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Variables influencing transport mode choice: a generalized cots approach[1]

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1. Introduction

The decision variables that influence transport mode choice are numerous. From a careful appraisal of the literature review it appears that two main typologies of variables can be identified: costs related to the transport of the goods and other service's attributes that play a crucial role in the selection.
Each of these two categories has been already revised in previous researches and some fundamental findings are reported in this paper as a preliminary base for the development of the present study.

[1] Il presente testo riproduce l'intervento svolto in occasione della XIII Riunione Scientifica Annuale della Società Italiana degli Economisti dei Trasporti ed è presente in una versione ridotta all'interno del volume degli atti del convegno.
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The analysis of the literature review will revise the internal costs variables, or out of pocket money, and the influence of qualitative attributes as decision variables.
The paper will conclude with a review of the external costs and their hypothetical internalization in the calculation of transport cost.

The paper will be organized as follows: a literature review on elements affecting mode choice, the third paragraph will deal with the methodological approach of generalized cost function that will be applied in paragraph four on the selected corridors. Some conclusions and further recommendations for research will terminate the paper.

2. Literature review on elements affecting mode choice

This paragraph presents the main publications that dealt with mode choice in freight transport.
The following literature is representative of the studies that gave a main contribution in the elaboration of the present paper it does not claim to illustrate the whole literature on freight mode choice.
The authors *Cunningham and Kettlewood* (1975), made an analysis of the influence of the supplier's image on buyer behaviour in the British rail industry. The companies of sample were manufacturing companies in Scotland. The outcome of the study showed that the main qualitative variables influencing patronage decisions were the availability of the vehicles, the reliability of the delivery and the ability to load and unload at own convenience.
Gilmour (1976) presented a study conducted in Australia, on the user's preferences on the Melbourne-Sydney services, trying to investigate the factors that were important in the mode choice. Through a cluster analysis the author concluded that direct transportation costs are, among the others, not the most important determinants for freight shippers. More relevant elements are the possibility to control the shipment, the availability of the required equipment and the reliability.
In the study of *Stock and La Londe* (1977) the analysis of companies' preferences has been carried out with 87 companies. In relation to the identification of the importance of several procedures used by the companies in evaluating mode performances, the main outcome

shows that reliability, freight charges, and transit time are the three most important elements.

McGinnis (1979) developed a field study with a sample of 351 shippers in the U.S.A. considering eight topics which were assumed to be relevant in influencing their choice of transport.

The eight variables were the following:

1. Freight rates
2. Speed
3. Reliability
4. Loss and damage
5. Inventories
6. Company policy
7. Shipper market conditions
8. Influence of the shipper's customers.

The respondent had to state the degree of importance on a 5 point scale for 30 statements associated with the eight attributes. Applying a factor analysis McGinnis obtained seven main factors, the three most important of which were the ones related to speed and reliability, freight rates, and loss and damages.

Burg and Daley (1985), made an analysis of the mode selection process and marketing impacts on shippers and carriers within shallow-draft barge transport in U.S.A..

. The results showed that shippers and carriers had different preferences, namely shippers placed more relevance on non-transportation cost factors, and the main element was the satisfaction of the customers, followed by transit time and freight charges.

The study of *Jeffs and Hills* (1990) analyses the determinants that affect the mode choice of shippers belonging to the printing and publishing sector in U.K.. Several attributes were considered and the results of the interviews were analyzed by means of factor analysis. The two main factors determining the mode choice were: "control" containing variables such as reliability, control over dispatches, avoidance of damages, etc., "doublet" which was related to size of the consignment and length of the haul.

A different approach to the topic was carried out by *Murphy et al*. (1991) in their study about the selection of links and nodes in international transportation, in which they interviewed another important group of operators that is the one of freight forwarders.

The main purpose was to investigate which were the important factors for freight forwarders, when selecting carriers. The results showed that their main concerns were about equipment availability, shipment information and the possibility to have loss/damage. Furthermore a factor analysis was performed resulting into two factors: the first more related to the transport itself, the second to the shipment.

The work of *Abshire and Premeaux* (1991) provides an analysis of the different perception of shippers and carriers in motor carrier selection. The most important criteria that shippers considered relevant were: the reliability of the service, the additional services that the carrier could provide them, the carrier financial stability, etc. The results of the study showed that carriers do not have the same perception that shippers put on specific criteria.

In the study of *Evers et al*. (1996) the authors try to capture the impact that shippers perceptions of individual transport service characteristics have on the shippers' general perception of transport modes. The applying factor analysis to the results of the interviews lead to six main factors: timeliness, availability, suitability, firm contact, restitution and cost.

Whit those factors three regression models were performed; where the dependent variable being the shipper's overall perception of transport modes. The final results of the regression model showed that out of those six criteria the most important for the shippers are availability and timeliness.

The application of content analysis developed by *Cullinane and Toy* (2000) takes into consideration 75 papers dealing with route/mode choice literature, mostly for Western production. This typology of analysis, developed in various forms, led the authors to report on the most often considered factor categories in freight route/mode choice literature, to rank those attributes. The first five categories, in order, are: cost/price/rate, speed, transit time, characteristics of the goods and service.

The list of the criteria considered in the literature taken into consideration is based on 19 criteria and out of them six are considered relevant in most of the papers.

The ranking, elaborated according to the relevance that was expressed in the papers, is showing the following:

1. Reliability and transit time
2. Freight rate and loss/damage
3. Customer services
4. Loading availability
5. Frequency, flexibility and track and trace.

The outcome of the review presented relatively homogeneous results. Some of the criteria had the same ranking, e.g. reliability and transit time that are the most important elements considered in the whole literature examined.

3. Methodological approach with generalized cost function

In transport economics, a method for capturing all the relevant components affecting transport performances is the use of the generalized cost concept. The sum of monetary variables and non-monetary variables merge into the concept of generalized cost.

This notion is not unknown to the transport economic theory; it is commonly applied and constitutes the methodological base of numerous studies and researches. The concept of generalized cost is one of the main and accepted concepts in transport economics. It belongs to transport economics theory and more precisely to the analysis of price and cost formation.

In the text of Button (2010), the generalized cost of a trip is "expressed as a single, usually monetary, measure combining, generally in linear form, most of the important but disparate costs, which form the overall opportunity costs of a trip". According to the author, the shippers are concerned with the financial costs of the trip but also with the speed, the reliability and the timetabling of the service.

With the utilization of different variables, the need to equal the diverse unit measures arises, the reason is that it will not be possible to measure their impact without translating them into monetary units. All costs items are reduced in a single index that in most cases is a monetary index used for the calculation of the final generalized cost.

According to Button, generalized cost can be defined as:

Generalized Cost Function (1)

$$G = g\,(C_1, C_2, C_3, \ldots C_n)$$

Where: G = generalized cost function
C_1, = out of pocket costs
$C_2, C_3, \ldots C_n$ = qualitative attributes.

Another definition of generalized cost can be found in the book of Marchese (2001), where the author states that the concept of generalized costs can be summarized as "the sum of the transport price/cost and the value of time for the trip". The transport cost and the monetary value of time are homogeneous and addable elements.
Considering the above-mentioned contributions, the definitions of generalized costs in the present text is the following:
Generalized costs are the sum of monetary costs (elements) and non-monetary costs (elements) of a journey.
The expression of the generalized costs is in a monetary unit and comes out of monetary costs and non-monetary attributes of the trip.
The monetary part of the cost function can be represented by the costs for: fuel, labour, insurance, deprecation, maintenance, etc.
The non-monetary part can be considered as a sum of qualitative attributes that are not immediately valuable with a monetary index, but play an important role in the perception and selection of a transport mode. In freight transport, those elements can be the value of time in relation to the urgency of the delivery, the reliability of a safe and on time journey, the impact on environment, etc.
A simple form for expressing a generalized costs function is the following:

Generalized Costs Function (2)

$$G = c + u\,(m_1, m_2, , m_3, \ldots m_n,)$$

Where: G = generalized costs function
c = monetary costs or out of pocket costs
$u\,(m_1, m_2, , m_3, \ldots m_n,)$ = non-monetary costs, function of several attributes

The methodology applied is based on the analysis of the monetary part of a transport service, passengers or freight complemented with the investigation and monetization of qualitative attributes.
From the literature review it can be argued that the generalized costs approach is a well-established methodology for capturing all the cost components that characterize a service, namely a transport service.
In this paper an analysis of the out of pocket and external cost will be presented and some considerations on the qualitative attributes will be developed.

4. Applications to European corridors

This paragraph will consider the monetary part or out of pocket costs related to intermodal transport and a comparison with the uni-modal solutions, the calculation of external costs will be also applied.
In order to do so, some case studies will be analysed, taking in consideration various freight corridors in Europe.
This paragraph will be structured as follow: in the first part, a description for each monetary cost item and pollutant for mode will be presented; the second paragraph will deal with the application of the cost functions to the detailed corridors.

4.1 *Description of costs items for mode of transport*

As it is easy to understand, costs figures are sensitive data that companies are reluctant to provide and academic sources are scarce or out of date. The data collection was a long and difficult process that was constituted by different phases:

- Data collection from existing sources;
- Face to face interviews with transport operators;
- Validation of the figures collected trough a comparison of the two above mentioned sources.

Out of the previous data collection, the major costs items were chosen and some cost figures were established.
The cost items considered are the following with speciations for each mode of transport: personnel and social security, energy and other

consumption material, insurance, repair and maintenance, tyres, rail track, overhead costs, depreciation and interest, leasing/rent, shunting operations, other costs, push locomotive cost, taxes and charges, loading/unloading activities.
The corridors considered are the listed below:

- Antwerp-Basel
- Antwerp-Frankfurt
- Antwerp-Strasbourg
- Genoa-Basel
- Genoa-Frankfurt
- Genoa-Strasbourg.

The specifications about distances and travel's hours are added in the annex.

Once having identified the cost items, the freight corridors and having performed the calculations for obtaining the out of pocket costs, the next step was the internalization of external costs on the same corridors.
The method's selection for the external costs internalization is rather complex, the difficulty is due to the large variety of methodologies and approaches already undertaken in previous researches.
For the purpose of the present paper a neutral and mindful method was sought, this would allow the application to each mode of transport on a European scale.
In this respect the best suitable methodology that could be followed is the one proposed in the Handbook on estimation of external costs in the transport sector- IMPACT published in 2008 by the European Commission.
In the report it is clearly stated that the its aim is: "…*to provide a comprehensive overview of approaches for estimation and internalization of external costs and to recommend a set of methods and default values for estimating external costs when conceiving and implementing transport pricing policy and schemes...*".
The Handbook's contribute is essential in order to use the same methodology and values once it will be decide to implement an internalization of external costs in the whole Europe. The values

presented can be considered a reference point and an official reference for the implementation of such measures of internalization.

Following this approach the pollutants considered for the internalization are: congestion, accidents, air pollution, noise pollution and climate change, up-down stream, nature and landscape, soil and water pollution.
The calculations will be performed for freight transport, with the following specifications:

- Road Transport: Heavy duty vehicles, driving on motorways during days and nights, Euro Class 4;
- Rail Transport: Electric trains driving days and nights;
- IWW Transport: Dry barges with a capacity between 1000 and 1500 tons.

The specifications above presented are particularly suitable for the specific corridors analyzed in the paper nonetheless a wide range of cost figures is presented in the Handbook and can be used according to specific criteria.
The calculation's implementation will be performed using excel application with the required information that are the following:

- Total external cost per mode of transport,
- distance in km,
- loading capacity,
- load factor,
- total amount of cargo that need to be moved,
- number of vehicles will be needed.

The final output will consist of:

- total external cost per the entire cargo,
- cost per ton/km, €/tkm,
- cost per ton, €/t.

The image below is showing how the excel tool looks like.

Fig. 1: Internalization of external cost tool

Mode	€/v km	distance in km	# Vehicles for 1000 ton, according to average vehicle capacity	V km	Average capacity one V	Total external costs 1 €	External cost per €/t km	External cost per average vehicle €/t
IWW	2,99	890	1	890	1500	2661,1	0,0019	1,774
Rail	1,21	718	2	1436	1000	1737,56	0,0012	0,868
Road	0,5675	609	40	24360	25	13824,3	0,0227	13,824

Source: Own elaboration based on Handbook of external costs

For each corridor a calculation has been implemented for obtaining the monetary costs that each client would have to pay in case an enforcement of European laws will take place.
For each transport corridor, the external costs will be presented and the total costs will be obtained based on the sum of out of pocket costs and external costs.
The external costs results have been obtained based on the external costs tool developed ad hoc for this purpose.

The description will start from the Port Antwerp's hinterland corridors and will continue with ones of the Port of Genoa. The calculations have been done for each mode of transport on the corridor and for different loading degrees, 100%, 50% and 80%. Once obtained the external cost, it has been sum with the out of pocket cost and the final result has been compared with the previous situation without internalization of external costs. This last part could allow comparing the possible shift in mode preference in case all the modes of transport will be interested by the introduction of such a policy measure.
For each corridor the specifications about distances will be maintained, for the exercise sake the loading quantity of 1000 tons will be assumed.

4.1.1 Antwerp-Basel Corridor

In the corridor Antwerp-Basel the out of pocket costs calculations showed that the preferred mode of transport could be rail and the most expensive inland navigation. When applying the calculation of

external costs, the situation is slightly different; while rail remains the cheapest solution for all the loading degrees scenarios, the most expensive mode becomes road transport.
The reason can easily be read in the table, the external costs that 40 trucks produce on the road is almost 14.000,00 €, and even doubled if the loading degree drops to 50%. The uni-modal modes, rail and inland navigation, are cheaper as well as the intermodal solutions.
In this case an internalization of external costs could influence the selection of transport mode in favour of rail, inland navigation or intermodal transport.

Tab. 1: External costs for the Antwerp-Basel Corridor

Antwerp-Basel							
Mode	**Out of pocket cost (AVE)**	**E.C per L.D. 100%**	**Sum**	**E.C per L.D. 50%**	**Sum**	**E.C per L.D. 80%**	**Sum**
Rail	20.221	1.737	21.958	3.475	23.696	2.171	22.392
Road-Rail	22.378	2.548	24.92	5.097	27.476	3.596	25.974
IWW	24.792	1.774	26.566	3.548	28.341	2.217	27.010
Road	26.188	13.824	40.013	27.648	53.837	17.280	43.469
Road-Iww	29.147	3.449	32.597	6.899	36.046	6.218	35.365

Source: own elaborations

The figure below is clearly showing the comparison among modes on the 100% L.D: scenario.

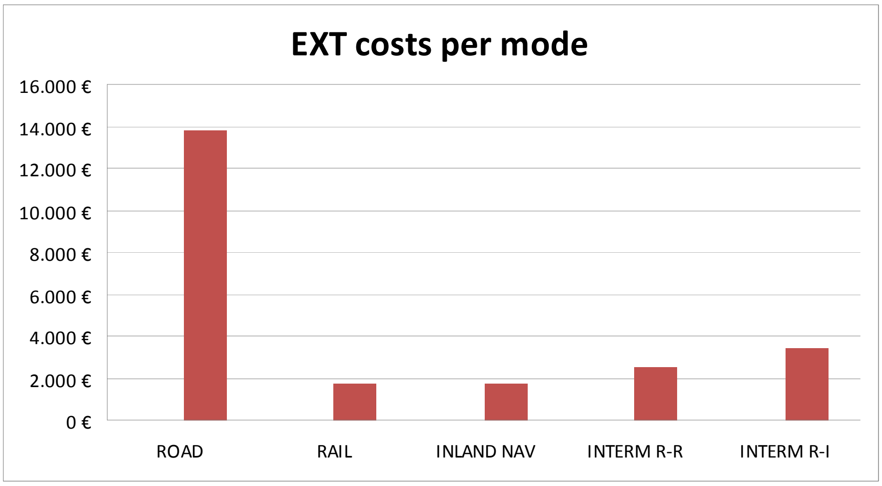

Fig. 2: External costs per mode for the Antwerp-Basel Corridor (100% L.D.)
Source: own elaborations

4.1.2 Antwerp-Frankfurt Corridor

The second corridor considered, Antwerp-Frankfurt, the shortest one from Antwerp, resembles the same situation than before. In fact the most expansive mode of transport was intermodal Road-Iww, after internalizing the external costs, this solution becomes cheaper than road only. In the scenario with a loading degree of 100%, that it is not the most frequent case, the total cost would be 26.000,00 €, in the worst case with 50% of loading degree up to 35.000,00 €.
The detailed description of out of pocket costs, external costs and total ones is summarized in table 2.

Tab. 2: External costs for the Antwerp-Frankfurt Corridor

Antwerp-Frankfurt							
Mode	Out of pocket cost (AVE)	L.D. 100%	Sum	L.D. 50%	Sum	L.D. 80%	Sum

Rail	12.289	968	13.257	1.936	14.225	1.210	13.499
Road-Rail	12.945	1.779	14.725	3.558	16.504	2.441	15.387
Road	16.892	9.125	26.018	18.250	35.143	11.406	28.299
IWW	20.199	1.196	21.395	2.392	22.591	1.495	21.694
Road-Iww	22.074	2.582	24.656	5.164	27.238	4.483	26.557

Source: own elaborations

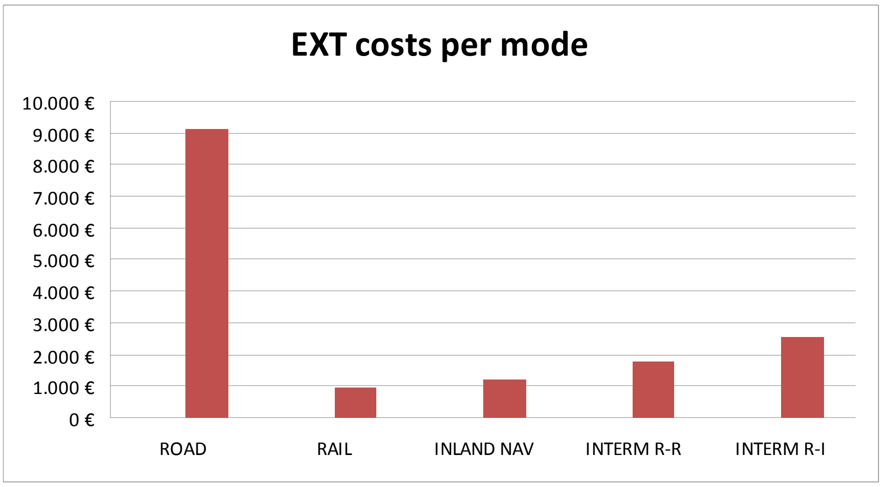

Fig. 3: External costs per mode for the Antwerp- Frankfurt Corridor (100% L.D.)

Source: own elaborations

4.1.3 Antwerp-Strasbourg Corridor

In the case of Antwerp-Strasbourg, the lesson that could be learned from the outcome of the calculations on internal costs was already indicating that the best solution, money wise, could be provided by rail transport and the most expensive by road transport.
Considering that road transport is the most polluting one, compared to the other two mode of transport, the outcome of the internalization of external costs is not surprising.
In the scenario with full loading degree, the additional external costs were respectively: 1.400,00 for rail, 1.544,00 for inland navigation

and 10.700,00 for road transport. It is plain that the total costs will follow this order confirming that the best solution will be provided by rail transport.
What reported for 100% loading degree is valid also for the other two scenarios, being notably higher for 50% loading degree.

Tab. 3: External costs for the Antwerp-Strasbourg Corridor

Antwerp-Strasbourg							
Mode	**Out of pocket cost (AVE)**	**L.D. 100%**	**Sum**	**L.D. 50%**	**Sum**	**L.D. 80%**	**Sum**
Rail	17.033	1.403	18.436	2.807	19.840	1.754	18.787
Road-Rail	17.689	2.214	19.904	4.429	22.119	3.095	20.785
IWW	20.603	1.544	22.148	3.089	23.693	1.931	22.534
Road-Iww	21.211	3.105	24.316	6.211	27.422	5.530	26.741
Road	22.477	10.714	33.191	21.428	43.906	13.393	35.870

Source: own elaborations

It appears clear from figure 4 that road transport is considerably above the other mode of transport, while the difference among the others is present but without such a big proportion.

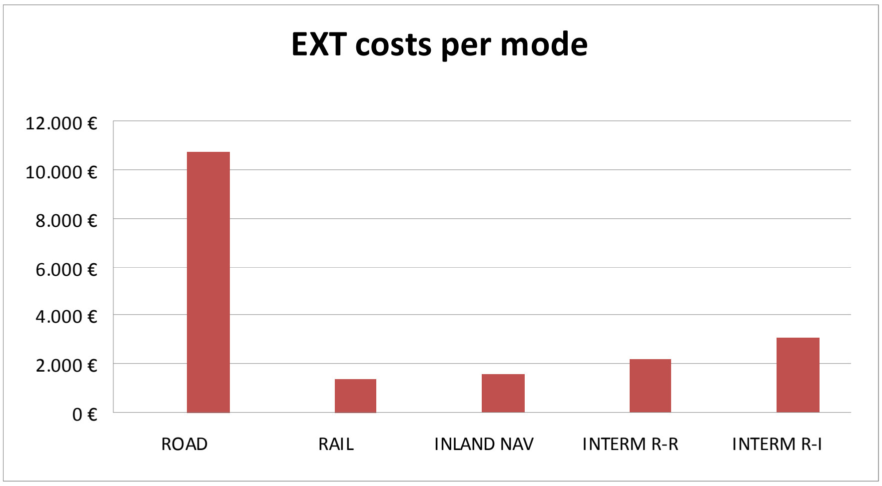

Fig. 4: External costs per mode for the Antwerp- Strasbourg Corridor (100% L.D.)

Source: own elaborations

4.1.4 Genoa-Basel Corridor

In the case of the corridors from Genoa, the modal possibilities are reduced to the uni-modal solutions: road and rail, and the intermodal road-rail combination. The first one to be considered is the corridor Genoa-Basel, where it possible to observe that the preference was given to rail transport and the most expensive mode was road transport. The internalization of external costs confirms the current status. The amount of money that would be paid to move 1000 tons by trucks will be almost 11.000,00 €, while the external costs produced by rail are a bit more than 1/10 of external road costs; this would be the situation in case the transports means will be completely loaded. The costs produced will be clearly higher is case of not complete capacity utilization.

Tab. 4: External costs for the Genoa-Basel Corridor

Genoa-Basel

Mode	Out of pocket cost (AVE)	L.D. 100%	Sum	L.D. 50%	Sum	L.D. 80%	Sum
Rail	17.111	1.103	18.214	2.207	19.318	1.379	18.490
Road-Rail	19.425	1.958	21.384	3.916	23.342	2.710	22.136
Road	21.367	10.759	32.127	21.519	42.887	13.449	34.817

Source: own elaborations

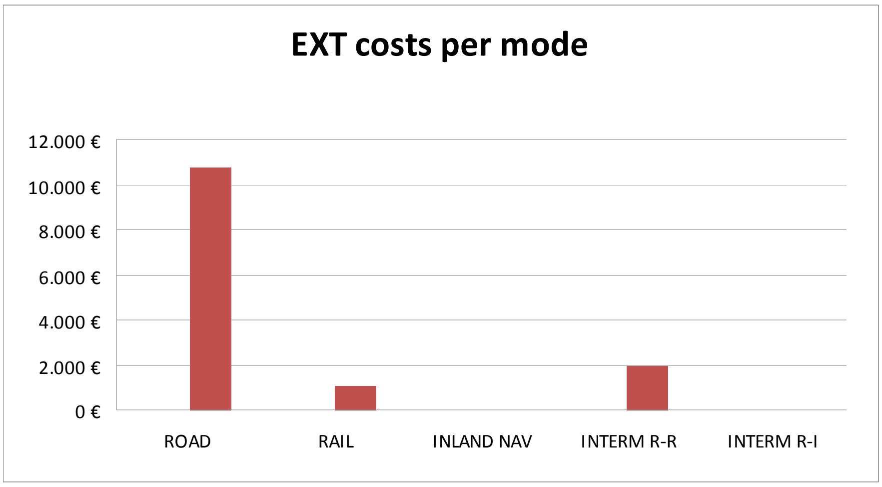

Fig. 5: External costs per mode for the Genoa- Basel Corridor (100% L.D.)

Source: own elaborations

4.1.5 Genoa-Frankfurt Corridor

The second corridor, Genoa-Frankfurt represents the corridor with highest external costs from the Genoese side, although the general considerations are valid also for this corridor.
Even with the addition of external costs, the cheapest mode is rail transport, followed by intermodal solution with a relatively small difference, around 1.500,00 to 3.000,00 €.

Tab. 5: External costs for the Genoa-Frankfurt Corridor

Genoa-Frankfurt							
Mode	**Out of pocket cost (AVE)**	**L.D. 100%**	**Sum**	**L.D. 50%**	**Sum**	**L.D. 80%**	**Sum**
Rail	26.038	1.882	27.920	3.813	29.851	2.353	28.391
Road-Rail	26.664	2.723	29.387	5.446	32.110	3.857	30.522
Road	35.280	18.160	53.440	36.320	71.600	22.700	57.980

Source: own elaborations

Intermodal road-rail transport is slightly above rail only transport, but definitely lower that road external cost.

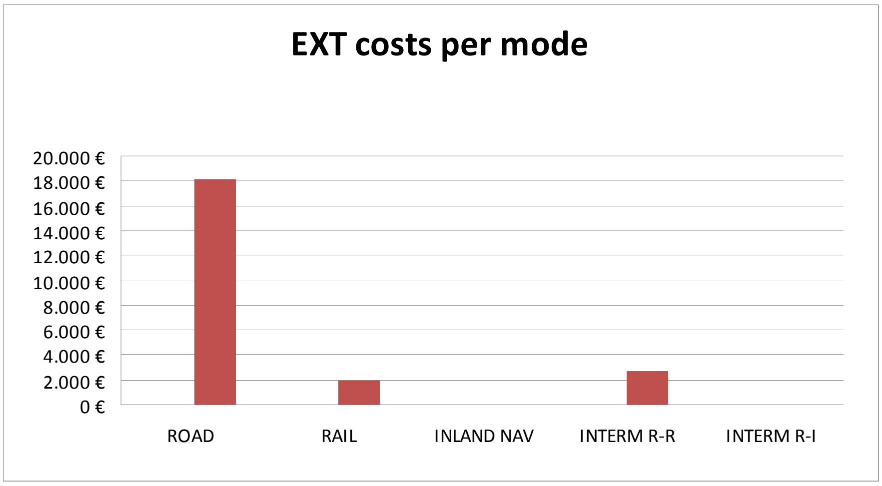

Fig. 6: External costs per mode for the Genoa- Frankfurt Corridor (100% L.D.)

Source: own elaborations

4.1.6 Genoa-Strasbourg Corridor

The last corridor is the one from Genoa to Strasbourg were the most convenient mode of transport is rail transport. This situation is verified in both cases, with or without internalization of external costs. The amount of external costs produced by road transport is ranging from 13.892,00 to 27.784,00 respectively in case of 100% and 50% loading degree.

Tab. 6: External costs for the Genoa-Strasbourg Corridor

Genoa-Strasbourg							
Mode	Out of pocket cost (AVE)	L.D. 100%	Sum	L.D. 50%	Sum	L.D. 80%	Sum
Rail	20.157	1.403	21.560	2.807	22.964	1.754	21.911
Road-Rail	20.989	2.214	23.204	4.429	25.419	3.095	24.085
Road	27.071	13.892	40.964	27.784	54.856	17.365	44.437

Source: own elaborations

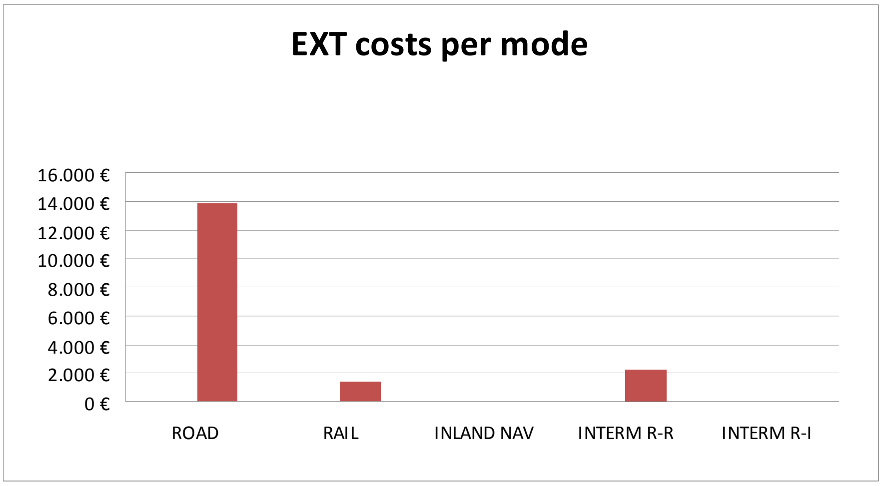

Fig. 7: External costs per mode for the Genoa- Strasbourg Corridor (100% L.D.)

Source: own elaborations

From the analysis above reported, some general conclusions can be presented.
The calculations brought to the clear results that road transport is the one producing more externalities, in all the cases. In case there will be an application of these calculations, therefore the internalization of external costs and the total costs will be considered, road transport will be the one with major penalizations.
On the contrary rail transport and inland navigation appear to be less pollutant and the external costs are affecting less on the total costs.

The outcome of these calculations is perfectly in line with the European policies that are headed for a re-balance of modal shift, also with the support of such measure.
An interesting comparison is the one between corridors reaching the same destination, but leaving form the two ports, e.g. Antwerp-Basel and Genoa-Basel.
In this first case, the external costs calculation shows that the external costs are higher in the Antwerp-Basel corridor than on the Genoese one, these considerations are applicable to all the modes. The only non-present modes are inland navigation and intermodal road- inland navigation on the Mediterranean side.
Completely opposite is the situation for the two corridors to Frankfurt, where it seems more convenient to use the Port of Antwerp instead of Genoa, since the difference in external costs are rather different. It is shown that from Genoa to Frankfurt the rail external costs are almost doubled compared to Antwerp-Frankfurt. The same occurs for road transport and intermodal transport.
The last case, to Strasbourg, is particularly interesting since the external costs for rail transport and intermodal transport are the same from both origins, while for road transport is more convenient to choose the route from Antwerp.

Those considerations are rather interesting, nonetheless the internalization of external costs is not jet a compulsory measure. The calculations above can however give a good indication of the possible consequences of such intervention.

Another remarkable consideration is about the actual modal split on those corridors and the comparison with their out of pocket costs.
From Grosso (2010) and other official sources, namely port Authority web sites, a general indication of the modal split is inferable. The sources show that the main part of the traffic that reaches those destinations is moved by road transport and a limited part by rail or, in the case of Antwerp, by inland navigation.
If the only element affecting shippers and freight forwards was the out of pocket cost, they would have chosen for an intermodal solution using either rail or inland navigation combinations.
From the literature review is confirmed that monetary costs are not the only ones influencing mode choices, therefore the current modal split on these corridors is influenced by qualitative attributes, such as the transit time, the reliability, the frequency etc.

5. Final results and recommendations

This paper took into considerations some elements that affect mode choice with particular focus on some European corridors.
An initial literature review on elements affecting mode choice was the base for the paper's development. In the third paragraph a methodology has been presented which is based on generalized cost approach.
A calculation of out of pocket costs has been produced and the additional inclusion of external costs has been considered for each mode of transport.
Some general considerations on the actual monetary cost for each mode of transport, on each corridor, came out of the analysis and additional remarks were outlined based on the consequence of the external cost internalization.

What is clear is the impact that external costs could have in the choice ranking of the clients. When looking at the current situation, in most cases, road transport is the most expensive mode, but the situation is worsened when adding external costs. In this hypothetical situation the advantage that rail, inland navigation and intermodal solutions could gain is significant.

An important aspect is represented by the qualitative attributes and their influence on mode choice. From the current modal split it is clear that they play a major role.

To further investigate on this topic, a proposal for deeper studies would be the application of investigation techniques, such as revealed or stated preferences in order to capture the monetary value of qualitative attributes.
An additional suggestion would be a deep analysis of technical and administrative aspects that can compromise a reliable and attractive intermodal service on those corridors.

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Annex

The distances and timing per Antwerp-Basel are:

- Road transport: 609 km, 7 hours;
- Rail transport: 718 km, 15 hours;
- Inland navigation: 890 km, 105 hours;
- Intermodal transport road + rail: 678 km by rail and 40 km by road, 14 hours by rail, 1 hour by road;
- Intermodal transport road + inland navigation: 850 km by inland navigation, 40 km by road, 104 hours by inland navigation and 1 hour by road.

The distances and timing per Antwerp-Frankfurt are:

- Road transport: 402 km, 6 hours;
- Rail transport: 400 km, 9 hours;
- Inland navigation: 600 km, 84 hours;
- Intermodal transport road + rail: 360 km by rail and 40 km by road, 7 hours by rail, 1 hour by road;
- Intermodal transport road + inland navigation: 560 km by inland navigation, 40 km by road, 83 hours by inland navigation and 1 hour by road.

The distances and timing per Antwerp-Strasbourg are:

- Road transport: 472 km, 7 hours;
- Rail transport: 580 km, 13 hours;
- Inland navigation: 775 km, 80 hours;
- Intermodal transport road + rail: 540 km by rail and 40 km by road, 11 hours by rail, 1 hour by road;
- Intermodal transport road + inland navigation: 735 km by inland navigation, 40 km by road, 79 hours by inland navigation and 1 hour by road.

The distances and timing per Genoa-Basel are:

- Road transport: 474 km, 7 hours;
- Rail transport: 456 km, 11 hours;
- Intermodal transport road + rail: 434 km by rail and 40 km by road, 9 hours by rail, 1 hour by road.

The distances and timing per Genoa- Frankfurt are:

- Road transport: 800 km, 12 hours;
- Rail transport: 788 km, 18 hours;
- Intermodal transport road + rail: 750 km by rail and 40 km by road, 16 hours by rail, 1 hour by road.

- The distances and timing per Genoa- Strasbourg are:
- Road transport: 612 km, 9 hours;
- Rail transport: 580 km, 13 hours;
- Intermodal transport road + rail: 540 km by rail and 40 km by road, 11 hours by rail, 1 hour by road.