% arrivals ≥ 15 min late	25% sailings ≥ 4 h late	25% shuttles ≥ 1 h late	10% flights ≥ 3 h late	10% sailings ≥ 1 day late	20% sailings ≥ 0.5 day late

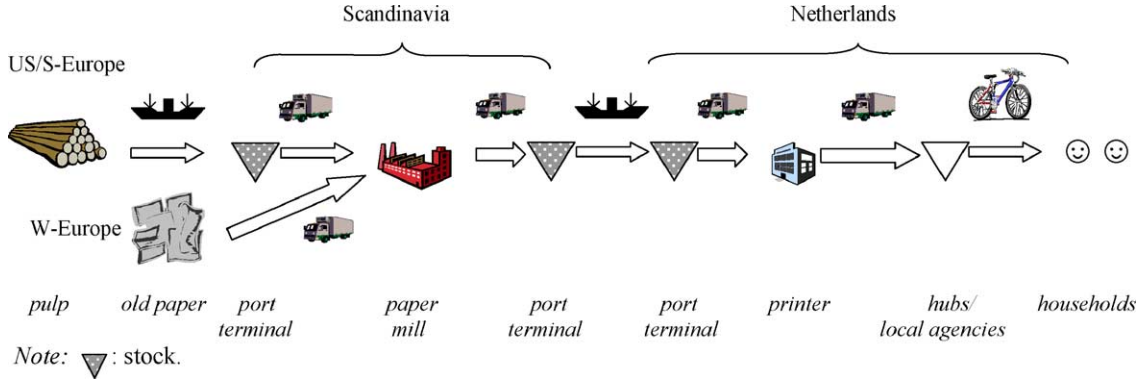


Fig. 4. Typical supply chain for newspapers.

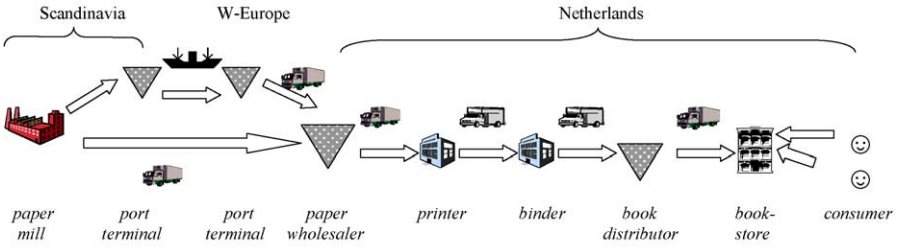


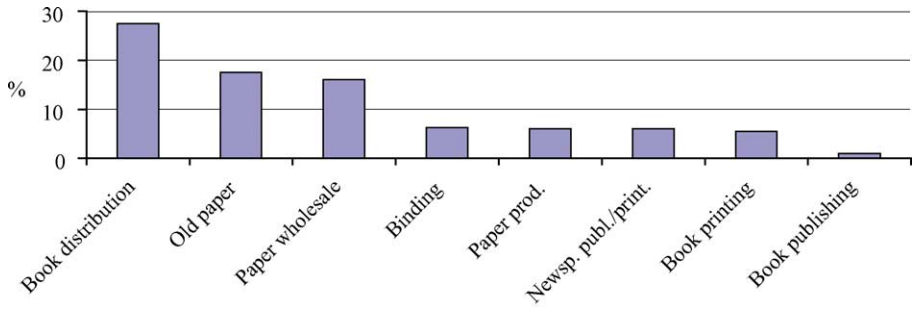
Fig. 5. Typical supply chain for books.

low-quality paper types are usually stored in large quantities. In contrast, newspapers obviously are not stored whereas only small stocks are kept of fine paper. In the paper and graphic industries, customer service levels are traditionally high (see also Kearney, 1993). Just-in-time deliveries have become practice in every sector, but are particularly demanded by book printers. In this way, they minimise storage costs and stock risks. Reliability in terms of on-time delivery is generally high. Paper producers claim that up between 96 and 100% of total deliveries are delivered at the agreed time, whereas newspaper publishers claim a reliability as high as 99.95–99.97%.

In the supply chains under study, various modes of transport are used. In continental transport (i.e. within Europe), however, road haulage dominates. Typically, firms are only responsible for outbound transport, which is commonly outsourced. The importance of transport costs tends to vary significantly (see Fig. 6). As a share of retail prices however, transport costs are not significant (see Figs. 7 and 8).

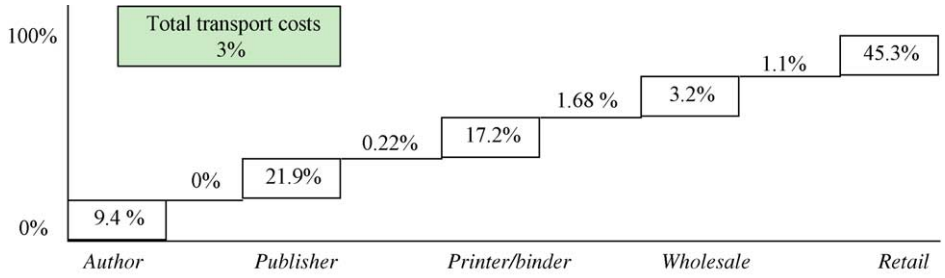
3.3. Shippers' responses to the 'fair and efficient pricing' scenario

Full internalisation of external costs was expected to have a substantial effect on freight rates (see Table 2). The percentages by which the average carrier rates were assumed to increase, are based on external cost estimates by Dings et al. (1999b) and estimates of carriers' absorptive capacity that were based on a Delphi survey (again, see Runhaar, 2002, for more details). The rate increases assumed are substantial; the 50% increase in road transport



Source: interviews.

Fig. 6. Share of outbound transport costs in total costs.



Percentages within boxes indicate the value-added per actor; percentages in-between boxes indicate the share of transport costs in total value added. *Source*: interviews.

Fig. 7. Transport costs as a percentage of book prices.

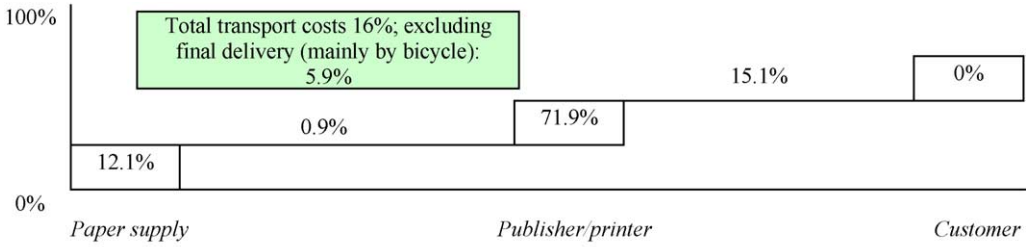
costs, for instance, would bring real carrier rates back to the level of the mid 1970s (see Dings et al., 1999a).

Based on theory and on the analysis of the sector under study, it was expected that the scenario would have a significant impact on book and newspaper production and distribution. In particular, the size of geographical market areas was expected to be affected. For instance, at present paper imports and exports are a significant feature of the functioning of this market, suggesting that in the case of higher transport costs decentralisation or more local production for local consumption would become more likely.

In the light of expectations, the results of the survey were surprising. Table 3 summarises the responses foreseen by the interviewees. In the 10-year time span that was examined, the scenario was expected to have a modest impact on production and distribution. The main logistical adaptations are a higher efficiency of transport operations due to improved freight consolidation and a reduced need for transport services due to a lower frequency of replenishment orders. Higher transport costs are expected to have only limited spatial effects. Decentralisation of production or distribution is generally stated not to be feasible since the cost of duplicating production or distribution facilities, synergy losses, or increased overall stock levels will by far exceed savings on transport costs. This is in line with what McKinnon found in a similar study (McKinnon, 1998). Spatial effects will be restricted to smaller geographical market areas due to a loss of remote customers (an involuntary decentralisation of supply) and more local or regional sourcing. These spatial effects of higher direct transport costs are however rather sector-specific. On average, customer service levels in terms of order lead times and reliability of deliveries will not change in the case of an increase in direct transport costs. Neither can a large-scale change in modal choice be expected. This is not only argued by the fact that the cost increase would be insufficient to compensate for lower quality (speed, reliability, frequency, etc.), but also because of logistical problems: minimum shipment sizes would often exceed the storage capacity of the receiving firm or result in higher stock costs and risks (cf. van Schijndel and Dinwoodie, 2000).

The adaptations to higher direct transport costs found in this study are basically the same as those mentioned in the literature and that relate to other industries and countries (see Section 2). This suggests that changes in the industrial environment (such as the terrorist attacks on 9/11/'01) have had no significant impact on logistical responses to changes in transport costs. One specific type of adaptation however was not found, namely a relocation of production or distribution facilities. Within the 10-year time span under study, relocation was found to be prohibitively expensive due to investment sunk in factories, machinery, distribution centres, warehouse equipment, and the like.

The main conclusion therefore is that higher taxation will barely turn the trend toward ever more transport-intensive logistics. The resulting increase in transport volumes will



Percentages within boxes indicate the value-added per actor; percentages in-between boxes indicate the share of transport costs in total value added. *Source*: interviews.

Fig. 8. Transport costs as a percentage of newspaper prices.

Table 3
Stated adaptations to Scenario 1

	PP	NP	PW	BP	BPR	BB	BD	OP
Logistical structure								
Decentral distribution/stock	X		XX					
Smaller geographical markets	X		XX		X			XX
Focus on markets			X			X		
Swapping			X					
Less remote suppliers				X	X			
No intermediate storage								X
Scheduling of product flow								
Raise stock	X	X	X		X		XX	
More consolidation	X	XX	X		X	X	XX	
Accelerate production		X						
Increase lead time				X				
Customer service								
Reduce delivery frequency			X	X				
Deliver to central facilities instead of home delivery							X	
Other								
Compensate elsewhere (reduce other costs)		X						
Change distributor				X				
Electronic publishing				X				
Extend opening hours						X		
Less timely product		X						
Rationalise assortment							X	
Management of transport operations								
Modal shift	XX	XX	X					X
Outsource transport		X			X			
Insource (instead of specialised services)		X				X		
Change carrier	X						X	
More information exchange with carrier	X							
Adapt equipment	X	X						X
Overnight transport	X	X						

Notes. PP: paper production, NP: newspaper publishing and printing, PW: paper wholesale, BP: book publishing, BPR: book printing, BB: book binding, BD: book distribution (including virtual book retailers), OP: old paper collection and wholesale, X: mentioned by one firm in the sample (of, on average, five firms), XX: adaptation was mentioned by two or more firms in the sample.

probably be compensated only in part by a higher transport efficiency.

3.4. Shippers' responses to the 'insufficient infrastructure provision' scenario

This scenario assumed a substantial increase in congestion on infrastructure networks (both on transport links, such as motorways, and on nodal infrastructure, including ports). Table 2 describes the assumed consequences of the scenario for transit times and delivery reliability (for more details, see Runhaar, 2002). In the case of rail transport, the scenario seems to involve an improvement in transit times, but assumes deterioration as compared to the autonomously expected trend.

Table 4 summarises the stated adaptations to this scenario. The interviewees in this time sensitive sector considered longer transit times and reduced delivery reliability more problematic than higher direct transport costs. Many firms had already reduced order lead times and improved reliability of deliveries in the recent past. Often their customers are the driving force behind this trend demanding fast, frequent, and reliable replenishment deliveries. This allowed them to reduce storage and stock costs. Increased congestion will endanger this practice. In newspaper publishing, longer transit times are problematic since delivery times for newspapers are fixed whereas printing is postponed for as long as possible in order to include the latest news. Delays due to congestion were not expected to be completely absorbed by reorganising transport operations, implying that adaptations in distribution or even production would be inevitable.

The main expected effects of longer transit times and reduced delivery reliability are a loss of customers (in particular remote ones), a decentralisation of production or stocks, adaptations in the planning and scheduling of production and distribution activities, and changes in transport operations. The main difference of this scenario

Table 4
Stated adaptations to scenario 2

	PP	NP	PW	BP	BPR	BB	BD	OP
Logistical structure								
Decentralise distribution/stock	XX		XX				X	
Decentral production		XX						
Smaller geographical markets			XX		XX	X		XX
Loss of customers (other)		XX					X	
Focus on markets			X			X		
Swapping			X					
Less remote suppliers				X	XX			
Scheduling of product flow								
Raise stock		XX			X		XX	
More consolidation			X		X		X	
Accelerate production		X		X				
Increase lead time	XX	XX	X	XX	X	X		
Adapt planning (other)		X	XX	XX		XX	X	X
Customer service								
Reduce delivery frequency			X				X	
Better information provision			X					
Stop delivering					X			
Deliver to central facilities instead of home delivery							X	
Other								
Compensate elsewhere (reduce other costs)		X						
Electronic publishing				X				
Extend opening hours			X		X	X		X
Less timely product		X						
Management of transport operations								
Modal shift	X	XX						XX
Outsource transport							X	
Change carrier	X			X		X	X	
More information exchange with carrier	X		X					
Adapt equipment								X
Overnight/off-peak transport	X	XX	XX	XX	XX	XX		X
More express delivery			X					
More direct hauls		XX						

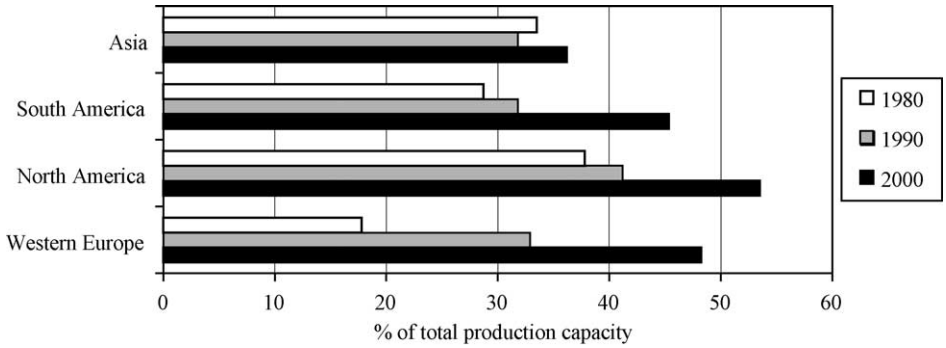
Notes. PP: paper production, NP: newspaper publishing and printing, PW: paper wholesale, BP: book publishing, BPR: book printing, BB: book binding, BD: book distribution (including virtual book retailers), OP: old paper collection and wholesale, X: mentioned by one firm in the sample (of, on average, five firms), XX: adaptation was mentioned by two or more firms in the sample.

with the previous one is that longer transit times and reduced delivery reliability will lead to a higher loss of customers and larger reductions in geographical market areas for some firms. Regarding other aspects of the organisation of production and distribution, longer transit times and reduced delivery reliability, similar to higher direct transport costs, will have only a modest impact. Trends such as time-based competition will continue, although sometimes at a lower pace than in the 'business as usual' scenario. Therefore, congestion will not stop or reverse the trend toward ever more transport-intensive production and distribution activities, either.

3.5. General observations

In general terms, the findings from the survey do not greatly differ from the few other empirical studies conducted previously (see Section 2). Neither a substantial increase in transport costs, such as the 50% increase in road freight rates studied in this article, nor large delays will have a fundamental impact on the ways in which production and distribution are organised, in contrast to theoretical suggestions: the structure and spatial pattern of the production and distribution network will largely remain unchanged. Increases in generalised transport costs will notably be compensated within the domain of transport operations and by adapting the scheduling of product flows. In addition, part of the 'problem' is passed on to commercial carriers, since many firms have outsourced a large proportion of their transport.

The hypothesis that the gap between theory and practice would be explained by different time spans, was not confirmed, since a 10-year time span was explicitly examined. It can be hypothesised that in the longer term, the two scenarios may indeed have spatial effects in that the changing costs affect the location of *new* firms. These firms



Source: CEPI, 2001: 32.

Fig. 9. Production capacity share of top-10 producers of paper and board (per continent).

may choose more favourable locations in terms of transport costs, or in terms of costs of other inputs that may compensate for higher transport costs (think of the low labour costs in the new Eastern European countries that will join the EU). The methodology employed in this study does not allow drawing conclusions about this potential effect. The literature however suggests that this possible effect should not be overestimated since it is commonly known that accessibility and transport costs usually are only one element in the locational choice of firms (e.g. Buck Consultants International in Demkes, 1999: pp. 17–18).

From the empirical evidence collected in this study, as well as other studies, the following explanations for the modest impact of increased transport costs were deduced:

- *robust logistical trade-offs:* Relatively high costs of distribution facilities, factories, and stocks appeared to be an important barrier in reorganising production and distribution in a less transport-intensive way. Exceptions were firms with a wholesale function and hence large volumes of transport.
- *sunk investment:* The costs of 'accelerated' writing-off often proved to be a barrier to relocate if transport costs increase. Sunk costs relate to investment in factories, machinery, distribution facilities, and sometimes labour force.
- *product characteristics.* In the case of products with a high value density or high commercial perishability, adaptations such as decentralisation of stocks would inflate total costs more than the initially assumed transport cost increase.
- *market structure.*Not all firms are equally flexible in their choice of supplier. Paper producers, for instance, are few in number due to production concentration in this sector (see Fig. 9). Although it is difficult to prove, firms that can easily pass on cost increases due to a strong market position may also have fewer incentives to adapt their operations in response to higher (transport) costs.
- *consumers' willingness to accept price increases or quality losses.* Newspaper publishers for instance might respond to a transport cost increase by an earlier closing of editorials, which would raise distribution lead times and opportunities to consolidate shipments. Yet most publishers expected that consumers would prefer a price increase to a quality loss due to a less timely product.

4. Conclusions and policy implications

Although regulation of developments in transport demand through taxation has become increasingly popular among European governments, manipulation of transport costs does not seem to be a very effective instrument in reducing the negative effects of freight transport. Indeed, it would lead to a more efficient operational use of transport resources. However, the trend of increasing transport-intensive production and distribution will hardly be affected. The logistics managers interviewed here mainly perceived the problems induced by the two scenarios as *transport* problems and not as *strategic* problems. The transport cost increases examined represent substantial but still realistic cost increases; larger increases are not deemed realistic (see Runhaar, 2002). Thus, although further research into the question at what levels transport cost increases will produce significant changes in production and distribution is interesting from an academic perspective, it may barely be interesting from a policy perspective.

Does the limited effectiveness of transport cost manipulation mean that governments should ignore this policy instrument? This work implies that the answer should be no, since it provides incentives for a more efficient use of transport resources. However, policy makers and politicians should be modest in their expectations regarding the effects on reduction of road freight transport.

At the same time, policy makers and politicians should be careful with their infrastructure investment plans. More infrastructure capacity will, at least temporarily, improve accessibility to certain areas. However, it will also stimulate the trend towards a more transport-intensive organisation of production and distribution (through, for instance, intensified time-based competition, resulting in lower load factors and hence more vehicle movements). Therefore, expansion

of infrastructure should be combined with pricing strategies, in order to provide sufficient incentives for raising transport efficiency (i.e. the ratio of tonne- to vehicle-kilometres).

Finally, additional measures will be needed in order to reduce the transport-intensity of production and distribution. The case studies as well as the literature discussed in this article show that the 'logistical structure' is hardly affected by transport cost manipulations. In part, this is caused by inertia and it is expected that in the long-term the effects could be more substantial. However, this requires attention to at least two additional policy strategies.

Physical planning interventions stimulate the first strategy of geographical concentration of firms that have a strong customer–supplier relationship (similar to what the Dutch Advisory Council for Transport, Public Works and Water Management recently advised). Alternatively, a strategy would be to cluster firms that operate within the same sector. The first approach would reduce transport distances, whereas the second focus would lead to 'thick' goods flows, which would favour multimodal transport. Implementation of this spatial strategy will face serious problems. One problem is that central governments only have a very indirect say with regard to the location choice of companies. Moreover, local communities mutually competing in attracting new firms will be less restrictive. Another difficulty is that customer–supplier relationships change in time and might not have an infinite duration. Finally, there might be a lack of agglomeration economies in particular industries.

A second strategy that deserves attention is to mobilise consumers. For example, organic or ecological food has become well established in an increasing part of the food retail and many governmental offices only use chlorine-free paper. Why not persuade critical consumers to select those products that require minimal amounts of energy (both in production and in transport)? A positive condition for success of this approach is that consumers have become more powerful vis-à-vis producers and retailers. One of the difficulties however is the lack of information on the transport-intensity of products. In the case of food, only the country of origin gives an indication (although a very rough one). Governments could play a facilitating role in making these facts more transparent (e.g. by developing eco-label like standards that incorporate the environmental impact of transport of the product in question). In this way governments can contribute to consumers' awareness of the environmental impact of the products they purchase.

References

Annema, J.A., van Wee, B., 2000. Transport and the greenhouse effect. The role of research in Kyoto-related climate policy in The Netherlands. European Journal of Transport and Infrastructure Research. 57–70.

AVV, 2000. Mobiliteit Verkend. Feiten achter het NVVP. Adviesdienst Verkeer en Vervoer, Rotterdam.

Banister, D., Maggi, R., Nijkamp, P., Vickerman, R., 1999. Actors and factors in the integration of strategic infrastructure networks in Europe. In: Beuthe, M., Nijkamp, P. (Eds.), New Contributions to Transportation Analysis in Europe. Ashgate, Aldershot, pp. 17–44.

Banister, D., Stead, D., Steen, P., Åkerman, J., Dreborg, K., Nijkamp, P., Schleicher-Tappeser, R., 2000. European Transport Policy and Sustainable Mobility. Spon, London.

Bowersox, D.J., Closs, D.J., Helferich, O.K., 1986. Logistical Management. A Systems Integration of Physical Distribution, Manufacturing Support, and Materials Procurement, third ed. McMillan, New York.

Cooper, J., Browne, M., Peters, M., 1994. European Logistics. Markets, Management and Strategy, second ed. Blackwell, Oxford.

Cooper, J., Black, I., Peters, M., 1998. Creating the sustainable supply chain: modelling the key relationships. In: Banister, D. (Ed.), Transport Policy and the Environment. Routledge, New York, pp. 176–203.

Demkes, R. (Ed.), 1999. TRILOG-Europe End Report. TNO Inro (project co-ordinator), Delft.

Dings, J.M.W., Metz, D., Leurs, B.A., Bleijenberg, A.N., 1999. Beter aanbod, meer goederenvervoer? Delft, CE.

Dings, J.M.W., Janse, P., Leurs, B.A., Davidson, M.D., 1999. Efficiënte prijzen voor het verkeer (Efficient prices in transport; in Dutch). CE Oplossingen voor milieu, economie en technologie, Delft.

EC, 1998. Fair Payment for Infrastructure: A Phased Approach to a Common Transport Infrastructure Charging Framework for the EU. Office for official publications of the European Communities, Luxembourg.

EC, 2001. European Transport Policy for 2010: Time to Decide. Office for official publications of the European Communities, Luxembourg.

Faivre d'Arcier, B., Andan, O., Raux, C., 1998. Stated adaptation surveys and choice process: some methodological issues. Transportation 25 (2), 169–185.

Forkenbrock, D.J., 2001. Comparison of external costs of rail and truck freight transportation. Transportation Research A: Policy and Practice 35 (4), 321–337.

Fowkes, A.S., Nash, C.A., Tweddle, G., 1991. Investigating the market for intermodal freight technologies. Transportation Research A 25 (4), 161–172.

Hesse, M., Rodrigue, J.-P., 2004. The transport geography of logistics and freight distribution. Journal of Transport Geography 12 (3), 171–184.

Kanafani, A., 1983. Transportation demand analysis. McGraw Hill, New York.

Kearney, A.T., 1993. Logistics Excellence in Europe: 1,000 Companies Reveal their Problems, Needs, and Solutions. A.T. Kearney, Amsterdam.

Mair, G., Arychuk, L., MacKay, S., 1999. The competitive alternatives. A comparison of business costs in North America, Europe and Japan, KPMG, Vancouver.

McKinnon, A., 1998. Logistical restructuring, freight traffic growth and the environment. In: Banister, D. (Ed.), Transport Policy and the Environment. Spon, London, pp. 97–109.

McKinnon, A., Forster, M., 2000. European logistical and supply chain trends: 1999–2005. Full Report of the Delphi 2005 survey, Heriot-Watt University, Edinburgh.

McKinnon, A.C., Woodburn, A., 1996. Logistical restructuring and road traffic freight, an empirical assessment. Transportation 23 (2), 141–161.

Muilerman, G.J., 2001. Time-based logistics, an analysis of the relevance, causes and impacts. PhD Thesis, TRAIL Research School/Delft University Press, Delft.

Musso, A., Memoli, M., Pascucci, M., Viegas, J., Mesquita, R., 1999. Shipper Survey Panel Report, SOFTICE Project, University of Rome La Sapienza, Rome.

NEI, 1999. REDEFINE, Relationship between demand for freight transport and industrial effects. Netherlands Economic Institute (co-ordinator), Rotterdam.

Proost, S., Van Dender, K., Courcelle, C., De Borger, B., Peirson, J., Sharp, D., Vickerman, R., Gibbons, E., O'Mahony, M., Heaney, Q., Van den Bergh, J., Verhoef, E., 2002. How large is the gap between present and efficient transport prices in Europe? Transport Policy 9 (1), 41–57.

Rao, K., Grenoble IV., W.L., 1991. Modelling the effects of traffic congestion on JIT. International Journal of Physical Distribution and Logistics Management 21 (2), 3–9.

Runhaar, H., 2002. Freight transport: at any price? Effects of transport costs on book and newspaper supply chains in the Netherlands. PhD Thesis, TRAIL Research School/Delft University Press, Delft.

van Schijndel, W.-J., Dinwoodie, J., 2000. Congestion and multimodal transport: a survey of cargo transport operators in the Netherlands. Transport Policy 7 (4), 231–241.

Southerland, M.T., 2004. Environmental impacts of dispersed development from federal infrastructure projects. Environmental monitoring and Assessment 94 (1), 163–178.

Svensson, G., 2002. The theoretical foundation of supply chain management. A functionalist theory of marketing. International Journal of Physical Distribution and Logistics Management 32 (9), 734–754.

TUB (2001). Analysis of the transport decision making process. Deliverable report D2/D3 of the SULOGTRA project. Technical University of Berlin (co-ordinator), Berlin, Heriot-Watt University, Zentrum für Logistik und Unternehmensplanung, Research Centre of the Athens University of Economics and Business, Transportes, Inovação e Sistemas, Cranfield University, NEI, Lois Berger, Templeton College.