

Summary

1 Abstract

1.1 Task and procedure

The goal of this project is to simulate the effects of transportation infrastructure changes on regional development, using the Swissmetro as an example. Essentially the research approach that was used touches on the following two methods:

- Simulation of regional development in Switzerland with a time horizon of 2030 using an integrated transport and land-use model (TRANUS);
- Combination of different variations of the future national transportation system and different scenarios of social, economic and political factors.

1.2 Model of Switerland

A model of Switerland was created using the modelling environment TRANUS in which the country was divided into 175 internal zones. The economy was represented through eleven economic branches, but only business and personal services were represented as induced sectors and as a result could be calculated directly from the model. The model of Switerland differentiates the population into five socio-professional categories of households depending on their size and structure.

In the transportation part of the model, only interzonal traffic of individuals was shown. The calculation of the modal split between individual and public transportation and the Swissmetro followed accordingly.

1.3 Simulation results

The consequences of two scenarios with varying factors until 2030 and four different Swissmetro variations were simulated in the model and compared with a reference variation without the Swissmetro. Altogether, the consequences of the Swissmetro vary within a range of a few percent. The large urban centers and the region of Lake Geneva belong in any case to the winners, while the peripheral areas and eastern Switzerland for the most part have to be assigned to the losers. As expected, the Ticino reacted the most dramatically to the presence of the Swissmetro.

As in the IREC (EPF Lausanne) study the project shows that the Swissmetro has a moderate centralizing influence on regional development, where the kind of scenario and the chosen Swissmetro variation have a decisive influence on the results.

2 Introduction

With the completion of the national roadway network and the first and second phase of RAIL2000, the connection on to the european high-speed train network, the realization of NEAT and the possible introduction of the Swissmetro, significant improvements and additions to the Swiss transportation system are planned. It is expected that the realization of these projects leave, in addition to direct effects on the transportation and mobility structure, long-term changes in the regional and socio-economic structure of the directly affected, as well as not directly affected, regions of Switzerland. The goal of this project is to simulate the regional effects of these transportation infrastructure changes using the Swissmetro as an example. In addition, the simulation results were compared to those of the IREC¹ study to produce a mutual synthesis of Swissmetro impacts.

Because this project is the first of its kind in Switzerland that works with a modern integrated transport and land-use model, it additionally serves the purpose of testing the feasibility of such a simulation model for conditions particular to Switzerland.

3 Methodology

Essentially the research approach that was used touches on the following two methods:

- Simulation of regional development in Switzerland with a time horizon of 2030 using an integrated transport and land-use model (TRANUS);
- Combination of different variations of the future national transportation system and different scenarios of social, economic and political factors.

3.1 Modelling software

At the heart of the simulation was the TRANUS modelling software, an integrated transport and land-use model. The most important characteristic of these kind of models is that the regional distribution of businesses and households as well as their socio-economic ties create traffic flows, as shown in the transportation part of the model. The calculated accessibility costs between the different model zones depend on traffic supply, influencing as a result the allocation of activities over time.

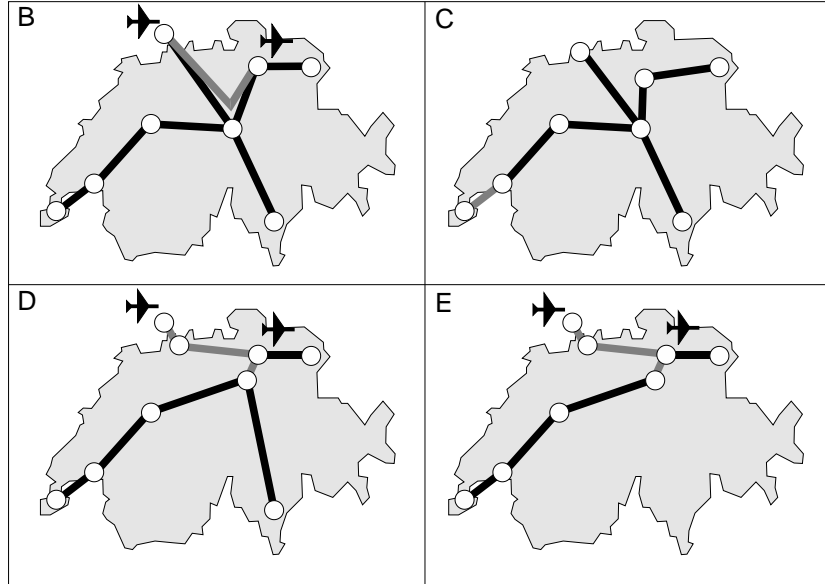
3.2 Scenarios and transportation system variations

Due to the long time horizon, it is necessary to consider different scenarios of the socio-economic developments and several feasible Swissmetro variations. Their combination gives the actual system, in which regional development will be simulated over time. From the five scenarios that were used in the IREC study, two were chosen to be modelled (scenario *Croissance* and *Durable*).

The resulting transportation systems that were projected appeared in five variations. The reference variation included the completion of national highways, NEAT, as well as the development of the RAIL2000 project, and forms the basis for the four variations of the Swissmetro, that differ in their chosen test lines, network, and location of stations.

¹Katell Daniel and Martin Schuler, 2000: Swissmetro et la Suisse en prospective: les incidences spatiales de la grande vitesse. F5, National Research Programme NRP 41, EDMZ, Bern.

Figure 1: The four Swissmetro variations chosen for the simulations.



4 The model of Switzerland

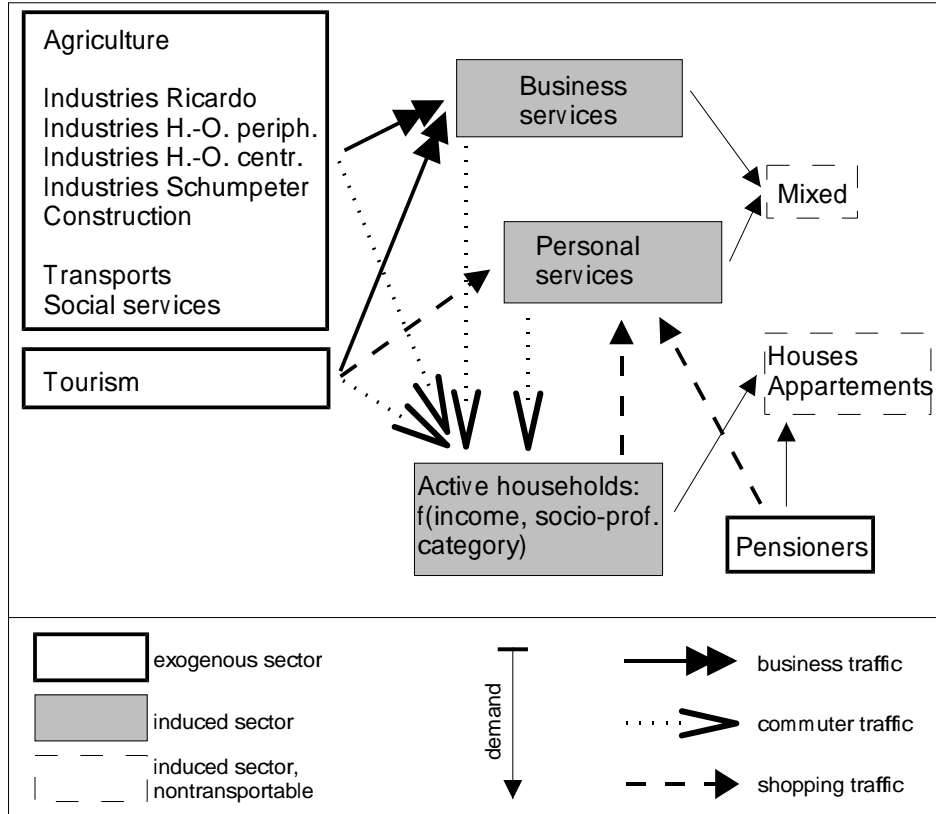
A model of Switzerland was created using the modelling environment TRANUS in which the country was divided into 175 internal zones. The economy was represented through eleven economic branches that represented only business and personal services, and as a result could be calculated directly from the model. The model of Switzerland differentiates the population into five socio-professional categories of households depending on their size and structure.

Business and personal services as well as households consume floorspace, although the data had to be reconstructed in part due to missing statistics.

Inter-sector relationships were fixed with regard to the project goal: To investigate possible improvements of the personal transportation infrastructure (Swissmetro). As a result, relationships between industrial sectors relating to goods transport were not taken into account. Instead, only business and personal services, active households, their floorspace as well as their regional distribution, were simulated. The active households were in demand by all economic sectors as work force (generating commuter traffic), while business services were only in demand by economic sectors (business-related traffic), and personal services were in demand by all household sectors (shopping traffic).

The transportation supply for interzonal personal transport shown in the model comprises of individual and public transportation as well as the Swissmetro, excluding air travel.

Figure 2: Inter-sector relationships in the model of Switzerland.



5 Simulation and results

5.1 Integration of the scenarios

The quantified scenario components of the IREC group form the foundation for simulating future conditions. They could not be transferred directly into the model, but first had to be adapted to meet its requirements and capabilities. It was especially necessary to calculate the growth and regional distribution of the eleven economic branches, the number and size of the households, as well as the coefficient of demand separately. Similarly, transportation costs in the scenario *Durable* were adopted; it was assumed that from the year 2000 to 2030, auto transportation costs per kilometer would double.

5.2 Simulation results

Figure 3: Five types of urbanisation: Impact of Swissmetro on the allocation of activities and households (%).

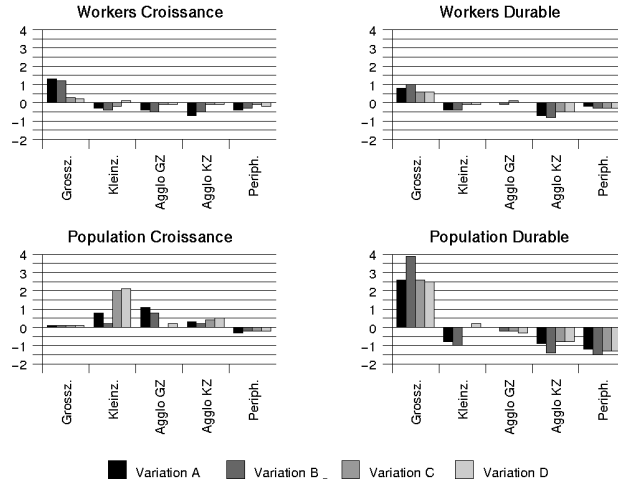
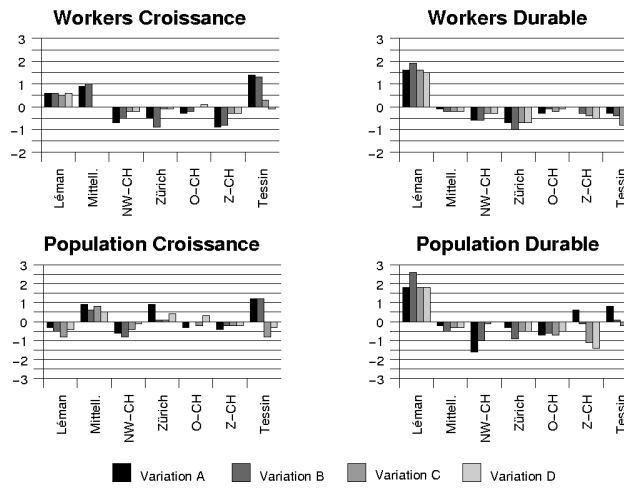


Figure 4: Seven *Grossregionen*: Impact of Swissmetro on the allocation of activities and housholds (%).



The most important finding of the simulation was that regardless of the chosen scenario and transportation variation, the Swissmetro had only a minimal impact on the allocation of activities. The large urban centers and the region of Lake Geneva belong in any case to the winners, while the peripheral areas and eastern Switzerland for the most part have to be assigned to the losers. As expected, the Ticino reacted the most dramatically to the presence of the Swissmetro.

5.3 Traffic indicators

The presence of the Swissmetro leads only to a very slight increase in the use of public transportation, accounting for only a small number of total trips. This confirms the results of the regional allocation that only a minor part of socio-economic relationships do profit from the improved accessibility afforded by the Swissmetro, leading to minimal allocation differences.

A comparison with Abay's² estimate of Swissmetro consumer demand confirm a volume of circa 150,000 rides per day between Geneva and Zurich.

6 Final conclusions

The results of the simulations approximate the expectations. This would allow us to conclude that the simulation of regional effects of transportation infrastructure modifications at the national level using an integrated transportation and regional use model has proven itself. In judging not only the simulation result, but also the use of transportation and regional use models in general, the following points should be considered:

- The making of and calibration of such models is extremely difficult and time-consuming. Necessary information is in part unavailable;
- The potential power of the model is restricted because various simplifications are required due to limitations in the modelling environment and missing data;
- In part, growth capacity in large urban centers could not be taken into consideration because no floorspace restrictions in simulating regional planning measures could be made.

To improve the quality of future simulations of regional effects of transport infrastructure measures, improvements to the existing TRANUS modelling environment are suggested. On the other hand, the chance of incorporating feedback of transportation supply and immissions — especially with respect to the allocation of different households — exists through a general departure from traditional, zone-based systems in favor of microsimulation and agent-based methods. Agent-based modelling make it feasible to include new work practices (i.e. teleworking).

²Georg Abay, 1999: Nachfrageabschätzung Swissmetro: Eine Stated-Preference-Analyse. F1, National Research Programme NRP 41, EDMZ, Bern.