Discussion Paper No. 10-010

Entry and Competition in Freight Transport: The Case of a Prospective Transalpine Rail Link Between France and Italy

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Das Wichtigste in Kürze

Schon lange stellen die Alpen europäische Transportplaner vor große Herausforderungen. Dieses Nadelöhr zu überkommen ist nur über umständliche Alpenpässe möglich, oder durch Strassen- und Eisenbahntunnels, die teuer zu betreiben und nur anhand sehr grosser Investitionen zu bauen sind. Von besonderer Relevanz ist hierbei die Sensibilität des Alpenraums und die damit einhergehenden hohen externen Kosten für die Alpenländer und ihre Bewohner. Im Mittelpunkt vieler Diskussionen steht seit geraumer Zeit die Förderung des Wechsels des Gütertransitverkehrs von der Strasse auf die Schiene. Eine politische Maßnahme hierfür ist die Schaffung neuer Transportalternativen im Schienenverkehr.

In diesem Papier untersuchen wir die zu erwartenden Auswirkungen des Neubaus eines transalpinen Eisenbahntunnels zwischen Lyon und Turin auf i) die Marktanteile der existierenden und der neuen Alpendurchquerungen und ii) die Konsumentenrente, das heißt die monetäre Nutzenveränderung für Unternehmen, die ihre Güter über die Alpen schicken. Das geplante Infrastrukturprojekt besteht aus einem 53km langen Eisenbahntunnel, der eine neue Transportmöglichkeit über die Alpen eröffnen und dabei die Strasse entlasten soll. Wir kalibrieren ein partielles Gleichgewichtsmodell, in dem versendende Unternehmen einen Transportmodus und eine Strecke wählen, um ihre Güter von einem Ausgangs- zu einem Zielpunkt zu transportieren. Spediteure setzen strategisch die Preise für ihre jeweiligen differenzierten Transportdienstleistungen. Wir leiten das Marktgleichgewicht her und simulieren anhand dessen den Eintritt eines Produktes von höherer Qualität und testen seine Wettbewerbsfähigkeit. Wir zeigen, dass die zukünftige Strecke auf regionalen Distanzen (zum Beispiel Lyon - Turin: 315km) wettbewerbsfähig und wohlfahrtssteigernd ist, auf längeren Distanzen im Nord-Süd-Korridor (zum Beispiel Paris - Mailand: 850km) seine Wettbewerbsvorteile verliert und im West-Ost-Korridor (zum Beispiel Madrid - Mailand: 1575km) zum Wechsel von der Strasse auf die Schiene führt.

Basierend auf den Ergebnissen dieser Studie ist der Neubau einer qualitativ hochwertigen Transportinfrastruktur nur eine Maßnahme aus vielen möglichen, um einen globalen Wechsel von der Strasse auf die Schiene zu erreichen. Für den französisch-italienischen Alpenkorridor könnten direktere und entschiedenere Maßnahmen – wie zum Beispiel die Schwerverkehrsabgabe in der Schweiz, die direkt in Investitionen für Schienenverkehrsträger fliesst – einen fruchtbareren Weg zur Erreichung des politischen Ziels eines verstärkten Wechsels von der Schiene auf die Strasse darstellen.

Non-technical summary

The Alps have long posed challenges to European transport infrastructure planners. Overcoming this immense bottleneck is only possible via arduous travels across high-altitude Alpine passes or through road and rail tunnels that require large efforts to be built and are expensive to maintain. We analyze the expected effects of building a transalpine rail tunnel between Lyon and Turin on i) the market shares of the established and the new suppliers, and ii) consumer surplus. The prospective project consists of a 53km rail tunnel providing freight shippers with a new alpine path. We calibrate an equilibrium model where freight shippers choose a mode and alpine path to ship goods from a given origin to a given destination. Freight carriers strategically set prices for the differentiated products they supply. Deriving the market equilibrium, we simulate the entry of a quality-improved product and test its competitive viability. The prospective alpine path proves both competitive and welfare-enhancing on the regional market, loses its competitive edge on the wider North-South market, and leads to a modal shift on the West-East market.

We find limited substitutability between freight transport products on a North-South transit axis. On the Ile-de-France-Lombardia market, the shippers' decision remains largely based on the mode choice. The new high-quality rail alternative attracts new demand but does not succeed in lowering road demand. When we shorten this axis to the regional market between Lyon and Turin, both a modal shift and an increase in demand for shipping occur, securing *exactly the same* variations in OG market share and in consumer surplus. In contrast to the North-South axis, the West-East transit market appears a better candidate for modal-shift. Between Spain and Lombardia, the new rail link appears attractive enough for shippers to switch modes. Global traffic does not increase after the introduction of the new link, suggesting higher volatility of shippers' preferences across products on this transit axis. Should European rail integration be fostered, the new transalpine link between Lyon and Turin could play a complementary part among other urgent projects. In this respect, it would be of interest to compare the respective impacts on the West-East transit axis of the Lyon-Turin Transalpine and the Perpignan-Figueras Transpyrenees between France and Spain.

Based on the analysis, the construction of a new high quality infrastructure may only be one tool out of a global modal shift-oriented policy toolbox. For the French-Italian Alpine corridor, more direct and committed intervention based on a variety of policy measures as observed in Switzerland may open a more fruitful path to the political goal of increasing modal shift towards rail.

Entry and competition in freight transport: The case of a prospective transalpine rail link between France and Italy*

Delphine Prady† Hannes Ullrich‡

Abstract

We analyze the expected effects of building a rail tunnel between Lyon and Turin on i) the market shares of the established and the new suppliers, and ii) consumer surplus. The prospective project consists of a 53km rail tunnel providing freight shippers with a new alpine path. We calibrate an equilibrium model where freight shippers choose a mode and alpine path to ship goods from a given origin to a given destination. Freight carriers strategically set prices for the differentiated products they supply. Deriving the market equilibrium, we simulate the entry of a quality-improved product and test its competitive viability. The prospective alpine path proves both competitive and welfare-enhancing on the regional market, loses its competitive edge on the wider North-South market, and leads to a modal shift on the West-East market. We argue that the new infrastructure is only one tool out of a global modal shift-oriented policy toolbox.

Keywords: Transalpine freight, New rail infrastructure, Simulation model, Competition
JEL Classification: R41, L92, H54, L13, C63

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1 Introduction

The Alps have long posed challenges to European transport infrastructure planners. Overcoming this immense bottleneck is only possible via arduous travels across high-altitude Alpine passes or through road and rail tunnels that require large efforts to be built and are expensive to maintain. A comparable infrastructure project outside of the Alps has been the Channel Tunnel, for example, connecting France and the United Kingdom via rail. Kay et al. (1989) predicted the social and private profitability of the Channel Tunnel project. In this paper, we analyze partial economic returns of public investment in a specific and much debated trans-Alpine rail infrastructure. To do so, we adopt a simple equilibrium model approach and compute the changes in direct infrastructure users' surplus. This approach can and should ultimately be integrated into a more elaborate cost-benefit analysis.[1]

More precisely, we analyze the competitiveness of freight transport supply by rail and road carriers on the Lyon-Turin corridor. We perform an equilibrium analysis in the context of a discrete choice model (see Anderson et al. (1992) or McFadden (1981)) which allows to analyze the demand and competitive supply of differentiated products. We predict the reactions of all competitors given strategies and consumer behavior when facing a new product. In our case, the new product is the prospective high speed rail link between Lyon and Turin, "La Liaison Ferroviaire Lyon-Turin".[2]

We simulate the entry of this new transalpine link on three different markets: regional transport between Lyon and Turin, transit between Spain and Lombardia, and transit between Ile-de-France-Nord and Lombardia. As an alternative policy measure we simulate a deliberate change in some alternatives' cost structure, that is the introduction of a higher road tunnel fee combined with a hypothetical reduction of rail costs.

We find limited substitutability between freight transport products – hereafter defined as a "mode+alpine path" bundle – on the North-South transit axis where the shippers' decision remains largely mode-driven. The new high-quality rail alternative does attract new demand but does not succeed in lowering road-demand. On the regional market between Lyon and Turin, both a modal shift and an increase in demand for shipping occur. The West-East transit market appears the best candidate for modal-shift as, between Spain and the region of Lombardia, the new rail link appears attrac-

[1] De Jong et al. (2005) present a survey on welfare evaluation in the discrete choice random utility framework.

[2] The gains in speed for freight trains are mainly driven by highly reduced slopes, namely down to 12% from currently 30%, in the prospective base tunnel. Detailed information is available on the web sites http://www.ltf-sas.com and http://www.transalpine.com/

tive enough for shippers to switch modes. Should European rail integration be fostered, the new transalpine link between Lyon and Turin could play a complementary part among other urgent projects.

Moreover, based on our analysis, the construction of a new high quality infrastructure may only be one tool out of a global modal shift-oriented policy toolbox. For the French Alpine corridor, more direct and committed intervention based on a variety of policy measures as observed in Switzerland may open a more fruitful path to the political goal of increasing modal shift towards rail.

The paper is organized as follows. In section 2 we describe our demand-and-supply model. We present our data set in section A and provide our empirical analysis and simulation results in section 3. Section 4 concludes.

2 Modeling Lyon-Turin Freight Transport

Our goal is to evaluate the prospective changes in social welfare of a rail infrastructure project. In our setting, based on Ivaldi and Vibes (2008), consumers, hereafter called *shippers*,[3] choose a transport mode, that is rail or road, and an alpine path to carry their goods between two specific regions. Suppliers, hereafter called *freight carriers*,[4] are assumed to compete in prices. We then derive the market equilibrium and provide results of counterfactual experiments.

As a first remark, we concentrate on non-combined[5] transport modes in the present analysis. Indeed, we have learned from several phone interviews with freight logistic firms[6] that such a mode is of little importance for most of their shipping activity. To a large extent, that is a peculiarity to the French transport sector in which, historically, the road has been the dominant mode of freight transport. Note also that freight services are not homogenous goods but consist of a widely diversified set of goods with specific haulage requirements and logistic needs. This heterogeneity is to some extent accounted for by equilibrium prices set according to commodity characteristics (such as freshness or hazardousness) which make one choice alternative more attractive than another. Given that we have information on broad commodity classes and aggregate price data only, we conduct our analysis based on

[3] "Consumers" can also be seen as logistic intermediaries acting on behalf of goods producers.

[4] For example, SNCF and Trenitalia for the Lyon-Turin rail project.

[5] Combined modes can be both accompanied and unaccompanied transport, where the former corresponds to piggyback transport and the latter to intermodal container transports. Piggyback transport is non-existent in our sample.

[6] GEODIS Calberson GE, GEFCO Network, among others.

these aggregate data. Our model is, in this respect, stylized and simplified but would lend to a more detailed analysis if more disaggregate data were available. However, in practice, transaction price data on transport services are particularly hard to obtain on a broad basis and we thus believe that using aggregate data provides valuable insights nonetheless.

Furthermore, as a spatial concern, one needs to distinguish between transit and regional freight transport. Transit and short-distance freight carriers exhibit different company characteristics. For example, long-haul transit freight carriers are rather firms with more than 50 employees, short- and mid-haul freight carriers are rather smaller firms.[7] Accounting for distance-differentiated markets enables us to better characterize competition between products. Indeed, it is unclear whether inter-modal competition is fiercer on long or short distance freight transport markets. Hence, we consider three types of markets targeted by suppliers that can be subsumed into two broader market categories, transit and regional transport. "Transit North-South" (freight traffic between Ile-de-France-Nord[8] and Lombardia) and "Transit East-West" between Spain and Lombardia were chosen based on their important relative shares of French-Italian transalpine passages. We define as short-distance transport freight traffic between the area of Lyon and the area of Turin. Freight traffic on these three markets amounts to 12.6% of total alpine freight traffic reported during the studied period. While this may appear a low figure, the traffic scale should not affect competition between the different alpine products. Rather than traffic volume, geographic coverage matters in products' competitiveness. Figure 1 illustrates these three markets.

2.1 Demand side

Assume a shipper takes a two-step decision:

- first, she decides which mode she wants to carry her commodity with;
- second, she chooses an alpine path.[9]

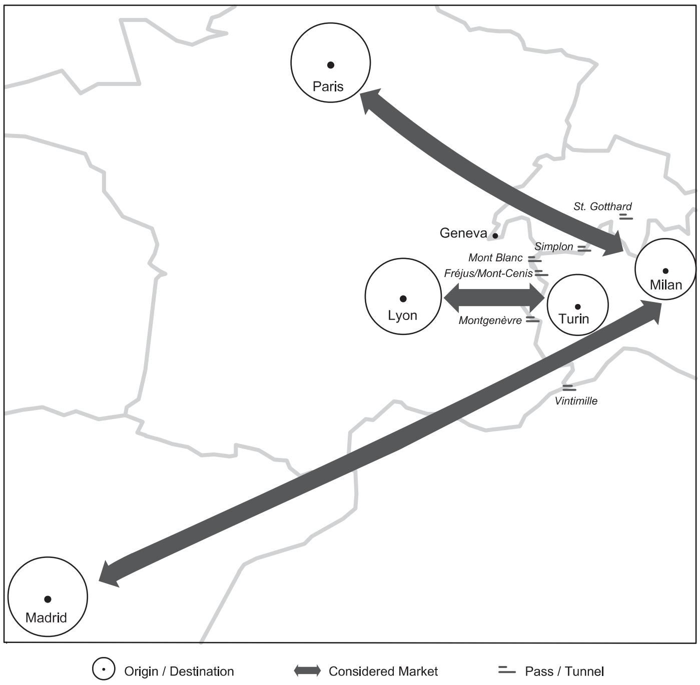
This second step is not farfetched. A shipper has an *a priori* ranking of paths. This idiosyncratic ranking is first based on the shipped good's specificities and, subsequently, on alpine paths' characteristics. Indeed, different

[7] London Economics (2003)

[8] Ile-de-France-Nord defines the metropolitan area of Paris and neighboring regions but excludes the Benelux countries.

[9] The available alpine path are: Mont Blanc, Fréjus, Vintimille, Montgenèvre, or Mont-Cenis.

Figure 1: Schematic illustration of three considered markets



paths exhibit different technical characteristics, as detailed below. An alternative is thus a combination of a transport mode and a path to cross the Alps. Product differentiation is mainly due to geographical and regulatory aspects.[10] We assume that shippers have in mind these qualitative differences of available products when sending their goods on a given origin-destination journey (hereafter O–D). In addition to the competing differentiated mode-path combinations, we assume the existence of an outside good, OG. This OG accounts for shippers that are interested in transporting their goods across the Alps by rail or road, yet currently do not. It represents a potential niche our suppliers can target, thereby inducing further traffic. This is important to bear in mind, since total consumer welfare would increase with additional induced traffic.

We classify J alternatives into G groups, where $g = 0, 1, 2$. Group 0 corresponds to the OG, 1 and 2 correspond to rail and road, respectively. Shipper i's utility associated with alternative j is:

$$U_{ij} = V_j + \epsilon_{ij} \tag{1}$$

where:

- V_j is the mean utility level common to all shippers,
- ϵ_{ij} corresponds to the departure of shipper i from the common utility level (also called random part, that is shipper i's unknown idiosyncratic taste for product j).

The random component leading to a nested logit demand model can be further decomposed as follows:

$$\epsilon_{ij} = \sigma\, \nu_{ig} + (1 - \sigma)\, \nu_{ij} \tag{2}$$

with σ being the degree of correlation between alternatives j belonging to the same group g. A high σ implies shippers give a higher weight to the group than to the alternative itself when they pick one. Competition is then fiercer between modes than between alpine paths. To be consistent with the random utility maximization concept, the parameter σ must lie between 0 and 1. In the extreme case of symmetric competition where the assumption of Independence of Irrelevant Alternatives (IIA)[11] holds between all alternatives, σ equals 0 and the model reduces to the simple logit specification. In the other extreme of segmentation, where preferences for alternatives are

[10]Specific haulage requirements, logistic needs, and conveyed goods.
[11]See McFadden (1981)

perfectly correlated within nests but independent between nests, σ is equal to 1.

Random components ν_{ig}, ν_{ij}, and consequently ϵ_{ij} are standard extreme value distributed.
We assume the mean utility level to be:

$$V_j = \Psi_j - h\, p_j \tag{3}$$

where:

- Ψ_j is the aggregate measure of quality of product j
- h represents the sensitivity of utility to price, that is the marginal utility of cost saving for the shipper.

We then compute the aggregate measure of quality as the weighted sum of the alternatives' characteristics:

$$\Psi_j = \alpha_1\, punctuality_j + \alpha_2\, alt_j + \alpha_3\, traveltime_j + \alpha_4\, maxcapa_j \tag{4}$$

where:

- $punctuality_j$ = ratio of highway kilometers over total road kilometers and actual published punctuality figures[12] for road and rail, respectively; expected positive sign for α_1.
- alt_j = altitude, in meters, of path j; expected negative sign for α_2.
- $traveltime_j$; expected negative sign for α_3.
- $maxcapa_j$ = maximum capacity per unit of transportation; expected positive sign for α_4.

We attach specific values to these variables, respective to each product. Some values deserve further explanation.
Variable $traveltime_j$ includes compulsory drivers' breaks. Every 4 hours and half, a truck driver has to rest for 45 minutes; after 9 hours of driving, a truck driver has to stop and rest for 10 hours.
Variable $punctuality_j$ codes for the probability for a freight carrier to meet his travel time target. This is a reliability measure. Even though obviously correlated, variables $punctuality_j$ and $traveltime_j$ do not exactly capture the same path features.

[12] See SBB Cargo's Annual Report (2004, page 18) and at SNCF: http://fret.sncf.com/fr/quisnous/actu/2007/presse/do070618.pdf

Variable $maxcapa_j$ indicates the maximum tonnage one unit load can carry. This takes into account the fact that there is a more strict heavy goods weight constraint on using road transport as compared to rail. Finally, variable alt_j mainly codes for changing conditions of mountainous weather.

We assume these four speed and reliability measures to be the most relevant for shippers in order to assess quality of available products. Shipper i chooses the utility-maximizing alternative j, satisfying:

$$U_{ij} \geq U_{ik} \quad \forall \quad k \neq j \tag{5}$$

Normalizing the mean utility of the outside good to zero, we compute the probability of choosing alternative j from the probability of choosing group g and the probability of choosing alternative j conditional on choosing group g. We apply the methodology proposed by Berry (1994) and widely used in the estimation of differentiated products demand.[13] This methodology builds upon the assumption that observed aggregate market shares are valid approximations of choice probabilities. It allows us to derive the mean utility levels as follows:

$$\ln s_j - \ln s_0 = \Psi_j - h\, p_j + \sigma \, \ln s_{j/g} \tag{6}$$

with s_j and $s_{j/g}$ respectively being the total market share and the group market share of alternative j.
Finally, the own price elasticity of demand of the alternative j is:

$$\mu_j = h\, p_j \left[s_j - \frac{1}{1-\sigma} + \frac{\sigma}{1-\sigma}\, s_{j/g} \right] \quad \forall \quad j \in g \tag{7}$$

2.2 Supply side

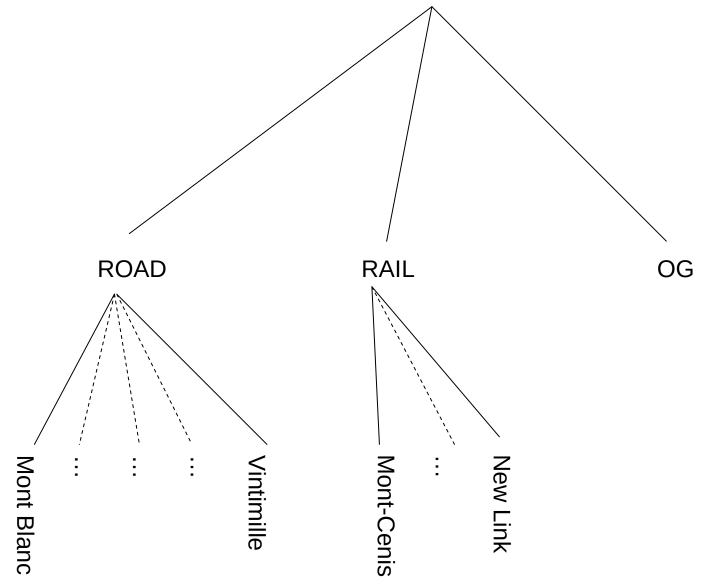
We focus on the competitive aspect of cross-alpine freight transport. Competing freight carriers offer shippers a differentiated product combining a transport mode with a specific alpine tunnel or pass – Mont Blanc, Fréjus, Montgenèvre, Vintimille, Mont-Cenis or Gotthard (see figure 2).[14]

In 2004, the 'Autoroute Ferroviaire Alpine', a joint venture between SNCF and TRENITALIA providing a rail shuttle service for lorries and semi-trailers through the Fréjus tunnel, has been experimented and its related traffic reported in our data. However, the generated traffic was so low and the restrictions so numerous that we do not consider this alternative relevant for our

[13] See, for example, Ackerberg et al. (2007) and Ortúzar (2001).

[14] We consider the Gotthard passage only on the transit market between Ile-de-France-Nord and Lombardia.

Figure 2: Basic discrete choice model



The shares of the Swiss paths Gotthard-road and Gotthard-rail are high enough (respectively 5.9 % and 2.0 % of their group market) for these two products to be considered as relevant competitive alternatives on the Transit North-South market.

analysis. It remains to be seen if this mode of transport will prove successful in the long run.

We assume that each differentiated product is offered by one firm only. This simplifies reality to a large extent. In particular, the road freight industry is quite atomistic. In the aggregate, 77.6% of road freight carriers employed 0 to 5 people and 2.3% of all transport companies had more than 50 employees in France in 2000. In terms of revenue, freight carriers with less than 50 employees accounted for 59.4% of the industry's total revenue.[15] Given this structure of road supply, competition is likely to be fierce among road carriers. Therefore, we would intuitively think the latter to be price-takers rather than makers. Notwithstanding, we argue that demand is rather captive on each geographical market. This justifies to some extent the strategic role of road carriers as price-makers. In what follows, we assume that road carriers have some power to set prices above marginal cost.[16]

In equilibrium, cross-alpine freight carriers set transport prices in order

[15]EUROSTAF (2003), page 4.

[16]Ivaldi (2007) maintains this assumption analogously.

to maximize their profits, knowing their competitors do the same:

$$Max \quad \Pi_j = (p_j - c_j)\; q_j - K \tag{8}$$

with fixed costs K.

The outcome is defined by the set of J necessary first order conditions, from Ivaldi and Verboven (2005):

$$p_j = c_j + \frac{1-\sigma}{h\,\left(1 - \sigma\, s_{j/g} - (1-\sigma)\, s_j\right)} \tag{9}$$

The price of a product j is therefore the sum of its marginal cost, c_j, and a mark-up term.

3 Empirical Analysis and Results

Shippers' and freight carriers' actions depend on their sensitivities to changes in the alternatives' characteristics. We want to measure the impact the prospective rail link between Lyon and Turin will have on the equilibrium market shares, prices and consumer surplus. Before rushing into the simulation analysis, we need to derive the equilibrium features of our three markets, where shippers can choose only from current available alternatives. Our data, reported in Appendix A, prevents straight statistical estimation of the model. Therefore, we need to calibrate the model, that is to find the equilibrium values of the demand parameters, h and σ, as well as the quality parameters in Equation 4. We can then define the equilibrium outcome and simulate likely changes following the new link's introduction. All numerical computations were done using *Matlab*.

3.1 Model Calibration

Following the procedure by Ivaldi and Vibes (2008), we first derive the demand parameters h and σ. To do so, we linearize Equation 7 defining price elasticities. We do not have data on elasticities but we do have data on market shares, prices, and, contrary to Ivaldi and Vibes (2008), marginal costs. We repeatedly draw 1000 vectors of elasticities, based on the normal distribution function, with a standard deviation of 4. We set the mean of this distribution to be equal to the commodity-specific values presented in Oum et al. (1990), weighted by the commodity shares transported on each link. We then obtain values of h and σ to each draw of 1000 elasticity vectors using ordinary least squares estimation. These values allow us to derive a

Table 1: Equilibrium outcomes

		Short-distance			Transit North-South			Transit East-West		
Share of outside alternative in %		15	30	45	15	30	45	15	30	45
Road Market Shares in %	Mont-Blanc	7.0	5.8	4.5	34.5	28.5	22.4	-	-	-
	Fréjus	57.4	47.2	37.2	34.6	28.5	22.4	0.8	0.6	0.5
	Montgenèvre	1.3	1.1	0.9	0.4	0.3	0.3	0.04	0.03	0.02
	Vintimille	0.5	0.4	0.3	0.8	0.6	0.5	83.76	68.97	54.18
	Gotthard	-	-	-	5.0	4.1	3.2	-	-	-
Rail Market Shares in %	Mont-Cenis	18.8	15.5	12.2	8.0	6.6	5.2	0.2	0.2	0.1
	Vintimille	-	-	-	-	-	-	0.2	0.2	0.2
	Gotthard	-	-	-	1.7	1.4	1.1	-	-	-
Marginal utility of cost saving (Parameter h)		0.006	0.005	0.005	0.001	0.001	0.001	0.002	0.002	0.001
Degree of within-group correlation (Parameter σ)		0.40	0.44	0.52	0.62	0.62	0.63	0.56	0.56	0.62
Own-Price Elasticities (Road)	Mont-Blanc	-4.27	-4.11	-4.19	-1.81	-1.85	-1.89	-	-	-
	Fréjus	-1.48	-1.63	-1.73	-1.87	-1.92	-1.96	-6.93	-6.93	-6.78
	Montgenèvre	-3.70	-3.54	-3.61	-3.25	-3.21	-3.2	-6.93	-6.93	-6.78
	Vintimille	-5.86	-5.60	-5.71	-4.34	-4.28	-4.22	-0.53	-0.98	-1.20
	Gotthard	-	-	-	-2.99	-2.96	-2.93	-	-	-
Own-Price Elasticities (Rail)	Mont-Cenis	-1.63	-1.53	-1.38	-1.23	-1.22	-1.21	-3.57	-3.58	-3.36
	Vintimille	-	-	-	-	-	-	-3.47	-3.48	-3.25
	Gotthard	-	-	-	-2.37	-2.34	-2.31	-	-	-
Consumer Surplus		296	160	43.8	1556	780	190	1092	528	150

marginal cost vector from Equation 9 for each of these draws. We finally keep the h and σ values, as well as the associated vector of elasticities μ_j, which correspond to the closest match of predicted marginal costs with our vector of observed marginal costs. We use these results to solve the system of equations defining first the quality parameters Ψ_j, second the quality components described in Section 2.1 and Appendix A.1, and third their coefficients in Equation 4. We thus solve a system of five linear equations and four unkowns, and derive consumers' valuations of each quality variable. We present the results on elasticity and parameter values in Table 1. Note that the elasticity values are calibrated to our very specific markets and thus cannot be easily interpreted outside of these markets nor be directly compared to estimates in the literature that stem from different markets or are aggregate averages.

Small values of h underline the intuitive fact that individuals have a larger marginal utility of income than a firm's marginal utility of saving costs. On both transit markets, h is even lower. Indeed, as pointed out in section 2, long-distance freight shippers are rather large companies while short- and medium-distance freight shippers tend to be relatively small companies. Intuitively, it makes sense that the latter care more about cost savings.

The high value of σ shows low substitutability between the nests of differentiated products in the alpine freight transport market. The **mode choice** remains the main component of the shippers' decision.

In terms of market shares, only the transit market between Spain and Lombardia exhibits a true dominant alternative: Vintimille (road). This remains true whatever the OG market share. This demand rigidity is also reflected in the price-elasticities ranking on this specific market since the lowest price-elasticity is associated with the Vintimille (road) alternative. More generally, the model endogenously implies that small market shares go along with high absolute values of elasticities. Therefore market shares' rankings on our three markets directly translate into elasticities' rankings, in absolute values. We present values of the quality indices and the weights of the quality indices' components in Table 2. All coefficients have the expected signs.

As we do not know the exact market configuration, we allow the OG share to vary between 15 and 45% of the total freight transport market. Alpine traffic forecasts could help to determine the situation we are in. However, these forecasts differ across scenarios and do not appear reliable. Indeed, most of them are suspected to largely overestimate freight alpine traffic by the years 2020 and 2030.[17] In what follows we focus on the "$OG = 15\%$" case for our equilibrium and simulation analysis. Qualitatively, the results carry over to the two scenarios with larger OG market shares.

[17] ECMT Report (2001)

Table 2: Quality Indices and quality component weights for all alternatives

		Short-distance			Transit North-South			Transit East-West		
Share of outside alternative in %		15	30	45	15	30	45	15	30	45
Quality Index – Road	Mont-Blanc	2.93	1.84	1.05	2.50	1.58	0.91	-	-	-
	Fréjus	4.27	3.10	2.12	2.54	1.62	0.95	2.74	1.86	1.01
	Montgenèvre	1.39	0.42	-0.17	0.87	-0.03	-0.68	1.38	0.49	-0.17
	Vintimille	2.03	0.97	0.32	1.53	0.62	-0.05	4.73	3.87	2.73
	Gotthard	-	-	-	1.79	0.88	0.22	-	-	-
Quality Index – Rail	Mont-Cenis	2.24	1.15	0.27	0.51	-0.40	-1.08	-1.71	-2.59	-3.54
	Vintimille	-	-	-	-	-	-	-1.68	-2.55	-3.51
	Gotthard	-	-	-	-0.09	-1.00	-1.66	-	-	-
Quality Index – New Transalpine Rail Link		3.38	2.44	1.47	1.35	0.51	0.12	1.79	1.06	-0.41
Quality component coefficients	Altitude	-0.0004	-0.0006	-0.0007	-0.0001	-0.0001	-0.0002	0	0	0
	Travel time	-0.17	-0.18	-0.16	-0.24	-0.25	-0.26	-0.71	-0.74	-0.64
	Punctuality	5.49	4.59	3.68	8.28	7.72	7.25	31.31	31.78	27.23
	Max capacity	0.0076	0.0070	0.0008	0.0102	0.0086	0.0069	0.1423	0.1506	0.1089

3.2 Simulations and Results

We can now simulate the entry of the new rail link using its quality characteristics and the demand parameters from the calibrated model. Appendix D elaborates this procedure in more detail.

3.2.1 Results in the short-distance market between Lyon and Turin

Table 12 (see Appendix B) shows the results, for different initial market shares of the outside alternative, in point-to-point transport between Lyon and Turin.[18]

A global overview of our first simulation result underlines three important effects of the new link provision in the regional market. First, the two rail alternatives manage to capture more than 37% of the total inter-regional traffic, the new transalpine link taking most of it (27%). Second, the two incumbent Fréjus products (road and rail) lose the most after the introduction of the new link. Third, consumer surplus increases by almost 6%.

The rail mode plays a very important part and appears fairly competitive on the inter-regional market between Lyon and Turin. Facing the biggest loss in terms of market shares, the representative supplier of the Fréjus road product nevertheless increases its prices by 13.5%. Its historical competitors tend to align their prices around an average of 365 euros.

Going into detail, we see that prices do not vary homogenously. The two main road alternatives, Fréjus and Mont-Blanc, increase their prices by similar amounts: 13.5% and 12.6% respectively. By contrast, the two "outsider" road products, Montgenèvre and Vintimille, cut their prices by quite large amounts: 37.6% and 33.6% respectively.

The rather captive Fréjus demand[19] and its high quality index relative to the other alternatives explain most of the price reaction to the new rail product. Indeed, these two features allow the Fréjus road supplier to compensate its loss in market share - mostly to the benefit of the new rail alternative - by a price increase. The less competitive Montgenèvre road and Vintimille road providers benefit from the weaker market position of the Fréjus road alternative. They even compete more fiercely[20] to gain market shares at the expense of the Fréjus road supplier. Therefore, road carriers' reactions to

[18]The new alternative is assumed to have the same marginal cost as the historical *Mont-Cenis* alternative served by SNCF since we do not have expected cost data for the new alternative. In principle, implementing a variation in cost would be straightforward.

[19]See the own price elasticity $\mu_{Frejus} = -1.48$.

[20]There are no tunnel fees for these passages. Hence, substantially lower marginal costs allow significant price drops.

the entry of the new "Liaison Ferroviaire Lyon-Turin" depend on their relative historic market power. Historic dominant providers are very sensitive to the induced inter-modal competition and consecutively alter their pricing behavior to compensate their loss in market shares. Historic "outsiders" take advantage of their competitors' weaker posture and toughen their pricing strategies in order to get "a bigger piece of the bigger cake".

The substantial increase in the rail market share is partly due to the increase of global market size.[21] However, most of it results from a modal shift in favor of the new rail alternative. Undoubtedly, the strong market position of the new link comes at the expense of the historical rail alternative Mont-Cenis. The latter, however, manages to keep a reasonable share of total regional traffic, thanks to its price competitiveness relative to the two main road products. As for the new link, its high quality index as well as its competitive price make it a viable competitor of the two main road alternatives on the regional market. Note, however, that we are looking at a very specific short-distance market. We thus have to be cautious when comparing the change in market shares to ones in more geographically aggregate settings.

As a concluding remark, the introduction of a high quality alternative and the decrease in the OG's market share induce an improvement of consumer surplus. However, this consumer gain remains of rather low magnitude.

3.2.2 Results in the transit market between Ile-de-France and Lombardia

Table 13 (see Appendix B) shows the results for freight journeys between the Ile-de-France and Lombardia regions.

Three salient facts summarize behaviors on this North-South freight transit market. First, intra-modal competition within both nests is fierce. Second, the new rail alternative captures 11.2% of the total market, quasi as much as the Gotthard (11.4%) which ranks third among road products. Third, consumer surplus increases by 6%.

As in the regional market, the entry of a higher quality rail product induces "predatory" behavior among outsiders, namely Montgenèvre, Vintimille and Gotthard road path providers, within the road nest. The latter engage in large price-cuts – -37%, -43.5%, -30.5% respectively – in order to increase their market share – by 200%, 450% and 128% respectively – and take the best out of weakened dominant Fréjus and Mont-Blanc road suppliers. However, contrast with the regional market, the new alternative does

[21] See the OG share decrease of 8%.

not trigger noticeable modal shift. It succeeds in attracting new shippers in the market – 8% decrease in the OG share – but globally fails in capturing demand from road alternatives. Its higher quality makes it the best rail alternative despite a price even higher - 1231 euros against 1121 and 1097 euros - than the ones of its two major road competitors, Mont-Blanc and Fréjus. Nevertheless, the new link does not appear to be competitive relative to road supply. In this respect the "Liaison Ferroviaire Lyon-Turin" alone cannot be the relevant modal shift device its proponents claim it to be. At least not on the North-South transit freight market. Therefore, only a more global transport policy scheme taking into account the strategic behavior in both supply and demand may achieve a substantial shift in transport modes.

Albeit of absolute importance, induced variations in prices and market shares do not alter the historic relative ranking of the different alpine products.

3.2.3 Results in the transit market between Spain and Lombardia

In the transit market between Spain and Italy shippers use the rail path in Vintimille. In Table 14 (see Appendix B) we see that the new rail link does not significantly impact global demand for shipping between Spain and Lombardia. Indeed, the decrease in the OG market share only amounts to 0.5% and consumer surplus does not change at all. Therefore, we conjecture that the new alternative's 7% market share corresponds to a genuine modal shift on this transit market. Indeed, the new link erodes road alternatives' market edge of 6,5%. Add to this the 0.5% decrease in the outside good share, it almost amounts to the total rail alternatives' share.

Far more striking, however, is the gain of the Fréjus road alternative which succeeds in elevating its market share by 12.8 percentage points due to strong price competition. In this market, the latter alternative takes the outsider role benefitting most from competitive price-setting on the dominant Vintimille alternative given its extremely captive demand.

3.2.4 Results from a change in the cost structure in the transit market between Ile-de-France and Lombardia

Table 15 (see Appendix B) shows results of a change in the cost structure in freight journeys between the Ile-de-France region and Lombardia. We simulate a twofold increase of tunnel fees at the Mont-Blanc and Fréjus road tunnels and a simultaneous reduction of marginal costs of rail transport by one half. We interpret this as a political measure of cross-subsidizing from road to rail transport. The change in the cost structure can achieve a modal shift comparable to that induced by the introduction of an entirely new infrastructure.

Comparing Tables 13 and 15 reveals a comparable reduction of the main french passages' market shares by raising their tunnel fees. An important part of this reduction is absorbed by the Gotthard road alternative tripling its market share due to its cost advantage. Modal shift from road to rail is not as strong - 11.1% rail share as opposed to 15.0% when introducing the new alternative - and only present towards the Gotthard rail passage. While the introduction of a new rail alternative induces new traffic, the fact of higher road costs and lower rail costs increases the share of the outside good. Given the absence of a new high-quality alternative, this political measure therefore reduces total traffic as well as consumer surplus. The relevant question is then whether the difference in consumer gains/losses over-compensates the costs of building a new infrastructure. At the very least, this simulation exercise illustrates that creating new infrastructure may not be an exclusive solution but that there exist various alternative policy measures leading to a comparable end.

4 Conclusion

The model used in this paper allows to derive demand and supply equilibrium behavior in a market with product differentiation. We apply this model to the alpine freight transport market with differentiated "mode & alpine path" products in order to test the competitive viability of the prospective "Liaison Ferroviaire Lyon-Turin" project.

As a first structural result we find limited substitutability between freight transport products on a North-South transit axis, despite their heterogeneity beyond the mere modal split. Indeed, on our Ile-de-France-Lombardia market, the shippers' decision remains largely based on the mode choice. The new high-quality rail alternative attracts new demand but does not succeed in lowering road demand. When we shorten this axis to the regional market between Lyon and Turin, both a modal shift and an increase in demand for shipping occur, securing *exactly the same* variations in OG market share and in consumer surplus. Therefore, the global impact of the new link on the North-South transit market seems merely local. The demand rigidity for road raises a methodological problem: mean utility specification demands a profound knowledge of shippers' choice criteria.[22] Micro-level data – collected during face-to-face interviews for instance – would be of great help in

[22]Time and monetary costs certainly remain the most important.

this respect. Precise criteria relevant for modal shift could be revealed this way and appropriate policy measures undertaken.

In contrast with the North-South analysis, the West-East transit market appears a better candidate for modal-shift. Between Spain and Lombardia indeed, the new rail link appears attractive enough for shippers to switch modes. Note that global traffic does not increase after the introduction of the new link, suggesting higher volatility of shippers' preferences on this transit axis. Should European rail integration be fostered, the new transalpine link between Lyon and Turin could play a complementary part among other urgent projects. In this respect, it would be of interest to compare respective impacts on the West-East transit axis of the Lyon-Turin Transalpine and the Perpignan-Figueras Transpyrenees.[23]

From a modeling viewpoint, improving the approximation of product flexibility – so far captured by variable *"Punctuality"* in our mean utility specification – should receive particular attention in future studies on the subject. As a matter of fact we believe the most obvious drawback of rail freight transport is its *exclusivity*: choosing rail in Lyon excludes changing modes until Turin. A delay forecast after the train departure cannot yet find remedy in a switch to a more flexible transport mode. In this respect intermodality seems to be the key component of a competitive rail product. So far, however, inter-modal freight transport has not had the success needed for a significant modal shift. In the French Alps, the "Rolling Highway" has been inexistent until 2005 when it accounted for 0.7% of total French Alpine freight tonnage. The corresponding value for Switzerland in 2005 was 5.2%. While on the rise in Switzerland, unaccompanied combined freight tonnage has been falling in the French Alps from 8.6% in 2000 to 5.9% in 2005, and this even while observing a decrease in total freight tonnage.[24]

Based on our analysis, the construction of a new high quality infrastructure may only be one tool out of a global modal shift-oriented policy toolbox. For the French Alpine corridor, more direct and committed intervention based on a variety of policy measures as observed in Switzerland may open a more fruitful path to the political goal of increasing modal shift towards rail.

[23] http://www.nouvelletraverseedespyrenees.com/historique.html

[24] Bundesamt für Verkehr (2006)

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A Data

A.1 Supply side

In order to characterize the alternatives and accurately assess freight carriers' costs and posted prices, we conducted several phone interviews and gathered all available (to us) information.

However, we cannot directly observe marginal costs. We collected data on costs and prices of infrastructure use, and on fuel consumption to approximate them. These components are short-run cost variables. That is why we deliberately leave aside personnel costs which correspond to long-run costs. This choice of components seems all the more reasonable that our cost values are very close to the ones computed and published by the Comité National Routier, on an annual basis.[25] We explain our approximations and computations in Appendix C. In what follows we detail posted prices and born marginal costs on each market.

A.1.1 Prices, costs, and characteristics for the short-distance market

Table 3 shows collected prices and computed marginal costs for each passage and mode. Table 4 presents the above-described quality components of the 5 existing alternatives as well as the new transalpine link. Travel times in hours are calculated based on speed, distance and stopping periods.

Table 3: Prices and Marginal Costs for passages from Lyon to Turin per 24t load (in euro)

		MC	Price
Road	Mont-Blanc	365	475
Road	Fréjus	331	489
Road	Montgenèvre	126	383
Road	Vintimille	290	600
Rail	Mont-Cenis	216	343
Rail	New transalpine link	216	reported after simulation

[25] http://www.cnr.fr/grilles_couts/e-docs/00/00/00/26/document_grille_cout.phtml

Table 4: Characteristics of the different alternatives for freight transport between Lyon and Turin

		Altitude	Punctuality	Travel Time	Capacity
Road	Mont-Blanc	1328	0.87	6	24
Road	Fréjus	1158	0.89	4	24
Road	Montgenèvre	1860	0.52	6	24
Road	Vintimille	9	0.97	21	24
Rail	Mont-Cenis	1158	0.77	11.60	60
Rail	New transalpine link	478	0.80	7.60	60

A.1.2 Prices, costs, and characteristics for the transit market between Ile-de-France-Nord and Lombardia

Table 5 shows prices and marginal costs for each product on the Ile-de-France-Nord-Lombardia transit market. Given their relatively high market shares, we include on this North-South freight market two "Swiss products": Gotthard-rail and Gotthard-road.

Table 5: Prices and Marginal Costs for passages from Ile-de-France-Nord to Lombardia per 24t load (in euro)

		MC	Price
Road	Gotthard	348	1085
Road	Mont-Blanc	553.5	1056
Road	Fréjus	564.5	1093
Road	Montgenèvre	357	1114
Road	Vintimille	479	1493
Rail	Mont-Cenis	518	920
Rail	Gotthard	515	913
Rail	New transalpine link	518	reported after simulation

Table 6: Characteristics of the different alternatives for freight transport between Ile-de-France-Nord and Lombardia

		Altitude	Punctuality	Travel Time	Capacity
Road	Gotthard	1150	0.98	23	24
Road	Mont-Blanc	1328	0.94	23	24
Road	Fréjus	1158	0.96	23	24
Road	Montgenèvre	1860	0.83	25	24
Road	Vintimille	9	0.98	28	24
Rail	Mont-Cenis	1158	0.77	28	60
Rail	Gotthard	1150	0.79	28	60
Rail	New transalpine link	478	0.80	24	60

A.1.3 Prices, costs, and characteristics for the transit market between Spain and Lombardia

For values on the transit market we consider what we call "geographic averages", i.e. we simply use price and cost values for the O-D relationship Madrid - Lombardia (North of Italy). This is admittedly quite a simplification but should nevertheless produce representative results. A much more complex analysis would be needed if all details of intra-European transit were to be fully taken into account. Table 7 shows prices and marginal costs for each passage and mode in Spain-Italy transit.

Table 7: Prices and Marginal Costs for passages from Spain to Lombardia per 24t load (in euro)

		MC	Price
Road	Fréjus	832	1926
Road	Montgeǹ612	586	1910
Road	Vintimille	606	1891
Rail	Mont-Cenis	913	1351
Rail	Vintimille	897	1351
Rail	New transalpine link	913	reported after simulation

Table 8 presents the quality components of the 6 existing alternatives as well as the new transalpine link.

Table 8: Characteristics of the different alternatives for freight transport between Spain and Lombardia

		Altitude	Punctuality	Travel Time	Capacity
Road	Mont-Blanc	1328	0.97	44	24
Road	Fréjus	1158	0.97	43	24
Road	Montgenèvre	1860	0.91	43	24
Road	Vintimille	9	0.99	42.5	24
Rail	Mont-Cenis	1158	0.77	49	60
Rail	Vintimille	9	0.77	48	60
Rail	New transalpine link	478	0.80	45	60

A.2 Demand side

Within our random utility framework and to best assess the benefits from the planned Lyon-Turin new link, individual level data would be needed. This kind of micro-level data can be produced through expensive and time-consuming surveys that are not feasible in the scope of this paper. We therefore choose to use the inversion method proposed by Berry (1994). This methodology requires aggregated data, such as market shares and information on prices, along with some quality variables within the discrete choice framework. Applying this method on the O-D pair Lyon-Turin we follow Ivaldi and Vibes (2008) and look for market shares of passages on this particular link.

For all three markets, we obtain market shares based on tons transported on each alpine passage from the CAFT[26] 2004 database. This database gathers information on freight transport with respect to origin, destination, alpine passage, transport mode, weight, etc. Table 9 illustrates these shares for the inter-regional traffic between Lyon and Turin which accounts for 4.6% of total freight traffic crossing the French-Italian Alpine corridor in 2004.

Table 10 illustrates these shares for the freight transit traffic between regions Ile-de-France-Nord and Lombardia. This traffic amounts to 1.6% of total freight traffic crossing the Western alpine corridor in 2004.

Table 11 presents the passages' shares for transit traffic between Spain and Lombardia. This market accounts for 6.4% of all traffic crossing the French-Italian Alpine corridor in 2004. On this O-D relation, the Vintimille-road

[26] "Cross-Alpine Freight Transport", Collected every 5 years over the entire alpine arch by Austrian, French and Swiss authorities.

Table 9: Short-distance current freight traffic shares of French-Italian passages between Lyon and Turin, 2004

Passage		Market Share
Road	Mont-Blanc	8.2 %
Road	Fréjus	67,5 %
Road	Montgenèvre	1.6 %
Road	Vintimille	0.5 %
Rail	Mont-Cenis	22.2 %

Table 10: Current transit freight traffic shares of French-Italian passages between Ile-de-France-Nord and Lombardia, 2004

Passage		Market Share
Road	Gotthard	5.9%
Road	Mont-Blanc	40.7%
Road	Fréjus	40.8%
Road	Montgenèvre	0.4%
Road	Vintimille	0.9%
Rail	Mont-Cenis	9.3%
Rail	Gotthard	2.0%

product clearly dominates the market. Strikingly enough are the comparable shares of both rail products: Mont-Cenis-rail captures a market share almost as large as the one of its Vintimille-rail group-competing product. Therefore, a new and better performing rail link close to the geographical location of the Mont-Cenis tunnel may be able to capture some market share.

Chosen markets only cover 12.6% of total freight traffic reported in the CAFT 2004 database. One may therefore be tempted to question the relevance of these markets or their ability to capture representative behaviors of consumers. As pointed out before, geographic features of one "product" are crucial to its competitiveness. The new rail link explicitly targets North-South freight traffic and aims at diverting it from other Alpine paths. The *ex ante* traffic size, on this peculiar market, is not relevant for the new rail to prove attractive or not. Moreover, we do account for market size, and its likely extension, via the outside option.

Table 11: Transit freight traffic shares of French-Italian passages between Spain and Lombardia, 2004

Passage		Market Share
Road	Fréjus	0.90 %
Road	Montgenèvre	0.04 %
Road	Vintimille	98.56 %
Rail	Mont-Cenis	0.24 %
Rail	Vintimille	0.26 %

B Simulation results

Table 12: Equilibrium outcomes after introduction of the new transalpine rail link

		Short-distance (Lyon-Turin)					
Initial share of outside alternative in %		15		30		45	
Values (in euro) and Change in %		Value	Δ	Value	Δ	Value	Δ
Road prices	Mont-Blanc	481	+12.6%	486	+2.3%	483	+1.7%
	Fréjus	555	+13.5%	561	+14.7%	556	+13.7%
	Montgenèvre	239	-37.6%	243	-36.5%	241	-37.1%
	Vintimille	398	-33.6%	403	-33.0%	401	-33.2%
Rail prices	Mont-Cenis	343	0.0%	344	+0.3%	339	-1.2%
	New Transalpine Link	434	-	460	-	462	-
Road market shares in %	Mont-Blanc	7.1	-4.0%	5.8	0.0%	4.8	+6.6%
	Fréjus	32.0	-44.6%	26.8	-43.2%	22.4	-40.0%
	Montgenèvre	5.8	+346.0%	4.5	+310.0%	3.8	+322.0%
	Vintimille	3.5	+600.0%	2.7	+575.0%	2.3	+666.0%
Rail market shares in %	Mont-Cenis	10.2	-45.7%	7.5	-51.6%	5.1	-58.2%
	New Transalpine Link	27.6	-	25.1	-	19.6	-
Market share of outside alternative in %		13.8	- 8.0%	27.7	-7.6%	42.1	-6.4%
Consumer surplus		313	+ 6.0%	181	+13.0%	69.6	+60.0%

Table 13: Equilibrium outcomes after introduction of the new transalpine rail link

		Transit North-South (Ile-de-France-Lombardia)					
Initial share of outside alternative in %		15		30		45	
Values (in euro) and Change in %		Value	Δ	Value	Δ	Value	Δ
Road prices	Mont-Blanc	1097	+4.0%	1101	+4.2%	1095	+3.7%
	Fréjus	1121	+2.5%	1125	+3.0%	1118	+2.3%
	Montgenèvre	704	-37.0%	709	-36.3%	713	-36.0%
	Vintimille	843	-43.5%	847	-43.3%	849	-43.1%
	Gotthard	754	-30.5%	757	-30.2%	757	-30.2%
Rail prices	Mont-Cenis	916	-0.4%	916	-0.4%	917	-0.3%
	Gotthard	868	-5.0%	872	-5.5%	876	-4.0%
	New Transalpine Link	1231	-	1269	-	1294	-
Road market shares in %	Mont-Blanc	26.6	-23.0%	22.2	-22.1%	17.9	-20.1%
	Fréjus	27.7	-20.0%	23.1	-19.0%	18.6	-17.0%
	Montgenèvre	1.2	+200.0%	1.0	+233.0%	0.7	+133.0%
	Vintimille	4.4	+450.0%	3.6	+500.0%	2.7	+440.0%
	Gotthard	11.4	+128.0%	9.4	+129.0%	7.3	+128.0%
Rail market shares in %	Mont-Cenis	3.1	-61.2%	2.4	-63.6%	1.8	-65.4%
	Gotthard	0.7	-59.0%	0.6	-57.1%	0.4	-63.6%
	New Transalpine Link	11.2	-	9.9	-	8.2	-
Market share of outside alternative in %		13.7	-8.0%	27.9	-7.0%	42.3	-6.0%
Consumer surplus		1649	+6.0%	876	+12.3%	295	+55.3%

Table 14: Equilibrium outcomes after introduction of the new transalpine rail link

		Transit East-West (Spain-Lombardia)					
Initial share of outside alternative in %		15		30		45	
Values (in euro) and Change in %		Value	Δ	Value	Δ	Value	Δ
Road prices	Fréjus	1165	-39.5%	1159	-40.0%	1158	-40.0%
	Montgenèvre	893	-53.2%	893	-53.2%	898	-53.0%
	Vintimille	1995	+5.5%	1962	+3.7%	1941	+2.6%
Rail prices	Mont-Cenis	1189	-12.0%	1189	-12.0%	1195	-12.7%
	Vintimille	1173	-13.2%	1173	-13.2%	1179	-12.7%
	New Transalpine Link	1601	-	1598	-	1691	-
Road market shares in %	Fréjus	13.6	+1600.0%	10.4	+1633.0%	7.6	+1420.0%
	Montgenèvre	1.6	+3900.0%	1.2	+3900.0%	0.85	+4150.0%
	Vintimille	62.88	-25.0%	53.2	-22.8%	44.65	-17.6%
Rail market shares in %	Mont-Cenis	0.01	-95.0%	0.007	-96.5%	0.005	-95.0%
	Vintimille	0.01	-95.0%	0.008	-96.0%	0.005	-97.5%
	New Transalpine Link	7.0	-	6.4	-	3.02	-
Market share of outside alternative in %		14.92	-0.5%	28.785	-0.4%	43.87	-2.5%
Consumer surplus		1092	0.0%	565	+7.0%	184	+22.6%

Table 15: Equilibrium outcomes after an increase in road tunnel fees and a reduction of rail marginal costs

		Transit North-South (Ile-de-France-Lombardia)					
Initial share of outside alternative in %		15		30		45	
Values (in euro) and Change in %		Value	Δ	Value	Δ	Value	Δ
Road prices	Mont-Blanc	1275	+20.7%	1278	+21.1%	1272	+20.5%
	Fréjus	1297	+18.7%	1300	+19.0%	1294	+18.4%
	Montgenèvre	707	-36.6%	711	-36.2%	715	-35.8%
	Vintimille	853	-42.9%	857	-42.6%	858	-42.5%
	Gotthard	783	-27.8%	785	-27.6%	782	-27.9%
Rail prices	Mont-Cenis	916	-0.4%	925	+0.6%	931	+1.2%
	Gotthard	682	-25.3%	688	-24.7%	693	-24.1%
Road market shares in %	Mont-Blanc	23.9	-31.1%	19.5	-31.6%	15.3	-31.5%
	Fréjus	24.9	-28.1%	20.4	-28.6%	16.0	-28.4%
	Montgenèvre	1.8	+331.8%	1.4	+317.1%	1.0	+296.2%
	Vintimille	6.4	+753.6%	5.1	+719.3%	3.8	+676.7%
	Gotthard	15.7	217.1%	12.6	+209.5%	9.7	+201.3%
Rail market shares in %	Mont-Cenis	7.9	-1.0%	6.3	-3.3%	4.9	-5.5%
	Gotthard	3.2	+92.6%	2.6	+88.2%	2.0	+82.8%
Market share of outside alternative in %		16.2	+8.0%	32.1	+7.0%	47.3	+5.1%
Consumer surplus		1471	-5.5%	690	-11.5%	103	-45.8%

C Costs and price approximations

C.1 Marginal costs - Road

For trucks, marginal costs include costs of infrastructure use, such as road and tunnel fees, and fuel costs. The former are available from infrastructure operators, that is highway and tunnel operators. We take fuel consumption values given by an online route planner.[27] Using the per liter price for truck diesel in June 2004 of 0.87 cents, we compute fuel costs on each passage.

C.2 Prices - Road

Pricing in truck freight is mainly done according to the type of carried goods, weight and distance. These components obviously leave room for price discrimination that we cannot take into account in this study. We use prices generated by a pricing tool used by a typical road freight carrier and obtained via telephone interviews with road freight companies. For more precise results, a more sophisticated - but less tractable - price behavior, for example non-linear pricing, should be adopted.

[27]http://www.autoroutes.fr

C.3 Marginal Costs - Rail

In rail transport, marginal costs are also given by the costs of infrastructure use and fuel consumption. Data on infrastructure charges can be found either at RFF that manages and operates the French rail network, or, at the European level, at the EICIS Portal.[28] Energy consumption of a standard locomotive pulling a standard train of 800 tons[29] is considered here. We also account for the higher energy consumption on tracks that exhibit steeper slopes. As we were not able to extract values on operational costs of freight trains from several interviews with large rail freight companies, we have to use rather hypothetical values here. Again, knowing exact marginal cost values could enhance the quality of our results. Furthermore, there obviously exists a remarkable degree of heterogeneity in train technologies, train sizes and weights that we leave aside in this study for the sake of simplicity and tractability.

C.4 Prices - Rail

For rail prices, we take tariffs for a 24t shipment on a standard 4-axle train wagon with a capacity of 60t on the distance of the existing rail link from SNCF's freight tariff scheme.[30] From an interview with a representative of a large European freight carrier we know, however, that actual prices usually lie about 15% below these tariffs, due to the possibility of negotiation, quantity discounts and else.

D Simulation of the entry of a new transport link

Once the model is calibrated we can proceed to the simulation of the entry of a new alternative. Since we know the new alternative's quality characteristics and have previously derived the coefficients of quality components in the quality index we obtain the quality index for the new alternatives and therefore V_j. Next, we need to recover freight carriers' pricing behavior when a new competitor arrives. We do this using the pricing Equation 9 and the

[28]http:// www.eicis.com
[29]Christen et al. (2004)
[30]http://fret.sncf.com/fr/espclnt/ncc/index.asp

following expressions for the alternatives' market shares that incorporate the quality index in the nested logit setting (see Clerides (2008) or Trajtenberg (1989)):

First, define:

$$D_g = \sum_{j \in J_g} \mathrm{e}^{\frac{V_j}{1-\sigma}} \tag{10}$$

Then, we obtain:

Intra-group market share:

$$s_{j/g} = \frac{\mathrm{e}^{\frac{V_j}{1-\sigma}}}{D_g} \tag{11}$$

Group market share:

$$s_g = \frac{D_g^{(1-\sigma)}}{\sum_g D_g^{(1-\sigma)}} \tag{12}$$

Total market share:

$$s_j = s_{j/g}\, s_g = \frac{\mathrm{e}^{\frac{V_j}{1-\sigma}}}{D_g^{\sigma}\left[\sum_g D_g^{(1-\sigma)}\right]} \tag{13}$$

Share of the Outside good:

$$s_0 = \frac{1}{\sum_g D_g^{(1-\sigma)}} \tag{14}$$

We solve Equation 9 for the new price vector p and obtain the new market shares using the above expressions, which is straight forward. Disposing of prices and mean utility values after the introduction of new alternatives we can furthermore compare the net consumer surplus the decision maker faces before and after the introduction of a new alternative. We take the expression in Ivaldi and Verboven (2001):

$$CS = \frac{1}{\alpha}\, ln\left(\sum_{g=1}^{G} D_g^{(1-\sigma)}\right) \tag{15}$$