WIRTSCHAFTSWISSENSCHAFTLICHES ZENTRUM (WWZ) DER UNIVERSITÄT BASEL

August 2007

The influence of Free-Trade on the environmental effects of transportation. Scale-, Technique- and Compositions-Effects

WWZ Working Paper 10/07

Stefan Vannoni

WWZ | PETERSGRABEN 51 | CH – 4003 BASEL | WWW.WWZ.UNIBAS.CH

The Author(s):

Stefan Vannoni
Center of Business and Economics (WWZ)
Petersgraben 51, CH 4003 Basel
stefan.vannoni@unibas.ch

A publication oft the Center of Business and Economics (WWZ), University of Basel.

Contact:
WWZ Forum | Petersgraben 51 | CH-4003 Basel | forum-wwz@unibas.ch | www.wwz.unibas.ch

The influence of Free-Trade on the environmental effects of transportation. Scale-, Technique- and Composition-Effects

Stefan Vannoni*

August 2007

Abstract

The changeover from a situation of Autarky to a situation of Free-Trade alters the trade and production patterns of the participating countries which in turn affects the transportation-sector. The amount of transported goods and the directions of the good-flows change. Profit-oriented shipping companies can and do respond to these changes by selecting adequate means and modes of transport for different routes and by building-up or restructuring a transportation-network. These changes affect the corresponding level of pollution from transport. We distinguish a scale effect which evolves from a higher frequency of transportation movements with an unchanged infrastructure of transportation, a technique effect which results by increasing the load per movement and a less than proportional increase in pollution per distance-unit and a composition effect which reflects an increase load per movement and a constant or *decreasing* pollution per distance-unit. Adding up all three effects could eventually lead to a lower pollution level in a situation with Free-Trade than with Autarky.

JEL-Classification: C51, F18, L91, Q56, R40

*stefan.vannoni@unibas.ch, Department of International Trade and European Integration, Faculty of Economics and Business, University of Basel, Switzerland. Thanks to Rolf Weder, George Sheldon and my colleagues at the Department for helpful comments and the WWZ-Forum for financial support. All errors are mine.

Contents

List of Figures

List of Tables

1 Actual Situation

Free-Trade seems to be every once a while an ideal scapegoat for several unpleasant developments. One of them is the increase in Carbon-dioxide emissions which arise mainly from fossil fuel combustion for which in turn the transportation sector is a significant contributor. If we import goods from far located countries – what becomes possible if we allow for Free-Trade – the distances these goods need to travel are very long. Intuitively we might think that this increases "transportation" (whatever that may be for now) and thus emissions from transportation have to rise. Is this the closing and inconvenient truth?

There is one quite perspicuous example which reveals that this might not be the case. Schlich und Fleissner [9] compared orange-juice originating from Brasil and shipped to Europe with apple-juice originating from different countries in Europe concerning the energy used for transport and production. Orange-juice from Brazil (including the transport over 10'000km with a function-specific ship and its empty drive back) is about 2 to 8 times less energy consuming than apple-juice from spatial close countries. For their comparison of German lamb-meat with lamb-meat from New Zealand they came to about the same result: lamb-meat from the Home-country (Germany) is about three times more energy consuming than the one from New Zealand.

Similar studies[1], some use expressions like "food-miles" for pointing at their research topic, have recently been published in newspapers and magazines. The quintessence in all these studies is the same: First, in production there might be so extensive economies of scale at work or strong comparative advantages which not only saves money for producers but also saves energy

[1] See e.g. Saunders and Barber [8], The Economist [11]

and emits less pollution, including the long way to consumers compared to a production site near the consumers. Second, the transportation process might be far better organized and much more efficient when large volumes have to be transported on certain routes which saves money and environment quality.

2 Conceptual Framework

The changeover from a situation of Autarky to a situation of Free-Trade alters the trade and production patterns of the participating countries (see e.g. Krugman and Obstfeld [5]). This in turn affects the transportation-sector. The amount of goods which have to be transported rises and the transport-flows and -distances are altered (see OECD [7]). But as we now from other freely operating markets prices and other market elements change and affect the incentives of market participants. One major participant in the transportation market are shipping companies.

Profit-oriented shipping companies can and do respond to these market changes with several actions. These include the selection of adequate means and modes of transport for different routes and building-up or restructuring a transportation-network. By selecting means of transport with large maximum load-capacities on highly frequented routes shipping companies can reduce their operating costs per transport-unit.[2] If more goods can be transported with one movement, unit-cost decrease (economies of scale). The same is true if routes are used intensively for transporting goods – unit-costs on that route decline (economies of density - see e.g. Hendricks et al. [3]).

[2]See e.g. Hummels [4], Martínez-Zarzoso and Nowak-Lehmann [6], Fuchsluger 2000 [2] and Spielmann [10].

Economies of scale and density encourage profit-oriented shipping companies to bundle goods for transportation; on one hand within a single transport movement and on the other hand on specific routes. By choosing transport means with large maximum capacities the necessary amount of energy used for the transportation process per unit of transported goods can be reduced (and so are the emissions). By switching to other transport modes (e.g. from trucks to trains) consumed transport energy and emitted pollution could be reduced *even on an absolute basis*.

2.1 Flow of Goods

By looking at a situation with two countries (Home and Foreign) and within them two points of production and consumption we can observe the effects of a changeover from a situation of Autarky to a situation of Free-Trade on the transportation sector and corresponding environmental pollution. Figure 1 shows the situation before and after opening borders for Free-Trade.

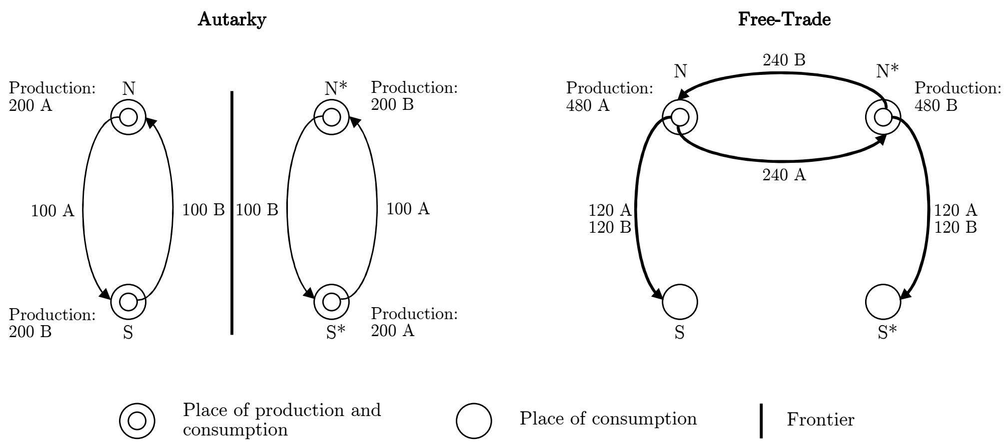

Figure 1: Flow of Goods

In Autarky two goods are produced in Home. We assume that good A is produced in the North (N) and good B in the South (S). Consumers are equally distributed between N and S. Let us furthermore assume that 200 units[3] of each good are produced while 100 of each good are consumed at N and S. So with Autarky 100 units of good A have to be transported from N to S and 100 units of good B have to be transported from S to N in Home.

In Foreign the opposite is true – good A is produced in the South (S*) and good B in the North (N*). Consumers are equally distributed between N* and S* and the same production and consumption situation is found as in Home (200 units of each good are produced while 100 of each good are consumed at N* and S*). In Foreign 100 units of good A have to be transported from S* to N* while 100 units of good B have to be transported from N* to S*.

The goods are standardized relative to transportation process – they can easily be combined and transported with different transportation modes. In a first step we furthermore assume a truck per country with a maximum load-capacity of 10 units.[4] With this truck a minimum of 10 movements is necessary for transporting the 100 units of goods from N to S and 10 movements from S to N in Home. The same amount of movements results in Foreign, which leads to an amount of 40 truck-movements in total. They occur between N and S and between N* and S* in Autarky.

If we open up trade between the two countries the production pattern is altered. Each country specializes its production on that good for which it has a comparative advantage. We assume that Home has a comparative advantage in producing the good A while Foreign has a comparative advantage

[3]These units might reflect tons "t".

[4]The reason why there is only one transport mean and mode might be the small distances and small volumes that have to be transported in Autarky.

in producing the good B.[5] So with free international flow of goods good A is exclusively being produced at location N and good B is exclusively being produced at location N*. The production of goods at point S and S* is shut down. We assume that the consumer patterns do not change – at point S and S* there is no production with Free-trade but still demand for both types of goods.

By specializing on the production of only one good in a country gains from specialization can be realized. We assume that thereby production of goods A and B can be increased by 60 units each with the same resources used.[6]

So with Free-Trade from point N 120 units of goods A have to be transported to S and 240 units of goods A have to be transported to N*. From N* 120 units of these goods have to be further transported to S*.[7]

From point N* 120 units of goods B have to be transported to S* and

[5]We might assume that Home is more capital abundant than Foreign and the production process for good A is capital intensive. Factors of production are considered as internationally immobile. For a detailed analysis on comparative advantage see e.g. Krugman and Obstfeld [5].

[6]We may think of capital moving from S to N and from S* to N*. The increase in production because of gains from specialization will then be greater in Home than in Foreign by moving capital from the South to North because of the capital intensive production for good A. Nevertheless for simplicity we assume a symmetric increase in the amount of production between both goods. Here only the fact is important that good A is exclusively produced in N and B in N* with Free-Trade.

[7]Basically the transport flows need not look like drawn in figure 1 – the shipping companies could also build-up a Fully Connected Network, with N and S* linked directly. We here want to stress the longer distance combined with the possibility of bundling goods, what we also observe in reality. Especially in the airline sector (with established carriers) and more and more in Europe's goods-transport sector the so called Hub and Spoke Network becomes more important.

240 units of goods B have to be transported to point N. From point N 120 units of these goods have to be further transported to S. The total amount of movements with the 10-unit-truck are increased to 96.[8] If we focus on the route N-S in Autarky 100t were transported to the South while with Free-Trade this volume increased to 240t.

2.2 Environmental Effects

When the volume of goods on one specific route is increased the shipping company has two possibilities to react: (a) with an increase in the number of movements (increase in frequency) or (b) with an increase in the maximum load capacity per movement. If she chooses the second option a change in the transportation infrastructure is needed. One option of changing the transportation infrastructure is to use a transport mean with a larger maximum load capacity but within the same transportation mode as in Autarky. A second option is to change the transportation mean (increase in capacity) *and* the transportation mode.

In the first case the maximum load capacity per movement and the emissions per distance-unit are increased. In the second case, when the transportation mode is also changed the increase in the maximum capacity can go along *without* an increase in emissions per distance-unit. We can think of this as a switch from an environmental-intensive transport mode (road haulage or air transport) to a less environmental-intensive transport mode (rail transport).

The environmental effects of the increased number of movements without altering the transportation infrastructure are captured by the *scale effect*.

[8] 24 movements take place between each pair of spatial points (N-S, N-N*, N*-N and N*-S*).

The emissions per transport-load are constant. The *technique effect* captures the reduction in emissions per transport-load through increasing the load per movement. The emissions per distance-unit increase[9] although less than the load per movement. The *composition effect*, finally, reflects the reduction in emissions per transport-load without increasing the emissions per distance-unit.

A numerical example for a route with a fixed distance (route N-S in figure 1 with a distance of 1km) should make this point clear.

	load	movements	z per mov.	z per km	distance	z-total	z per t
a)	10t	10	0.1	1.0	1km	11	0.11
b)	10t	24	0.1	1.0	1km	26.4	0.11
c)	20t	12	0.2	1.5	1km	20.4	0.085
d)	30t	8	0.3	1.0	1km	10.4	0.043

Table 1: Numeric example for the environmental effects

Starting from the situation of Autarky (see row a in table 1) the truck with a capacity of 10t is used.[10] This truck emits 0.1 units of pollution per movement (e.g. for un- and uploading) and 1.0 units per km travelled with full load. With 10 movements 100t (which have to be transported on this route in Autarky) can be transported and 11 units of pollution are emitted in total. This yields 0.11 units of pollution per tonne transported.

In situation (b) the same truck is used but 24 movements are necessary to transport the 240t of goods on this route with Free-Trade. This increases the total amount of pollution-units – the pollution per tonne transported is constant at a rate of 0.11. The increase in total pollution from 11 to 26.4

[9]Because with a larger transport mean more emissions are emitted per kilometer.

[10]For simplicity we assume only transport means with full load.

units of pollution reflects the scale effect.

In situation (c) a truck with a maximum load capacity of 20t is used. The fixed units of pollution per movement are also doubled (0.2) and the emissions per km are increased by a factor of 1.5. The total amount of pollution for transporting the 240t of goods equals 20.4.[11] The pollution per ton transported decreased to 0.085 units of pollution. The reduction from 26.4 to 20.4 corresponds to the technique effect.

In situation (d) the transportation mode is changed – instead of road haulage rail transport is used. Rail transport has even a larger maximum capacity (30t) and higher emissions per movement (0.3). The emissions per km instead are the same as for the 10t-truck (1.0).[12] The total amount of pollution is 10.4 units, which is smaller than the starting level in Autarky. The composition effect reduced the emissions by 10 units (from 20.4 to 10.4) and was, together with the technique effect, able to more than offset the scale effect. With the larger volume of transported goods less environmental pollution resulted.

Graphically the three effects are shown in figure 2. The possible combinations of movements and load per movement are depicted in the upper part of the figure. More load goes along with less movements for a fixed volume of goods. In Autarky a transport volume of 100t[13] has to be transported by the 10t-truck – at least 10 movements are necessary if the truck operates with full load. The lower curve in the upper part of the figure shows some

[11] 12 movements while each emits 1.7 units of pollution.

[12] One could easily make the assumption of a smaller factor per km than for the 10t-truck. Here we want to remain more on the "safe side" by only allowing the same emissions per km like the 10t-truck.

[13] Precisely this should be transport performance (tons-km) but since we assume a fixed route of 1km we can ignore the distance-unit here.

possible combinations of load and movements for this situation.

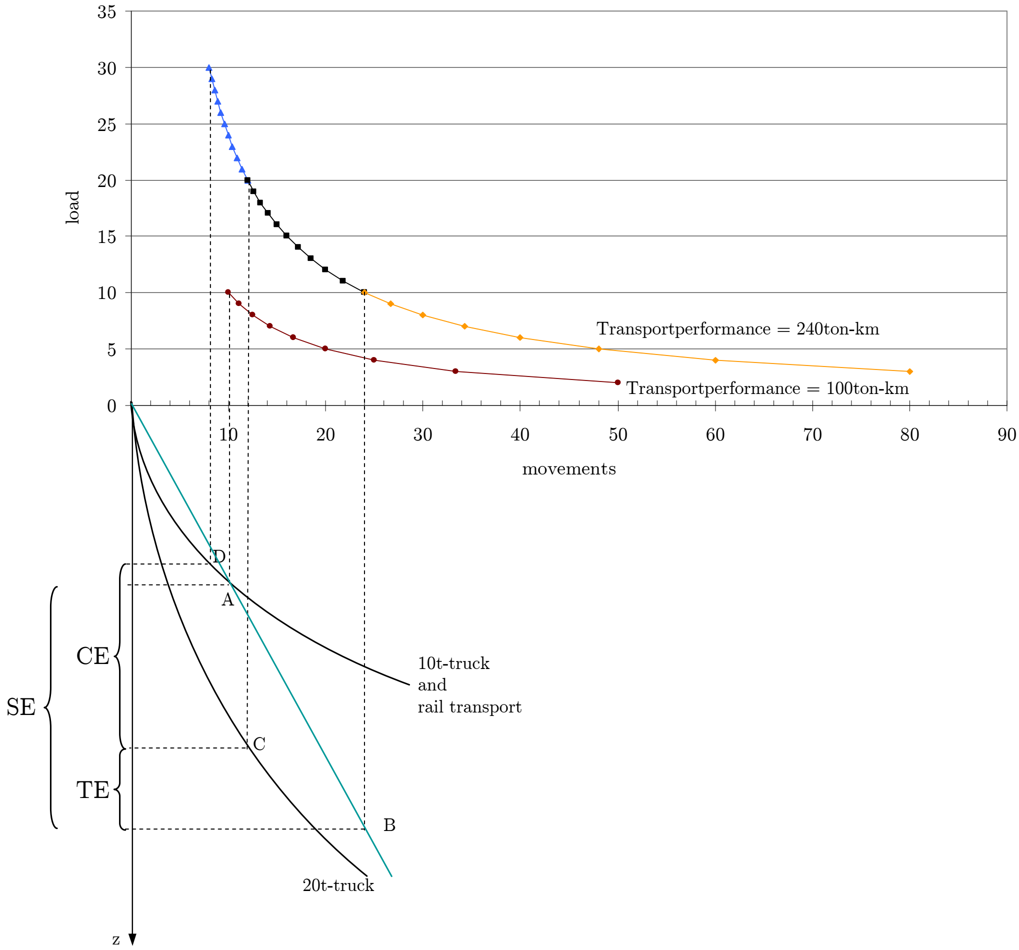

Figure 2: Scale, Technique and Composition Effect

In the lower part of the figure the corresponding pollution function for the 10t-truck and the 20t-truck are plotted.[14] The pollution functions are not linear because one additional movement with a quasi full load-truck pollutes more than an additional movement with a quasi empty truck.

[14]For not having to many functions in the figure we assume that the pollution function for rail transport is the same as for the 10t-truck. In fact it would lie above the 10t-truck function.

Starting from Autarky where 100t of goods have to be transported the lowest possible level of pollution is the corresponding pollution at point A (see lower part of figure 2). The 10t-truck operates with full load and 10 movements are necessary. With Free-Trade the transport volume increases by the factor 2.4 (note in the upper part of figure 2 that the lower curve shifts to the right). With the 10t-truck now 24 movements are necessary. Because there is no change in load per movement (the emissions per ton is constant, see numerical example in table 1) we do not move along the 10t-truck-function (see lower part of figure 2) – the emissions increase proportionally to point B (along the light blue-line). The difference on the z-axis depicts the scale effect.

If instead the 20t-truck comes into action the necessary amount of movement decreases (in the upper part of figure 2 the right-hand curve is elongated upwards until the combination "20 loads/12 movements"). The corresponding emissions can be seen on the z-axis at the level of point C. This is the lowest level of emissions which is possible with the 20t-truck. Through the technique effect (vertical difference between B and C on the z-axis) the amount of pollution is reduced.

If the goods are transported by rail transport the maximum load per movement increases to 30t (see upper part of figure 2) and the necessary amount of movements can further be reduced. In the lower part of the figure we move back to the 10t-truck and rail transport-function – every movement emits less pollution than with the 20t-truck. For transporting the Free-Trade volume of goods (240t) by rail transport we end up at a *lower* level of pollution than with Autarky (point D). The composition effect further reduces (and together with the technique effect in fact more than offsets) the scale effect-induced increase in emissions.

2.3 Hub and Spoke vs. Fully Connected Network

One argument against the shown pollution-reducing net-effect of Free-trade might be that until now only one specific route was considered. These environmental friendly effects might result on one intensive used route but the total travelled distance is increased by transporting the goods via a Hub (like the spatial points N and N* in figure 1) why the transport system as a whole should pollute more.

If we consider the described numeric example on page 9 in Autarky 40 full load movements with the 10t-truck were necessary (20 movements in each country) and the total pollution equals 44 units.[15] When Free-Trade is possible the total transport volume increases by a factor of 2.4 (from 400 units to 960 units). To see the above mentioned scale, technique and composition effects we assumed that the goods have to be transported via a Hub. But what happens to the environment if the shipping companies choose to build-up a Fully Connected Network instead of a Hub and Spoke Network (see picture on the left in figure 3)?

If the same 10t-truck is used and the diagonal distance between N and S* and between N* and S would be 1.4km[16] the emissions increase to 88 units of pollution.[17] We assume that with an increase in transport volume of only 20% on each route it is not interesting for a profit-oriented shipping company to change its transportation infrastructure. So the Free-Trade situation with the

[15]Remember that per movement a fixed emission of 0.1 units and per km with full load 1.0 units of emissions accrue, which leads to 1.1 per movement if the distance is 1km.

[16]What makes sense from a Pythagoras-point of view with each cathetus measuring 1km.

[17]48 full load movements take place on 1km-routes and 24 full load movements on 1.4km routes. For a full load 1km route still 1.1 units of pollution accrue and for a 1.4km-route ($0.1 + 1.0 \cdot 1.4$km) 1.5 units of pollution are emitted.

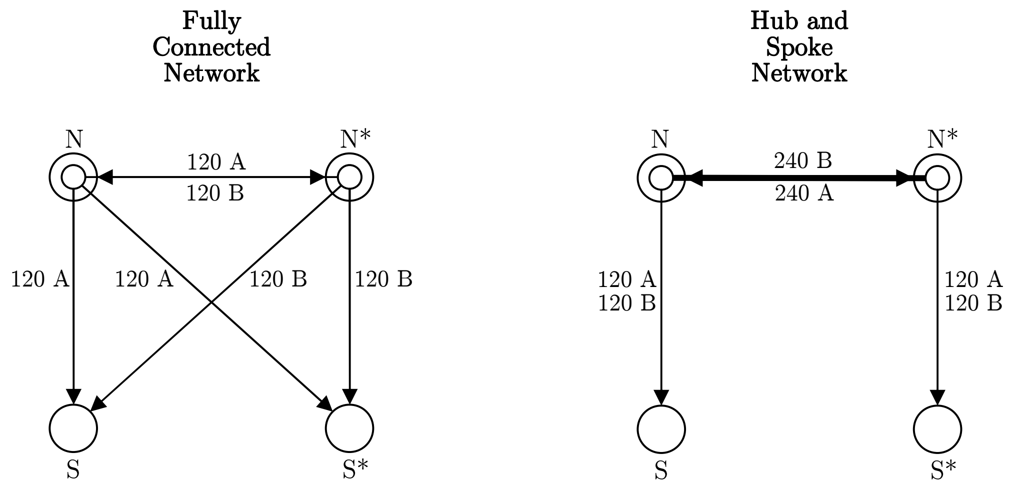

Figure 3: Fully Connected Network vs. Hub and Spoke Network

Fully Connected Network in our example is clearly worse for the environment concerning emissions from transport.

But if we consider the Hub and Spoke Network on three routes the transport volume increased by 140% (see figure 3 on the right) compared to the volumes of 100t in Autarky. This may be an incentive for shipping companies to change the transportation infrastructure. We may however remain again on the "safe side" and assume that only for the international route (between N and N*) the transportation means and modes may change. For the originally inland routes we still assume the 10t-truck to be in operation (this may be because of regulations or high infrastructure costs). With rail transport on the international route and 10t-truck transport on the inland routes 73.6 units of pollution are emitted.[18] This is a higher level than with Autarky but a lower level than with the Fully Connected Network. Emissions

[18] Each full load movement with rail transport emits 1.3 units $(0.3 + 1.0 \cdot 1\text{km})$ and 16 movements are necessary. On the inland routes 48 full load movements, each with 1.1 pollution-units are necessary.

per transported tonne have decreased from 0.11 (44 units/400 tons) to 0.077 (73.6 units/ 960 tons) although in total the environmental harm increased.

Is it possible at all to end up with a lower level of pollution while 2.4 times more transport volume and longer distances have to be met with Free-Trade? If we assume that on all three routes on the right in figure 3 incentives are large enough to use rail transport on all routes, then we will. In that case 41.6 units of pollution are emitted[19]. These would be less pollution than in Autarky.

3 Empirical Approach

The decisive element, if Free-Trade can lead to a reduction of pollution from the transportation sector in absolute terms, seems to be the composition effect. For this reason in a first step we try to estimate the magnitude of this effect. To capture its magnitude it is important to focus on a specific transportation route where different transport modes compete and the distance is fixed. Within Europe a quite interesting route for inland shipping is the River Rhine. On the route between Rotterdam (The Netherlands) and Basel (Switzerland) the three transportation modes inland navigation, rail transport and road haulage can be chosen for goods-transport coming from overseas via Rotterdam to Basel. Rotterdam is a significant Hub for Europe and Basel a Hub for inland navigation (around 16% of Swiss imports in tons are imported at the inland port of Basel) and for rail transport. By looking at the shares of the transportation modes the effect of increasing transport volumes on the choice of transportation mode can be estimated. By adding characteristics like price, reliability and duration for a single movement for

[19] 32 full load movements are necessary, each polluting with 1.3 units

the different transportation modes as well as the political regulations affecting them, it should be possible to segregate the composition effect from other – for this research objective irrelevant – influences.

The idea is to model a discrete choice situation where finite amount of alternatives are available and the utility of the decision-makers is taken into account. The utility for the shipping companies by choosing the alternative i for a specific type of good in year n may be described as follows.[20]

$$U_{in} = U(z_{in}, S_n) \tag{1}$$

There are two types of variables – variables which "describe the alternatives" z_{in} (like the characteristics mentioned above) and variables which "describe the decision-maker" S_n. The latter change only across decision-makers (here: points in time) and not across the alternatives (here: transportation mode) while the former change across both. The decision-maker (in our example all aggregated shipping companies who choose for a certain type of good and year) chooses alternative i only if $U(z_{in}, S_n) > U(z_{jn}, S_n), \forall j \neq i$ where $i, j \in J$. The utility function is not fully known why we assume it as a random utility function $\tilde{U}$ with an unobserved error term ε.

$$\tilde{U}_{in} = V(z_{in}, S_n) + \varepsilon_{in} \tag{2}$$

In a first step we focus on one specific good (e.g. clothing and footwear) which is imported from China to Switzerland since we know from interviews with logistics experts, that most of these goods are shipped by sea to Rotterdam from where they are transported to Switzerland. These goods can be transported by inland navigation, rail transport or road haulage from Rotterdam to Switzerland. Transport volume data for the three different transport

[20] For the following derivations see e.g. Ben-Akiva and Lerman [1].

modes, and air transport as well, are available.

The possibility P, that the shipping company chooses transport mode i out of the total available alternatives J for transporting the specific good in year n, is

$$P_J(i) = Pr[\tilde{U}_{in} = \max_{j \in J} \tilde{U}_{jn}] \tag{3}$$

By maximizing the utility the decision-maker takes into account the difference of the systematic utility components. We assume the systematic utility component as linear. So for alternative i the observable systematic component of the utility for the decision-maker can be described as following.

$$V_{in} = \alpha_{0i} + \beta z_{in} + \gamma_i S_n \tag{4}$$

For alternative j the observable systematic component looks very similar $V_{jn} = \alpha_{0j} + \beta z_{jn} + \gamma_i S_n$. By subtracting this equation from equation 4 we get

$$V_{in} - V_{jn} = (\alpha_{0i} - \alpha_{0j}) + \beta(z_{in} - z_{jn}) + (\gamma_i - \gamma_j) \cdot S_n, \forall\ n \tag{5}$$

Note that α_0 corresponds to an autonomous attractiveness gap which is independent from the variables describing the alternatives or the decision-makers. The coefficient β corresponds to a weight for the variables describing the alternatives while γ weights the variable which does only spread across the years but not across alternatives. Because only differences between the different α_0 and γ_i (and not the coefficients itself) can be observed we choose $\alpha_{0j} = \gamma_j = 0$ which means that we take the alternative j as an anchor from which all alternatives can differ positively or negatively. The attractiveness gap between the alternatives $(z_{in} - z_{jn})$ has to spread over the different observations N. If it is constant it cannot be differentiated from the autonomous attractiveness gap $(\alpha_{in} - \alpha_{jn})$. The difference $(\gamma_i - \gamma_j)$ reflects the shift in the autonomous attractiveness gap due to the change of variable S between the years.

3.1 Multinomial Logit-Model

The probability for the decision-maker choosing alternative i out of the available options J is the utility he gains by choosing i relative to the sum of utilities of all alternatives.

$$P_{in} = \frac{exp(V_{in})}{\sum_{j \in J} exp(V_{jn})} \tag{6}$$

The probability is dependent on the function V which consists of variables describing the alternatives and decision-makers. By differentiating equation 6 with respect to S_n we get the change in the decision probability for alternative i as a result of a change in the variable S_n. Here the linear function of V should be helpful – although calculations are not yet carried out.

So by estimating the parameter γ with the Maximum-Likelihood-Method and multiplying it by probability for choosing alternative i and the probability for *not* choosing alternative i (put it different: for choosing alternative j), we should get the effect of an increasing volume of transport-goods on the route Rotterdam–Basel on the probability for choosing a specific transport mode (like inland navigation or rail transport).

References

[1] Ben-Akiva, Moshe E. ; Lerman, Steven R.: *Discrete choice analysis: theory and application to travel demand.* MIT Press, Cambridge, Mass., 1985

[2] Fuchsluger, Joachim: An analysis of maritime transport and its costs for the Caribbean / Economic Commission for Latin America and the Caribbean (ECLAC), United Nations. 2000. – Forschungsbericht. http://www.eclac.cl/publicaciones/xml/9/9929/carg0625.pdf

[3] Hendricks, Ken ; Piccione, Michele ; Tan, Guofu: The Economics of Hubs: The Case of Monopoly. In: *Review of Economic Studies* 62 (1995), S. 83–99

[4] Hummels, David: Transportation Costs and International Trade Over Time. In: *Journal of Economic Perspectives, forthcoming* (2007), 07. – Mimeo, http://ntl.bts.gov/lib/24000/24400/24443/hummels.pdf

[5] Krugman, Paul R. ; Obstfeld, Maurice: *Internationale Wirtschaft. Theorie und Politik der Aussenwirtschaft.* Prentice Hall, 2004

[6] Martínez-Zarzoso, Inmaculada ; Nowak-Lehmann, Felicitas: *Road and Maritime Transport Costs: A Comparative Analysis of Spanish Exports to Poland and Turkey.* 03 2006. – Ibero-Amerika Institut für Wirtschaftsforschung, Georg-August-Universität Göttingen

[7] OECD: *Road Travel Demand. Meeting the Challenge.* OECD, Paris, 2002

[8] Saunders, Caroline ; Barber, Andrew: Comparative Energy and Greenhouse Gas Emissions of New Zealand's and the UK's Dairy Industry / AERU, Lincoln University. 2007. – Forschungsbericht

[9] Schlich, Elmar ; Fleissner, Ulla: Comparison of Regional Energy Turnover with Global Food / Internet-Journal 'Gate to Environmental and Health Science/Global Food/Life Cycle Assessment Case Studies'. 2003. – Forschungsbericht

[10] Spielmann, Michael: Umweltindikatoren im Verkehr. Kennziffern für einen ökologischen Vergleich der Verkehrsmittel. / Chair of Environmental Sciences; Natural and Social Sciences Interface, ETHZ. – Forschungsbericht

[11] Website: *The Economist. Voting with your trolley. Can you really change the world just by buying certain foods?*, 2006