

**IMPRINT-EUROPE**

*Implementing Reform in Transport*

*Effective Use of Research on Pricing in Europe*

*An European Commission funded Thematic Network (2001-2004)*

# **Pricing of intermodal transport: lessons learned from RECORDIT**

**Andrea Ricci**

**[aricci@isis-it.com](mailto:aricci@isis-it.com)**

**ISIS – Institute of Studies for the Integration of Systems**

**Rome, Italy**

**<http://www.isis-it.com>**

*This essay was prepared for the second seminar of the IMPRINT-EUROPE Thematic Network: “Implementing Reform on Transport Pricing: Identifying Mode-Specific issues”, Brussels, 14th/ 15th May 2002*

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## ***References***

## **1 ABSTRACT**

This paper addresses the pricing issues specifically related to intermodal transport, whereby an intermodal chain is recognised to be more than the juxtaposition of a series of modal activities.

Intermodal transport is in fact defined as a sequence of activities involving modal haulages, transshipments and terminals, and requiring the intervention of a variety of operators, whose roles partially overlap and compete. This entails an inherent complexity of the cost and price formation mechanisms, and an overall lack of transparency resulting both from the technical difficulty to establish a reliable and effective accounting framework, and from the high level of competition currently observed between operators.

Specific obstacles to cost valuation and pricing are also related to the choice of the units of measure, whereby intermodal traffic is usually assessed with reference to the Loading Unit concept, rather than in terms of vehicles moved.

The RECORDIT project (Real Cost Reduction of Door-to-door Intermodal Transport) is briefly presented, with particular reference to its pricing-relevant objectives: designing an original accounting framework for intermodal transport, and documenting the value of individual cost items (both internal and external) based on the detailed, bottom-up analysis of three intermodal trans-european corridors and their all-road competing alternatives.

Intermodal transport is found to be consistently cheaper than all-road solutions, and its external costs significantly lower, thereby confirming the high potential of intermodal transport in increasing the sustainability of the transport sector.

For price setting purposes, RECORDIT has carried out a comparison between social costs (internal + external) and taxes and charges currently paid. The evidence from the three corridors analysed does not lead to uniform conclusions, owing to a high level of variability of results in relation to corridor-dependent parameters, and thereby confirming the need for a price-setting approach that allows to adequately reflect the specific characteristics of each route.

Further research and policy initiatives can be envisaged to facilitate the pricing reform process, particularly directed at reducing information gaps and increasing transparency, also through the establishment of more effective institutional and market mechanisms.

## 2 INTRODUCTION

Freight intermodality is increasingly considered as major potential contributor to solving the sustainability problems of the European transport sector. In the perspective of a generalised transport pricing reform, intermodal solutions should therefore be assessed as “just another transport mode”, in order to: i) investigate the credibility of the widely accepted view that intermodal transport is more efficient (in terms of total social costs) than its modal alternatives, and ii) provide the necessary input to price setting through reliable valuation analyses.

But intermodal transport is not a simple juxtaposition of modal activities, and the estimation of its costs requires additional, original insights, e.g. into terminal and transshipment activities and, even more importantly, into the nature and extent of the added value associated to intermodality as such, notably through the role of specific service providers (forwarders, integrators, etc.).

At the outset, it is therefore necessary to identify the functional and technical specificity of intermodal chains, and the cost and price formation mechanisms attached thereto.

## 3 COSTS AND PRICES OF INTERMODAL TRANSPORT

### 3.1 *Intermodal transport chains: definitions and layout of cost formation mechanisms.*

Intermodal transport is defined as “the movement of goods in one loading unit, which uses successively several modes of transport without handling of the goods themselves in transshipment between the modes”.

This entails that:

- ⇒ two or more different transport modes are deployed, and therefore at least one transshipment takes place
- ⇒ the main haulage is not carried out by road, but by rail or water, while trucks/lorries are used for the initial and final legs of the goods movement (pre and post haulage).

The general layout of an intermodal chain can be described as a sequence of activities, classified in nine main blocks, each generating internal and external costs:

#### *i. Loading/unloading - Shipper / consignee*

The first and the last step of a transport process are the companies which dispatch and receive the consignment. Their costs include those incurred in loading (unloading) and storing the units used for transport (containers, trailers). In addition a company may incur costs in leasing or owning units used for transporting the goods. External costs are geared to the use of machinery and equipment for the above operations.

#### *ii. Pre haulage / Post haulage*

Pre and post haulage to and from terminals (e.g. rail) is typically provided by road transport companies. Road haulage companies incur costs involved in the ownership and operation of vehicles, which in most cases involves the payment of taxes. The total costs include the time spent loading and unloading as well as movement. Costs may also be incurred for the payment of infrastructure in the form of tolls. External costs are generated by the truck movement

#### *iii. Transshipment*

This can be defined as the location in which loading units are physically transhipped from one vehicle to another similar vehicle of the same mode (e.g. truck to truck). Internal costs involved are the capital cost of the equipment necessary for transshipment, its operation and the storage area required. External costs are geared to the use of machinery and equipment for the above operations.

#### *iv. Terminal transfer*

A terminal is defined as a place containing the functions and technical assets whereby a loading unit may be transhipped between two *different* kinds of carrying units. Transfer may be between the various modes – rail, road, sea and inland waterway. External costs are geared to the use of machinery and equipment for the above operations.

v. *Marshalling Yard transfer*

The function of a marshalling yard is the transshipment of loading units from one *train to another*, or, more commonly, the rearrangement of wagons into a single train. External costs are generated by the movement of vehicles (locomotives, wagons) and by the use of other equipment and machinery for the transfer operations.

vi. *Main haulage: Road*

Road haulage companies incur costs involved in the ownership and operation of vehicles, which in most cases involves the payment of taxes. Costs may also be incurred for the payment of infrastructure in the form of tolls and road pricing. This includes all national road tax stickers and motorway vignettes operative in Switzerland and Austria as well as tolls for Alpine and Channel crossing. External costs are generated by the movement of trucks.

vii. *Main haulage: Rail / Train*

The costs refer to a *terminal-to-terminal* journey performed by rail transport. They include any charges for the use of the rail infrastructure. These charges may or may not cover the costs of the infrastructure. External costs are generated by the movement of trains.

viii. *Main haulage: Inland waterway*

The cost structure of this transport block is similar to that experienced for main haulage by train. Charges may be incurred for the use of infrastructure. External costs are generated by the movement of barges.

ix. *Main haulage: Maritime*

The cost structure of this transport block is similar to that experienced for main haulage by train. No charge is paid for infrastructure (the sea). Costs for piers and berths maintenance and repair are normally allocated to terminals. External costs are generated by the movement of ships.

### **3.2 One service, a multitude of market players.**

The complexity of the layout illustrated above reflects directly on the organisation of the intermodal market, which is characterised by a multiplicity of players, including end-users (shippers and consignees), infrastructure managers, operators (modes, terminals) and service providers (forwarders, integrators), which interact at various levels and in non standardised forms. The cost and price formation mechanisms associated to the production of the intermodal transport service are therefore extremely difficult to assess.

A typical example is the handling of profits and mark-ups throughout the cost formation sequence: owing to the high number of operators involved in customer/client relationships, it is extremely difficult to establish a satisfactory (i.e. faithful, transparent and standardised) rule to avoid double counting while ensuring the required completeness of information.

The emerging role of the so-called integrators, while simplifying the picture by consolidating the process of service production, may on the other hand induce an increased lack of transparency for the market users (whereby a significant part of transaction costs would become agency costs).

### **3.3 A highly competitive environment**

Intermodal transport involves a large number of operators from the private sector. The market environment in which they operate is highly competitive. As opposed to the general situation observed for many other transport services, direct competition can often be found among players

operating on the same network segment. This situation largely influences the pricing strategies of operators and their overall market attitude:

- ⇒ published prices, when they exist, are often found to be substantially different from real prices offered to customers. Discounts for high volumes, for frequent and/or regular shipments, and, more generally, for strategically preferred customers are common practice, and hardly documented
- ⇒ similarly, cross subsidisation between routes is frequently adopted by operators seeking to gain dominant positions on specific itineraries and services.

The current market set-up does not in fact provide for the necessary transparency, resulting in market distortions and efficiency limitations; the highly competitive environment characterising the intermodal transport sector, which should in principle guarantee - if only in the medium/long term - the attainment of efficient market equilibria, paradoxically implies, in the short term, a real difficulty in achieving the appropriate level of visibility and information exchange, such as needed for a transparent interplay of the market forces.

The difficulty in accessing pricing relevant information is clearly also a major obstacle to the estimation of real costs: devising an effective pricing policy in such an opaque context is indeed a very ambitious challenge.

### **3.4 Loading Units Vs Vehicles**

Deriving *unit costs and prices* that are relevant to both policy makers and market players is a complex affair:

- ⇒ the market of intermodal transport is organised with reference to the movement of Loading Units (LUs), rather than vehicles: in fact, the LU can be considered as the equivalent of the vehicle in other forms of transport, whereby it is the LU - and not the various vehicles on which it is successively loaded - that physically moves all the way from origin to destination. But Loading Units can be of different types, with three main options: containers, swap bodies and trailers, each with its characteristics that relate to different organisational, technical and market needs. Despite the current trend towards standardisation, several solutions remain therefore available, even within each LU category, e.g. swap bodies that can be 20-foot or 40-foot long. For pricing purposes, analysts and operators alike therefore tend to express values in Euro/LU.km rather than in Euro/veh.km, as the former are more market-relevant and of direct interest to end-users (shippers and consignees).
- ⇒ on the other hand, transport charging and taxation policies commonly refer to values in Euro/veh.km, therefore prompting the need for a “translation” of values expressed in LUs to values expressed in vehicle terms. Such conversion is far from straightforward, if one considers that a given vehicle (e.g. a 40 tonnes articulated truck) can accommodate various combinations of different LUs, with varying load factors.

## **4 MARKET AND POLICY RELEVANCE OF INTERMODAL TRANSPORT PRICING**

### **4.1 The current European market of intermodal transport services**

Owing to the above mentioned difficulty in accessing if only basic information on market performances, even establishing a reliable measure of intermodal market shares is hazardous. Official statistics are few and outdated. The basic figures available and the corresponding trends however show that the market share of intermodal transport in total European transport is limited: 8% of all intra EU transport (in tkm) takes place via intermodal transport. Nevertheless, all forms of European intermodal transport have shown a considerable growth over the last decade. Between 1990 and 1996 the average annual growth in tkm amounted to 9.3% for all forms of intermodal

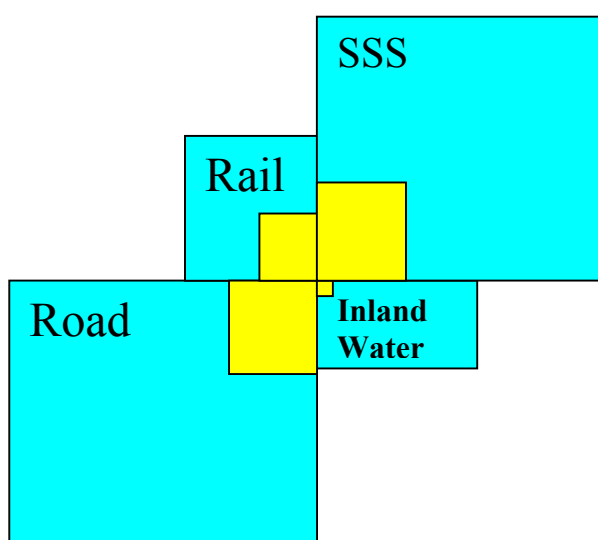
transport<sup>1</sup>. As for intermodal rail/road transport, however, volumes are reported to be declining since 1998, while short sea shipping and inland waterways intermodal transport are still growing fast.

<b>Table 1: Intermodal traffic in 1996</b>
8% of total intra UE traffic (tkm)
14% of international freight traffic (tkm)
1% of domestic freight traffic (tkm)
9,3% is the average annual growth of tkm between 1990 and 1996 of international intermodal traffic (tkm)

Source: based on data from DG TREN website and Eurostat

In fact, the performance of intermodal transport varies considerably with the mode used for the main haulage phase, with intermodal traffic representing as much as 36% of total international traffic for rail, but only 13% for Short Sea Shipping and as little as 4% for Inland Waterways.

**Figure 1: relative size of the European market for intermodal transport**



Source: RECORDIT

## **4.2 Promoting intermodal transport: the policy context**

### **Current institutional framework**

To some extent, the shape and performance of the intermodal transport market reflects the characteristics of the current institutional framework, which influences both supply and demand of intermodal transport services. Legislation and agreements concerning regulation and de-regulation, liberalisation and free market mechanisms are a significant part of this framework, which is in fact the result of policy and legislation at various institutional levels, i.e. European, national, and sub-national.

Instruments available at each such level fall into two broad categories: regulatory and economic.

Regulatory interventions are primarily focused on:

<sup>1</sup> Source : EU Energy and Transport in figures, DG TREN website.

- the introduction of market forces: liberalising market access and ensuring fair and efficient pricing within and between transport modes
- the establishment of a common legal framework, relating to environmental regulations, social regulations, measures to promote combined transport, to regulate truck operations.

As for economic instruments, on the other hand, they mainly correspond to:

- funding, subsidies and incentives, e.g. through the European Development Fund (EDF), the Pilot Action for Combined Transport (PACT), the forthcoming Marco Polo programme, as well as through transportation plans, policies and programs at national and regional level.
- taxation and charges (e.g. vehicle taxation, fuel tax on diesel, eurovignette and its forthcoming successor, motorways tolls).

A direct, quantitative relationship between institutional interventions and the current economic performance of the intermodal sector is difficult to establish, owing to the great variety of concurrent measures undertaken at the various levels of government, and to the indirect nature of the causal links. Nevertheless, the observation of recent developments allows to formulate a series of overall remarks.

- Liberalisation has certainly contributed to a decrease in market prices on most accounts. Although a thorough comparison based on actual price levels is difficult to carry out, a rough estimate indicates that prices have dropped of approximately 30/40 % as a consequence of the various liberalisation interventions
- On the other hand, the regulatory regime has encouraged haulage firms to compete by providing supplementary services, which has resulted in their carrying more goods and providing more services than have been priced and reported to the regulation authority. Balancing the price and the service effects, an estimate of a net price reduction in the range of 15 to 25 % appears reasonable<sup>2</sup>.
- It is however in the area of social regulations that the main influence on performances should be sought: limits imposed on allowed driving time, for instance, have a direct and substantial impact on costs and prices, considering that driver costs account for some 50 per cent of all road operation costs.
- With reference to inland waterway transport, the harmonisation of transport subsidisation policy, which began with Directive 70/1107, has helped slow down the use of subsidies in the EU member countries and stabilise the market for inland waterway shipping.
- A main market distortion often cited by competing sectors is that the navigation industry finances only a minor share of infrastructure costs which, depending on cost accounting methods, is estimated between 10 and 15 %<sup>3</sup>.

### **The policy perspective.**

Many factors point at intermodal transport as a strategic option for Europe: road network limits (on many accounts), but also market globalisation, manufacturers seeking logistic rationalisation through the increasingly widespread recourse to just-in-time and similar concepts, public authorities promoting a more efficient and sustainable use of land, growing generalised competition forcing the industry into the search for new profitability instruments, etc.

Promoting intermodal transport entails massive shifting of freight movement from road to more environmental friendly modes (rail, waterways, short sea shipping). In this respect, intermodal transport has been recognised as a priority in EU and national transport policies.

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<sup>2</sup> Liberalisation and structural reform in the freight transport sector in Europe, 1997, OCSE

<sup>3</sup> ibidem

While capacity expansion is likely to be crucial to the future growth of intermodal transport, it will by no means be sufficient to guarantee the desired modal shift.

Policies and actions must therefore be designed and implemented to:

- increase the productivity and efficiency of the intermodal sector (notably through technological and organisational enhancements)
- reduce the imbalances currently observed between intermodal and road (notably through institutional, fiscal and pricing interventions).

The White Paper of the EC on the revision of the Common Transport Policy devotes a special attention to intermodal freight transport services. In its section: “*Linking up the modes of transport*”, it advocates a number of technical, economic and organisational innovations that directly aim at increasing the attractiveness of intermodal solutions. On the other hand, and no less importantly, many other measures and actions proposed by the White Paper, although they do not target intermodal freight transport as such, are immediately relevant to the general objective of promoting intermodality. Specifically one should mention: the revitalisation of European railways (through radical increases in efficiency and the eventual establishment of a dedicated freight network), the generalised improvement of the quality of transport services and, last but not least, the introduction of an adequate system of transport infrastructure charging.

## **5 RECORDIT: ASSESSING THE REAL COSTS OF INTERMODAL TRANSPORT**

### **5.1 Objectives and overall approach**

RECORDIT directly addresses the above mentioned policy needs. It is based on the recognition that, in Europe, the current intermodal market is characterised and constrained by an insufficient knowledge of the mechanisms of cost and price formation. Increasing the transparency of those mechanisms will stimulate fair competition, and, as a result, raise efficiency levels and improve the quality of service, while contributing to increase the sustainability of the transport sector, social welfare and quality of life.

The RECORDIT purpose is twofold: on one hand, to identify priority areas where intermodal costs could be reduced through a better organisation of services and a more effective and systematic use of efficient technologies; on the other, to support the pricing reform currently in preparation, whereby users are expected to pay for the full costs arising from the production of the transport services, through the incorporation in prices of the so-called negative externalities generated by those services (environmental damages, congestion costs, accident risks, etc.).

To achieve these objectives, RECORDIT has therefore:

- ⇒ devised and tested an original accounting framework for intermodal freight transport, where both internal costs (those faced by the various operators for the production of the service), and external costs (those currently borne by society at large) are described. The approach is based on a highly detailed representation of the sequence of activities that are carried out for the production of the door-to-door transport services (as per the layout illustrated above). RECORDIT has reviewed this entire process at the maximum possible disaggregation level, and mapped all cost factors associated to each step, resulting in over 800 individual cost items, all of which are described in the RECORDIT accounting framework, together with their units of measure and the methods to appraise the corresponding values. For what concerns externalities, RECORDIT has adopted the damage cost approach, based on the Impact Pathway methodology, which starts from the technical characteristics of the activity (technology and type of vehicle, load factor, corridor length), then calculates the so-called “burdens” associated to the activity (i.e. emissions of pollutants, emissions of noise, frequency of accidents), then models the physical impact of these burdens on human health, crops, materials, etc., and finally

estimates the monetary value of these damages (through market values when available, as for e.g. crops and materials, or through Willingness-To-Pay values otherwise)

- ⇒ calculated the entire range of costs for three trans-European, door-to-door corridors (corresponding to a cumulated length of over 9000 km, across 16 European countries, including both Member and Accession States). The result is a database of costs, internal and external, which, although limited to the three RECORDIT routes, provides basic, fundamental insights at the European level as a whole, especially considering that both the intermodal solutions and their all-road, competing alternatives are systematically documented
- ⇒ identified those cost items (cost drivers) that play a major role in determining the performance of intermodal services, thereby leading to recommendations on priority actions to reduce those costs. In parallel, the pricing relevance of results has been analysed, through the appraisal of the potential impacts of internalisation.

## 5.2 Pricing-relevant results

All quantitative findings from RECORDIT are based on the calculations carried out for three trans-european corridors:

- ⇒ the freight freeway between Patras - Brindisi - Milano - Munich - Hamburg and Gothenburg;
- ⇒ the tri-modal transport chain between Genova - Basel - Rotterdam and Manchester;
- ⇒ the door-to-door intermodal chain along the corridor Barcelona - Lyon - Torino - Verona - Budapest and Warsaw.

In fact, while the primary objective of the project was to document the cost and price formation mechanisms, and therefore to estimate total real costs, the most interesting results for pricing purposes are those yielded by the comparison of intermodal costs with those of all-road transport on the corresponding routes.

More specifically:

- ⇒ comparing total costs (internal + external) across the two options (intermodal Vs all-road) sheds light on their relative attractiveness, and should therefore contribute to explain their current market position
- ⇒ comparing external cost with taxes and charges currently paid allows to identify market inefficiencies, both within modes and across them.

Summary results from RECORDIT are provided below to this effect.

Total internal costs for the movement of container<sup>4</sup> (i.e. costs directly borne by the end-user, including taxes and charges) are summarised in the table below:

**Table 2: Internal costs of intermodal Vs all-road transport**

<i>Corridor</i>	Intermodal			All-road		
	€/movement	Length (km)	€/km	€/movement	Length (km)	€/km
Genova-Manchester	2315	2134	1.08	2836	1912	1.48
Patras-Gothenburg	3970	4128	0.96	4894	3599	1.36
Barcelona-Warsaw	3350	3270	1.02	3448	2735	1.26

Source: RECORDIT

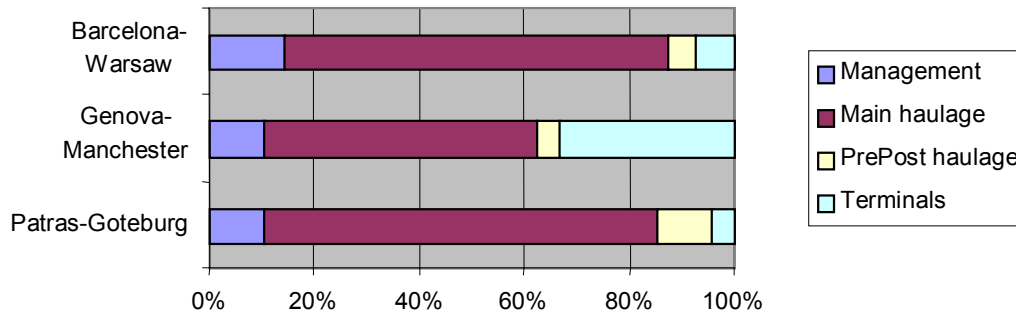
The intermodal option turns out to be consistently cheaper than the all-road alternative, despite being longer. Its competitiveness is however severely undermined by the poor performance of

<sup>4</sup> all costs are shown for a so-called "class A" container

intermodal transport in terms of trip duration, which is between 70% (Patras-Gothenburg) and 400% (Genova-Manchester) longer than for all-road.

It is also interesting to note (see figure below) that, whilst main haulage is the most important cost in all cases, the share of movement and transshipment at terminals can increase to over 20%. The shares will vary depending critically on the number of transshipments necessary along the intermodal route, and the length of the pre- and post-haul legs. On very short routes the pre and post haul costs can rise to near 50%.

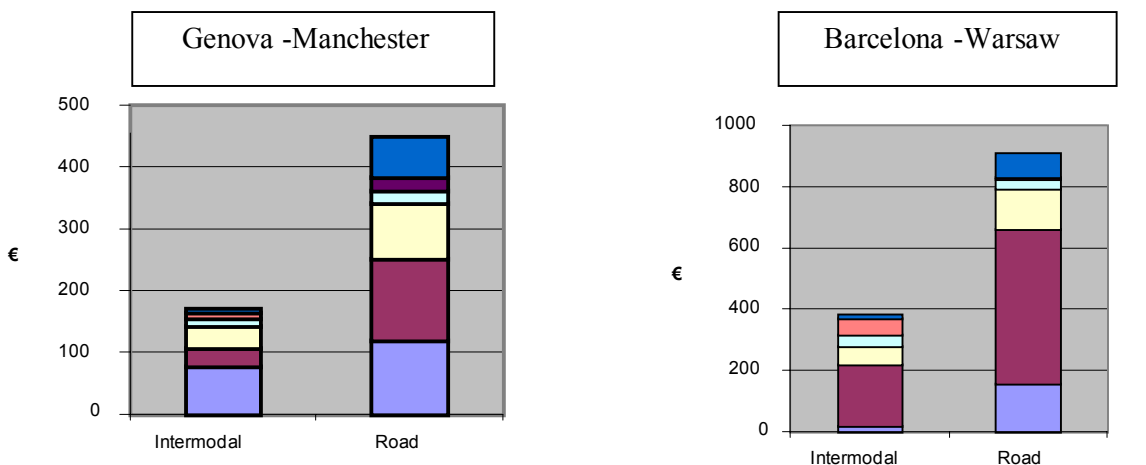
**Figure 2: the main internal costs components of intermodality**



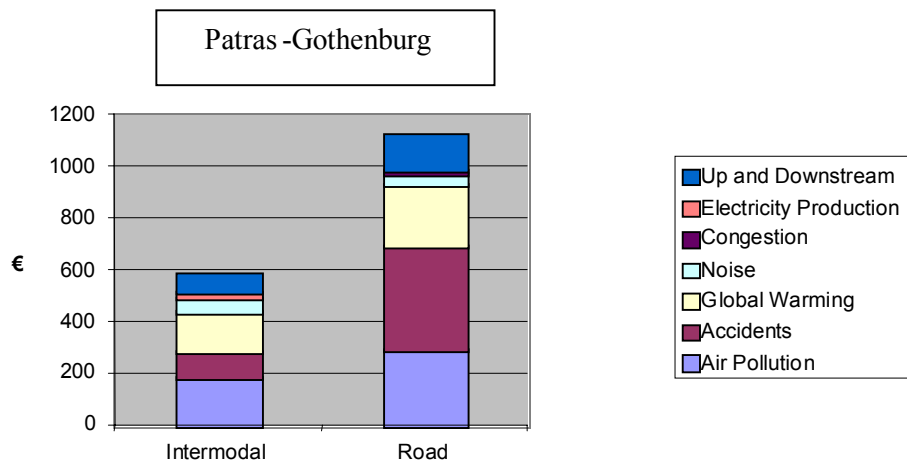
Source: RECORDIT

A similar comparison for marginal external costs confirms the better performance of intermodal transport, as illustrated below:

**Figures 3, 4 and 5: external costs of intermodal and all-road transport**



Source: RECORDIT

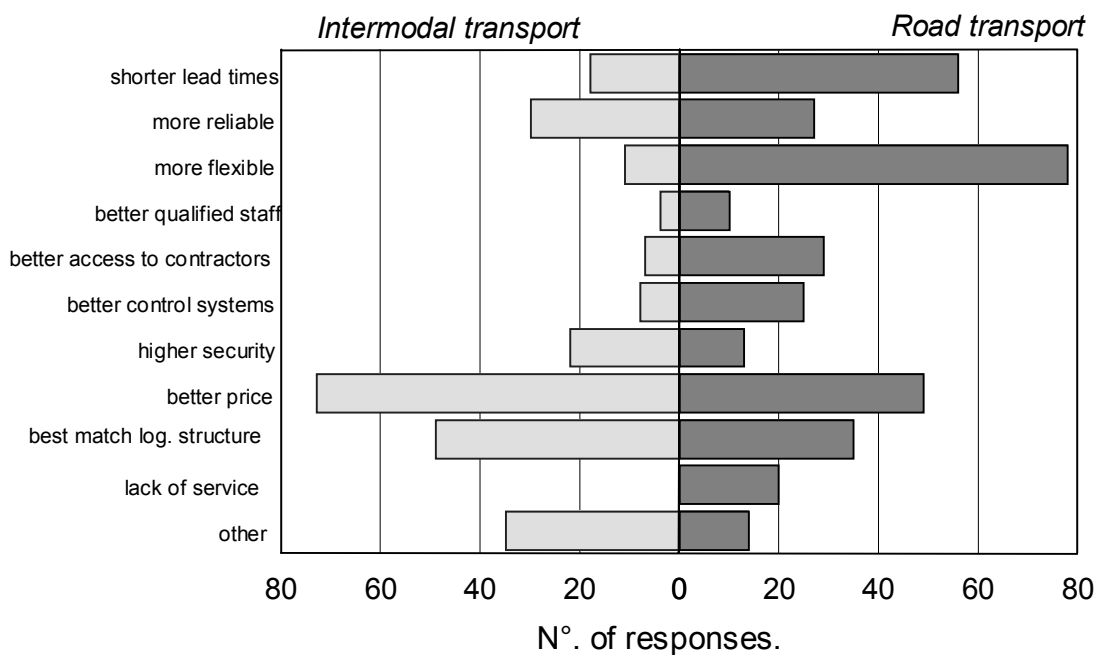


These figures confirm that promoting a massive shift of freight traffic from road to intermodal services would yield significant benefits for the environment and for the community at large. However, they also show that the main obstacle to such a shift lies in the inefficiency of intermodal solutions, at least as perceived by the end-users.

In fact, findings from other research in this area provide additional pricing-relevant input, which may help interpret the relationship between prices and market behaviour:

- ⇒ the study offering the greatest insight into the intermodal market in Europe was carried out by STRATEC (Lobé, P, 2001) in 1999-2000. Examining 12 routes in Europe the study found that although there are many factors influencing demand, price is still critical. Elasticities are however complex and highly route-dependent
- ⇒ on the other hand, a survey carried out within the IQ project also concludes that whenever intermodal transport is perceived as superior to its all-road alternative, the factor playing the most important role in the modal choice is price; if the price is right, users may be prepared to accept that intermodal transport is much slower than road.

**Figure 6: quality perception of intermodal Vs all-road transport**



Source: IQ

When it comes to the comparison between total external costs (including wear and tear of infrastructure), and taxes and charges currently paid (including those levied on the use of infrastructure, e.g. tolls, etc.), the evidence from three corridors proves however insufficient to derive generalised conclusions. The main reason behind such difficulty is the high level of variability of results, and their sensitivity to a large number of specific, corridor-related parameters. Both for intermodal and all-road transport, the RECORDIT corridors show that a variety of different situations can in fact occur: with the exception of the Barcelona-Warsaw route, for which a clear undercharging situation is observed for both road and intermodal, other corridors and segments show contradictory patterns, whereby, in some cases, road transport appears to be already covering its external costs; as for the relative position of road and intermodal (in terms of current level of coverage of external costs), it also strongly varies between routes and countries, owing to substantial differences in national charging policies, but also in the value of external costs (e.g.

accident costs, which vary considerably across countries, and air pollution costs, which are extremely sensitive to the presence of urban or peri-urban stretches in the corridors analysed).

Research on the pricing of the different modes of transport, and the economic theory behind it, clearly point at the need for an integrated, coherent approach in pricing reform, that would avoid introducing further cross-modal distortions. The study of the intermodal transport case stresses such need even further, as it highlights the direct and manifold interactions between the behaviour of individual modes on one hand, and, on the other, the performance of intermodal transport that combines them along a variety of complex patterns.

A case in point is the role of pre- and post-haulage activities embedded in the intermodal chain. These road-based components of the trip are in fact often considered as the weak link of freight intermodality, not only owing to the intrinsic lower performances (e.g. in environmental terms) of road Vs e.g. rail, but furthermore because pre/post haulage is usually carried out with vehicles (trucks) that are consistently less efficient (EURO class) than those used for long road haulages, and with higher percentages of empty trips. Pricing of road externalities can therefore be expected to induce changes in external cost values (e.g. per km of road trip) that will be higher for intermodal than for all-road. On the other hand, the ultimate impact of these changes on the performance of the door-to-door movements clearly depends on the relative length of individual modal sections within the trip. Similar interactions can be also found between intermodal transport and other individual modes, and their impacts in the framework of the pricing reform will vary considerably depending on the pricing instrument adopted. The table below provides a simple illustration of this concept.

**Table 3: charging policy options and their relation to modal components**

Policy	Road	Rail	ShortSea Terminals	Inland Waterways	Unit of Measurement	Influenced by local conditions	Translation into cost per vehicle.km via
Annual vehicle tax	x				vehicle year	no	vehicle km/year
Vignette country A	x				vehicle year	yes	vehicle km/year
Fuel/energy tax	x	x	x	x	litre	no	fuel consumption km/l
Emission regulation	x				emission/l	no	vehicle capital/operating
Distance tax	x	x	x	x	vehicle.km	no	direct
Infrastructure charge (capital/maintenance)	x	x		x	vehicle.km	yes	vehicle km on route types
Infrastructure charge (environmental)	x	x	x	x	vehicle.km	yes	vehicle km on route types
Location charge (environmental)	x	x	x	x	vehicle.km	yes	vehicle km on route types
Infrastructure charge (congestion)	x	x			vehicle.km	yes	vehicle km on route types
Quota - fuel, movements	x				per year	no	scarcity pricing

Source: RECORDIT

In any instance, and whatever the instrument adopted, the pricing reform will modify the relative attractiveness of intermodal transport Vs its modal alternatives (mainly all-road). This inevitably calls for analyses incorporating both direct elasticities (i.e. internal to the intermodal sector), and cross-elasticities (e.g. to estimate net modal shifts from road to intermodal solutions), which, as outlined above, are strongly dependent on the specific, and at times very local characteristics of individual routes. In fact, any assumption about an average elasticity for intermodal transport in Europe is disguising a wide variation on different routes.

### **5.3 Lessons learned from RECORDIT and further research needs**

#### **Reducing uncertainties and understanding variability**

Pricing reforms are only effective when based on a solid and robust assessment of real costs and the associated formation mechanisms. These in turn are strongly affected by the uncertainties characterising most of the valuation methodologies currently available. While research is proceeding steadily to reduce such uncertainties, and other research projects (e.g. UNITE, the EXTERNE sequels, etc.) will undoubtedly allow to enhance the intrinsic credibility of valuation methodologies (particularly for what concerns external costs), it is essential that the current level of uncertainty be at least assessed and documented, so as to provide a credibility frame to the cost estimations produced at this time.

This should be carried out through extended sensitivity analyses, and subsequent statistical elaborations.

Concerning external costs, uncertainties arise from three sources:

- a) the scale of the production unit (emissions from vehicles, accident rates)
- b) the model of the physical impact (on a population's health and damage to crops for instance)
- c) the final translation into monetary terms (the value attached to better health for instance).

The final figure that is used to estimate external costs (measured in terms of €/vehicle km) is the product of these three individual components, and therefore the uncertainty surrounding this final impact value contains all the uncertainties of the individual components.

RECORDIT has established a reference data set of internal and external costs, based on the information collected on three trans-European corridors. This represents a valuable starting point for a detailed assessment of intermodal costs at the European level, but it is by no means sufficient in the perspective a full-fledged generalisation such as envisaged in the framework of European policy setting. The variability analyses carried out by RECORDIT show that individual cost items can vary considerably from one corridor to another (at times by orders of magnitude). While this might partially reflect the methodological uncertainties highlighted above, it is widely agreed that these variations are mainly mirroring the actual difference in real costs, due e.g. to varying technological inputs, management and regulatory practices, etc., as well as (for external costs) to varying geographical, meteorological, land-use contexts, varying patterns of electricity production mixes, etc.

This calls for a wider data collection campaign, in the form of additional bottom-up corridor studies, to enhance the current database and increase the meaningfulness of the variability analyses, as basic prerequisites for more reliable transferability and generalisation exercises.

A particular case in point refers to subsidy data. The RECORDIT case studies have shown how difficult it is to identify and document the wide and ill-defined range of subsidies currently characterising the freight market. While the overall value of subsidies awarded to large sections of the transport market are at times available, it is very seldom that such values can be allocated to the movement of goods on specific corridors in a reliable manner. Also, it appears that a variety of "hidden", or indirect subsidies are currently in place, which it is extremely difficult to pinpoint and evaluate. A dedicated effort in this area would certainly contribute to fill this important knowledge gap, and lend increased reliability to specific conclusions such as e.g. on the extent to which the current system of taxes and charges covers external costs.

## **Integrating intermodal transport in the design of pricing reforms**

RECORDIT has developed a dedicated tool (the RECORDIT DSS), which allows to simulate the impacts of policy packages on costs and price formation. Accordingly, a number of policy packages, geared to the objectives and strategies outlined in the CTP, have been analysed in terms of their potential impact on costs, prices and the increase of intermodal market shares. As for the latter, demand impacts have been grossly estimated through the application of average elasticity coefficients, while it appears that only the integration (or linkage) of the RECORDIT framework to more traditional transport models could allow the simulation of the full chain of impacts from policy formulation to overall demand shifts, and subsequently to the corresponding changes in network utilisation, bottlenecks reduction etc.

Also, the on-going formulation of the transport pricing reform does not happen in a vacuum. A wide range of policies, actions, regulations, and business strategies are already in place to increase the attractiveness of intermodal transport, some originating many years ago, other more recent, both at the European and at the national level. Such policies are producing, and will produce in the future a variety of impacts on the costs and prices of freight transport services, on the availability of infrastructure, on the relative competitiveness of alternative modes. Prior to formulating further measures and actions the expected impacts of current policies should be assessed. The RECORDIT DSS can be seen as a basic building block to carry out such assessments, but a detailed and systematic investigation into the cost-relevant characteristics of current policies should be carried out to ensure that the baseline scenario could be established in the most comprehensive and credible manner.

RECORDIT has carried out a limited number of simulations in order to assess the main impacts of selected, possible measures and policy packages (e.g. a 50% reduction of electricity consumption in rail, an increased level of interoperability of rail networks, a rationalisation of load factors in road haulage). The quantitative results obtained provide useful, though fairly gross insights on the potential effectiveness and efficiency of such measures, and represent only a first, limited sample of possible policy packages targeting a switch of freight transport from (currently prevailing) road to alternative, less road-intensive solutions. A systematic review, formulation and assessment of a wider range of policy packages would allow one to considerably improve and refine the policy formulation process, through the comparative, quantitative analysis of alternatives.

## **Improving collaboration and information exchange among market players**

Pricing reforms can only produce the expected results if information is available to all market players with a reasonable level of completeness and symmetry. The current institutional and market organisation fails to guarantee the necessary level of data availability and transparency, in the intermodal sector even more than for other modes of transport. As previously outlined, this is largely inherent to the multiplicity of operators, the partial overlapping of the services they supply, and the strong level of competition resulting thereof. Several actions could however be envisaged to overcome what turns out to be a major obstacle to the implementation of an effective pricing reform:

- ⇒ owing to the complexity of the intermodal chain, it is more than often impossible to estimate the sheer volume of goods transported between any two locations in Europe. The prevailing transnational nature of intermodal traffic, which used to facilitate the tracking of freight flows as they crossed national borders, now only materialises in a further difficulty, geared to the length of the movement and, as a consequence, to the increased complexity of tracking consignments along corridors that are several thousands kilometres long. Innovative technologies are now available to help fill such basic information gaps: solutions based on EDI and variants thereof, and the future development of GALILEO, should considerably facilitate the establishment and shared use of a comprehensive body of quantitative information.

Implementation and transaction costs remain however high at this time, as analysed by e.g. the INFREDAT project, where a cost/benefit evaluation of alternative hi/medium and low tech solutions for the tracking and tracing of goods was carried out

- ⇒ several market players are currently seeking new roles and exploring new market opportunities associated to the growth of freight transport, as well as the most efficient ways and means to gain profitable market positions therefrom. In the wake of liberalisation of e.g. the rail market, this translates into highly aggressive market behaviours that, in the short term, induce highly protective information handling approaches. RECORDIT has experienced considerable difficulties in bringing some of the major operators to share their insights on the intermodal market. Establishing a public-driven platform for information gathering, and subsequent sharing, could contribute to ease such difficulties, with obvious advantages to all participants in the medium/long term

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