A model based spatial analysis of urban-rural disparities: 
Policy impacts on residential structures and passenger 
transport demand

Veronika Kulmer\textsuperscript{a}, Olivia Kolanda, Karl W. Steiningera,b

\textsuperscript{a}Wegener Center for Climate and Global Change, University of Graz, Leechgasse 25, 
A-8010 Graz, Austria 
\textsuperscript{b}Department of Economics, University of Graz, Universitätsstraße 15, A-8010 Graz, Austria

Abstract

We study the paths of interlinkage between spatial residential structure and passenger transport demand in order to quantify the impacts of different policy instruments on residential location choice and commuting flows. To that end, we develop a four-region CGE model based on new economic geography. Each representative region is characterized by a specific residential density, population size and access to public transport. The CGE model provides information on policy-induced changes in spatial distribution of residents, work force as well as commuter flows. We find that spatial planning instruments have a higher reduction potential in terms of residential urban sprawl development and commuting volume compared to transport policy but less so affect overall transport volume or number of trips. The results indicate that residential choice is strongly driven by housing prices while variable transport costs are of minor importance in long term housing location decisions.
1 Introduction

1.1 Urban Sprawl and Transport

Europe experiences a trend of increasing transport volume and low-density out-of-centre expansion known as urban sprawl. According to EEA (2006), since the mid-1950s European cities have expanded by 78%, while the population has only grown by 33%. During the last 20 years, built-up areas expanded by 20% satisfying a 3% population increase during that time. As a consequence, Europe faces various challenges such as increasing land consumption, scattered residential development, high transport volume, loss of biodiversity and environmental pollution.

Within the literature, determinants and impacts of urban sprawl are widely discussed, mostly for the US (see Brueckner, 2000; Glaeser and Kahn, 2004; Burchfield et al., 2006). Therefore, a variety of driving forces for urban sprawl are identified such as economic growth, price of land, environmental quality, low cost of transport (e.g. fuel prices) or weak land use planning and zoning regulations. However, the driving forces depend on the scope and scale of the study region and its geographical resolution.

The present study focuses on urban sprawl and its inter-linkages with transport demand at the regional level with a special focus on urban-rural disparities. One crucial consequence of urban sprawl is increased traffic. People desire to live away from city cores, while most production and local supply is located in the centres. This causes additional commuting to the core regions. On the other hand, dispersed living in rural regions with poor public transport infrastructure requires massive use of the private car. Transport demand is thus dependent on the spatial organisation of an economy via distances and modal split. In Europe, most urban and peri-urban areas are characterized by a high share of workplaces, higher wages and regional growth in terms of infrastructure and recreational, sports and educational facilities compared to rural areas. Rural areas, on the other hand, lack in local suppliers, schools and appropriate infrastructure. In spite of that, 56% of the European population lives in rural areas (EU, 2008).

The linkage between rising transport volume and sprawl is empirically evident and analyzed in various studies (see e.g. Cervero, 1994; Ewing, 1997; Bento et al., 2005). The results of these studies vary due to method, study region or period of analysis. One main conclusion from this literature is the identification of a link between urban sprawl and commuting that is in accordance with the empirical evidence of both commuting distances and car ownership rising over time, yet the cause-and-effect chain is not clear. Strategies proposed to reduce (individual car) passenger transport demand are diverse. They include transport demand management, technology policy, spatial and land-use planning, fiscal and regulatory policy.
This study hence addresses two issues:

(i) What are the major driving forces and main influences on households’ interdependent residential and work-place choice?

(ii) Which policy instruments and regulatory options are needed in order to obtain an ecologically sustainable and energy-efficient spatial distribution of residential population and workforce?

Thus, the purpose of this paper is first to study and identify how households’ residential location choice in its spatial manifestation is interlinked with demand for commuting passenger transport. Second, we aim to analyze the impacts of different policy instruments on residential location choice and commuting flows. The focus is on spatial planning instruments and transport policy options in terms of fiscal and regulatory policy. Spatial planning is considered of high importance not only in terms of transport mitigation but also for preservation of biodiversity and sustainable land consumption.

1.2 Theoretical Background

In order to answer the issues addressed, the literature on new economic geography (NEG) provides guidance (for an overview of the NEG see e.g. Fujita et al., 1999, or Baldwin et al., 2003). The NEG uses a general equilibrium framework and aims to explain the formation of economic agglomeration in geographical space. It provides new insights to interregional migration and international trade (Fujita and Mori, 2005). It is the only general equilibrium framework that determines the location of agglomeration explicitly through micro-founded mechanisms. The NEG was initialized by Paul Krugman (1991a, b), who developed a model that explains why, how and when economic activity is agglomerated in only a few places. The model – known as “core-periphery model” – illustrates how increasing returns to scale, transport costs and factor mobility may influence the spatial economic structure. The model further provides information on centripetal forces that push economic agglomeration and centrifugal forces that promote dispersion.

The lion’s share of contributions to the NEG literature is of theoretical nature. Still, there is a considerable lack of empirical studies, and NEG based models are hardly used in policy analysis. Researchers from both economics and geography (e.g. Martin, 1999; Neary, 2001) have criticized the NEG theory and empirics to be underdeveloped and declared NEG models to be too general and abstract. Despite of its shortcomings, many policy issues could actually benefit from further research into the NEG. Questions of general interest to policy makers concern the economic geography of Europe, economic integration as well as convergence of regions and countries. Moreover, the NEG provides a promising framework to analyze the interdependence
of location, firm and consumer behaviour within a general equilibrium setting that endogenously determines the structure of supply and demand.

The remainder of this paper is organized as follows. Section 2 reports on the model outline and data used for calibration. Section 3 deals with the analysis of the effects of spatial planning instruments and transport policy. Section 4 summarizes the results and concludes.

2 The Model

2.1 Model outline

This section presents a multi-region, static general equilibrium model that explains households’ choice of residence and place of work. The residential choice model (RCM) is based on the stylized model of Bednar-Friedl et al. (2011), which extends the core-periphery model of Krugman (1991a, b) by incorporating urban features such as a competitive housing market and commuting flows as well as the consideration of environmental aspects.

Basic structure and economic sectors

The model of Bednar-Friedl et al. (2011) comprises two regions, an urban core and its hinterland and two sectors of production, a housing sector and an aggregated macro good (comprising the production of all other consumption varieties), which produce by the use of sector-specific labour. The macro good is produced under increasing returns to scale in a monopolistically competitive market (Dixit-Stiglitz, 1977). Households have a preference for variety and purchase differentiated product varieties in both regions (home varieties and those that are imported from other regions at a cost). The housing sector produces under constant returns to scale. The supply of housing good in each region is fixed in quantitative terms and is characterized by regional product heterogeneity of the Armington (1969) type. Utility maximizing consumers are mobile between the four regions in their housing and workplace decision and thereby ensure regional housing and labour market equilibria. Their migration decision thus depends on regional disparities in housing prices, product variety and environmental quality as well as on transport costs. In the long run equilibrium, per-capita utility equalizes across regions such that no household has an incentive to relocate.

To address the issue of urban sprawl and commuting in a multi-regional context, we go beyond Bednar-Friedl et al. (2011) and extent the model to four regions, yet we abstract from environmental quality. This modification allows addressing urban-rural issues of spatial organisation and transport in more detail, while keeping the structure simple enough for NEG based model development (and its linkage to an applied
transport model, see Section 3.3). To construct and calibrate such a model, we consider empirical data on housing prices, production possibilities, residential population and transport costs:

Regional structure

RCM comprises four regions, which differ in terms of (i) agglomeration advantage, (ii) housing price, (iii) population size and (iv) transport costs. They represent different region types: urban area (UA), peri-urban area (PUA), densely populated rural area (DRA) and sprawled rural area (SRA). Table 1 shows a definition of region types by means of economic, transport and structural data.

Table 1: Definition of region types

<table>
<thead>
<tr>
<th>Type of region</th>
<th>Characterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban area (UA)</td>
<td>Population larger than 100,000; well-functioning public transport links; employment centre; compact development and mixed used neighbourhood</td>
</tr>
<tr>
<td>Peri-urban area (PUA)</td>
<td>Population between 8,000 and 30,000; regional centres in terms of employment and shopping; good public transport</td>
</tr>
<tr>
<td>Densely populated rural area (DRA)</td>
<td>Small rural municipalities; bad access to public transport; compact residential development; lack of local suppliers</td>
</tr>
<tr>
<td>Sprawled rural area (SRA)</td>
<td>Small rural municipalities; no access to public transport; lack of working places; no local suppliers; sprawled residential development</td>
</tr>
</tbody>
</table>

The study region comprises 351 municipalities, which differ in terms of density characteristics, local supply and transport orientation. In order to delimit the number of municipalities used in the analysis, we use the commuter catchment of one UA region, i.e. all municipalities with a maximum trip time of 60 minutes (motorized private transport) to UA. A clustering of municipalities to four representative region types is performed in two steps: (i) clustering of UA and PUA according to population size, residential density, type of dwelling and share of outward commuting and (ii) differentiation of DRA and SRA by means of share of outward commuting, travel time, access to public transport and distance to UA and PUA. Figure 1 shows the spatial distribution of the analyzed municipalities according their type of region.
Both commodities, the housing good and the aggregated macro good, are tradable between and within the regions. Trade of the aggregated macro good characterizes shopping transport, while trade of the housing good represents commuting. Given four representative regions (the clustering according to our types of region as specified in Table 1), 16 traffic flows arise for each commodity, comprising 4 intraregional and 12 interregional flows. Transport costs $T$ are imposed on each flow. There is no need to consider transportation as an explicit sector in our model, i.e. transport costs are exogenous. In order to consider transport costs in the CGE model, we use the approach of iceberg costs (Samuelson, 1952), i.e. only a certain fraction $1/T$, $T>1$, of the transported good arrives at its destination. Iceberg costs represent a technical simplification easing mathematical formulation of transport activity. While iceberg costs are generally stylized in NEG models (see Baldwin et al., 1993; Fujita and Mori, 2005), our empirical analysis uses data from the Austrian Transport Forecast (Käfer et al., 2007) that is parameterized to the iceberg factor.

2.2 Data set and calibration

Data from national censuses (Statistics Austria, 2003, 2004, 2005) and consumer surveys (Statistics Austria, 2006) are used for the creation of a social accounting matrix (SAM)
representing commuting flows and the spatial distribution of the residential population as well as the work force over the regions in the study area. The SAM is calibrated to the year 2001. Because of the simplified structure of the SAM, not all driving forces and factors determining residential location choice are considered; therefore slight deviations from real 2001 data occur. However, in order to ensure a good approximation, the SAM satisfies consistency with the following quantitative criteria with respect to the study area: (i) ranking between the regions regarding the distribution of residential population and workforce, (ii) relative distribution of housing prices over the regions and (iii) ranking between the regions regarding production possibilities and supply of the housing good H and the macro good X.

Table 2: Distribution of residential population and workforce and bias to real data for the representative regions

<table>
<thead>
<tr>
<th>Regions</th>
<th>UA</th>
<th>PUA</th>
<th>DRA</th>
<th>SRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential population</td>
<td>27.16%</td>
<td>19.91%</td>
<td>23.95%</td>
<td>28.99%</td>
</tr>
<tr>
<td></td>
<td>[0.29%]</td>
<td>[2.72%]</td>
<td>[3.46%]</td>
<td>[-6.49%]</td>
</tr>
<tr>
<td>Workforce</td>
<td>40.21%</td>
<td>24.64%</td>
<td>16.06%</td>
<td>19.09%</td>
</tr>
<tr>
<td></td>
<td>[-1.26%]</td>
<td>[-1.83%]</td>
<td>[0.64%]</td>
<td>[2.45%]</td>
</tr>
</tbody>
</table>

As can be seen from Table 2, the model calibration approximates the real distribution of residential population and workforce well. The bias between calibrated and real distribution is lower than 6.5% in each region. The spatial distribution of residential population and workforce further determines commuting volume and hence commuting flows are also reasonably approximated with a maximum bias of 5.2%.

UA show by far (over 40%) the highest number of workers (see also Table 2). However, residential population is comparatively low. UA are employment and industry centres, with a high share of shopping and recreation possibilities, but not favourably residential areas. One reason is that land prices are extremely high (tenfold that of SRA and DRA). By contrast, SRA have the highest share of residential population but do not offer enough workplaces for its residents. In other words, SRA as well as DRA are so called “bedroom communities” with a lack of local suppliers, services, workplaces and infrastructure. Hence, DRA and SRA show the highest outward-commuting share and are responsible for more than 60% of total interregional commuting volume.

In order to determine transport costs between and within the regions, as stated above, we use data from the Austrian transport forecast (Käfer et al., 2007) and parameterize these data to the iceberg cost factor T. We further assume that transport costs do not differ between commuting and shopping trips. In order to determine intraregional transport costs, we apply the average distance between all municipalities that belong to one type of region (see Figure 1). In terms of interregional transport costs we adopt the same approach, i.e. distances between model regions represent average commuting flows between municipalities. The lowest transport costs occur for trips within UA.
(T=1.03), because of short distances and good public transport. The highest transport costs arise for trips within SRA (T=1.19) because of long distances, high number of trips and high car dependency. Because municipalities are highly scattered within SRA, the resulting average distance is highest in this type of region (see Figure 1).

In terms of parameterization we also need to define elasticities of substitution. The following are of particular relevance here: First, the elasticity of substitution between the housing good and the aggregated macro good (\(alpha\)). Second, the elasticity of substitution between domestic and imported housing goods (\(beta\)), which represents the Armington elasticity in the housing market following the assumption of product heterogeneity (Armington, 1969). Third, the elasticity of substitution between different product varieties aggregated within the composite consumption good (\(gamma\)). For \(alpha\) and \(beta\) we assume a value of 1 (Cobb-Douglas functional form). In order to define \(gamma\), we choose a value of 5, taken from Eppink and Withagen (2009).

3 Policy Analysis

We conduct three policy simulations, where we analyze two spatial planning instruments and one transport policy. We thus aim to analyze the effects of different (types of) policy instruments on residential spatial structure and on commuting activity levels. We further couple the RCM with the Austrian transport forecast model (ATM) (Käfer et al., 2007) in order to quantify the effects of the applied instruments on overall transport volume (not just commuting trips), number of trips and modal split.

3.1 Spatial planning

In general, spatial planning instruments regulate the availability of housing and ensure that site development is well dimensioned relative to transport network and size of labour force. In order to study the effects policy can have to counteract rising sprawl levels and the arising commuting volume, we implement two spatial planning instruments: (i) area limitation in rural regions both sprawled (SRA) and densely populated (DRA) and (ii) expansion of housing availability in urban (UA) and peri-urban areas (PUA). Both instruments are implemented at such a stringency level that outward commuters to any other region (except their own) originating in DRA and SRA are reduced by 10%. The thus tackled commuting flows show longest distances, highest number of trips and are primary taken by car with some important indication for their environmental impact.

Area limitation in sprawled and densely populated rural regions (AL)

Instruments of area limitation such as land-use tax, tradable development rights and zoning tax aim to regulate or to stop arbitrary zoning on municipal level. The main focus is on the identification of land in locations that meet certain requirements such as
accessibility to public transport, mixed-use neighbourhoods, compact development and promotion of re-use of vacant and derelict land. The objective of a 10% reduction in interregional commuters originating in DRA and SRA is found to be met by an area limitation (for housing) to 34% in those regions (DRA and SRA). With fewer households residing in rural regions yet maintaining the need for workers in (peri-)urban regions, commuting can be mitigated this way.

Table 3: Distribution of residential population and workforce due to limitation of available housing in sprawled and densely populated rural regions (and changes compared to the no-policy case)

<table>
<thead>
<tr>
<th>Regions</th>
<th>UA</th>
<th>PUA</th>
<th>DRA</th>
<th>SRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential population</td>
<td>30.23%</td>
<td>22.43%</td>
<td>19.84%</td>
<td>27.50%</td>
</tr>
<tr>
<td>Workforce</td>
<td>40.63%</td>
<td>24.91%</td>
<td>15.98%</td>
<td>18.48%</td>
</tr>
<tr>
<td></td>
<td>[+1.03]</td>
<td>[+1.07%]</td>
<td>[-0.48]</td>
<td>[-3.29]</td>
</tr>
</tbody>
</table>

Table 3 reports the impacts of instruments of area limitation (type of policy instrument) on the spatial distribution of residential development. We observe a high influx of residential population to UA and PUA, whereas DRA and SRA are affected by a significant loss of residential population. These impacts can be traced back to changes in land prices (see Figure 2). An area limitation in DRA and SRA causes scarcity of building land and leads to a considerable increase in land prices in those regions. Figure 2 shows a land price doubling in DRA and strong decreases in land prices in UA and PUA. This shift in land prices promotes attractiveness of UA and PUA and thus strengthens agglomeration.

Figure 2: Change in land prices due to limitation of available housing in sprawled and densely populated rural regions

![Figure 2: Change in land prices due to limitation of available housing in sprawled and densely populated rural regions](image)

Expansion of housing availability in urban and peri-urban areas (EBL)

We analyze residential land policy that promotes compact development and mixed-use neighbourhoods. It subsumes instruments such as building land tax, land value tax and development impact fees. These instruments aim to prohibit further residential zoning before existing but not yet utilized building land is used. A 41% expansion level
of building land achieved through land mobilizing measures in UA and PUA leads to a 10% reduction in interregional commuting originating in DRA and SRA, the latter as defined the level necessary to allow comparability across types of instruments in our policy analysis.

Table 4: Distribution of residential population and workforce due to the expansion of available housing in urban and peri-urban regions (and changes compared to the no-policy case)

<table>
<thead>
<tr>
<th>Regions</th>
<th>UA</th>
<th>PUA</th>
<th>DRA</th>
<th>SRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential population</td>
<td>29.34%</td>
<td>22.35%</td>
<td>20.01%</td>
<td>28.21%</td>
</tr>
<tr>
<td></td>
<td>[+8.36%]</td>
<td>[+12.25%]</td>
<td>[-16.43]</td>
<td>[-2.67]</td>
</tr>
<tr>
<td>Workforce</td>
<td>40.16%</td>
<td>24.58%</td>
<td>15.66%</td>
<td>19.60%</td>
</tr>
<tr>
<td></td>
<td>[-0.12%]</td>
<td>[-0.23%]</td>
<td>[-2.56%]</td>
<td>[+2.57%]</td>
</tr>
</tbody>
</table>

The 41% expansion of building land in UA and PUA leads to a major decrease in land prices in those areas (see Figure 3). Hence, UA and PUA become more attractive and immigration is the result. Moreover, a nearly 50% increase of land prices in DRA leads to a substantial decrease in residential population (see Table 4).

Figure 3: Change in land prices due to the expansion of available housing in urban and peri-urban regions

3.2 Transport policy

Beyond spatial planning instruments, transport policy is also able to influence commuting flows and may affect residential development. Within transport policy, strategies and instruments to reduce commuting are manifold such as demand side management, technological policy, fiscal and regulatory policy. This paper focuses on instruments that affect the price of transportation, in particular of variable transport costs, such as road pricing, cordon pricing and fuel taxation.

Increase in variable transport costs (IVT)
We simulate an increase in variable transport costs by 30% caused by e.g. an increase in the fuel tax or by road pricing. According to the Austrian Household Budget Survey 2004/2005 (Statistics Austria, 2006), variable transport costs are about 8% higher in overall consumption expenditure share in DRA and SRA than in UA and PUA due to longer distances and higher number of trips involved. As a consequence, residential population in DRA and SRA is affected more by an increase in variable transport prices at equal per km rates.

| Table 5: Distribution of residential population and workforce due to an increase in variable transport costs (and changes compared to the no-policy case) |
|-----------------|-----|-----|-----|-----|
| Regions        | UA  | PUA | DRA | SRA |
| Residential population | 27.21% | 19.95% | 24.08% | 28.76% |
|                | [+0.22%] | [+0.19%] | [+0.56] | [-0.8] |
| Workforce      | 40.33% | 24.45% | 16.37% | 18.85% |
|                | [+0.30%] | [-0.78%] | [+1.91%] | [-1.28%] |

Interestingly, we find that impacts of 30% higher variable transport costs on residential population and commuting flows are negligible. Table 5 reports just a small decline in residential population in SRA. The three other regions show an inconsiderable increase in residential population. Thus, also commuting flows are hardly affected. It follows that in contrast to spatial planning instruments (cf. Table 3 and Table 4) transport policy has a minor impact on residential development and commuting flows. This implies that transport costs play a minor role in households’ residential choice, while land prices represent a main driving force for spatial settlement.

The literature is ambiguous concerning these results. Marler (2006) and May et al. (2003) state that spatial planning instruments are more efficient in rural regions to stop sprawl and to reduce private passenger transport. In addition to that May et al. (2003) find that instruments to increase transport costs are least efficient in rural regions. On the other hand, Kim et al. (2005) find that transport costs, in particular travel costs and travel time to work, are of key importance for residential choice and that housing prices play a minor role in households’ intention to move. Wardman (1998) and Perez et al. (2003) find similar results.

### 3.3 Insights from coupling these results with a transport model

In order to get results on a finer level of resolution we couple the residential choice model with the Austrian transport forecast model (Käfer et al., 2007). Complementary to the results obtained by the RCM as reported above, the ATM reports detailed policy impacts on (overall, not just commuting) transport volume, modal split and emissions.
The Austrian transport forecast model comprises a transport network model and a stochastic model of demand. In general, structural data on residential population and work force development is exogenous in this model. To improve upon this, our methodological approach is to endogenize residential development in the coupled RCM-ATM by incorporating structural output of the RCM into the ATM. As shown above, the RCM provides information on changes of the spatial distribution of residential population and labour force and commuting patterns through policy intervention. The thus determined changes can now be used in the ATM in order to estimate the effects of the policy instruments on overall (i.e. trips of all purposes) transport volume, number of trips and modal split.

In terms of definition, transport volume considers number of trips and distance and is measured in passenger-kilometres. In this study, transport volume (and number of trips) per region by definition include all traffic flows originating from that region or being internal to this region. The modal split comprises the following modes of transport: car driver, car passenger, public transport, bike and pedestrian.

**Transport volume and number of trips of motorized private passenger transport**

The impacts on number of trips and transport volume of motorized private passenger transport of the spatial planning instruments both area limitation (AL) and expansion of building land (EBL) are similar in the direction of effects (see Figure 4 and Figure 5). As mentioned before, both instruments cause migration of residential population from DRA and SRA and therefore transport volume is reduced considerably in these regions. The migration also leads to a significant reduction in number of trips taken by car, reported in Figure 5. On the other hand, the increase in residential density in UA and PUA, in case of AL and EBL, leads to ambiguous results. First, transport volume is increasing for PUA (see Figure 4) as are the number of trips (see Figure 5). The increasing number of trips taken by car together with the influx of residential population is responsible for the increase in transport volume in PUA. Second, in contrast to PUA, both spatial planning instruments, AL and EBL, lead to a reduction of transport volume of motorized private passenger transport in UA (see Figure 4). UA is characterized by compact and mixed-use neighbourhoods and offers good access to public transport and hence distances are shorter and people switch to public transport. Consequently, transport volume is decreasing. Third, in case of AL and EBL, the number of trips of motorized private transport in UA is rising (see Figure 5). Hence, the substantially shorter distances in compact and mixed-use neighbourhoods offset on average the higher number of trips caused by the residential influx.

A 30% increase in variable transport costs (IVT) leads to a considerable reduction of transport volume of motorized private passenger transport in all areas (see Figure 4). DRA and SRA are more affected and thus show highest reduction. One major reason for that is found in the higher share of variable transport costs in total consumption
budgets relative to UA and PUA (see section 3.2). Figure 4 also reports a considerable reduction of transport volume in UA and PUA. Through higher transport costs people switch to public transport and distances are reduced because of better route choice. An increase in transport costs also affects number of trips taken by car. The slight decrease in number of trips in DRA and SRA (see Figure 5) is a result of relatively high variable transport costs. Through higher transport costs, the number of trips taken by car increases in PUA. Hence, results suggest that the compact and mixed-use neighbourhoods together with the limited access to public transport in PUA lead to shorter distances but to a higher number of trips. As expected, the number of trips of motorized private transport decreases in UA, because of well-functioning public transport links and compact and mixed-use neighbourhoods.

**Figure 4: Changes in transport volume of motorized private passenger transport for different regions and policy scenarios**

![Figure 4](image)

**Figure 5: Changes in number of trips of motorized private passenger transport for different regions and policy scenarios**

![Figure 5](image)

**Modal Split**

Figure 6 illustrates the impacts of spatial planning and transport policy on modal split. Area limitation (AL) and expansion of building land (EBL) considerably promote environmentally friendly passenger transport, in particular cyclists and pedestrians. However, public transport declines, mainly in the case of AL. The effects of spatial
planning instruments on car-drivers and car-passengers are of minor importance. As expected, higher transport costs (IVT) favour environmentally friendly modes of transport. As reported in Figure 6, cyclists and pedestrians show a considerable increase in transport volume (more than 10%). Furthermore, public transport becomes more attractive and transport volume increases by more than 5%. Impacts on car-drivers are modest.

Figure 6: Changes in modal split (measured in transport volume) for different regions and policy scenarios

4 Conclusions

This paper attempts to study and identify how households’ residential location choice in its spatial manifestation is interlinked with demand for passenger transport. The paper further aims to analyze the impacts of different policy instruments on residential location choice and commuting flows. First, a multi-region, static general equilibrium model is developed that depicts households’ interdependent choice of residence location and place of work. With this model, the impacts on residential spatial structure and commuting level of two spatial planning instruments and one transport policy option are analyzed. In order to obtain additional detail of policy impacts in terms of overall transport volume, number of trips and modal split, we couple this model with the Austrian transport forecast model.

Results of the policy analysis report that spatial planning instruments, such as area limitation in densely populated and sprawled rural areas, have a key impact on residential location choice. Via changes in land prices they are thus most suitable to mitigate urban sprawl and to reduce land consumption and commuting volume. On the other hand, spatial planning instruments hardly affect transport volume and number of trips. Results for this type of instruments report only a modest shift in the modal split in favour of environmentally friendly passenger transport such as pedestrians and cyclists. These results suggest that energy-efficient spatial planning is a necessary but not sufficient condition in order to reduce motorized private passenger
transport. Thus, further incentives in transport policy such as expansion of public transport supply and quality improvement or other transport demand management instruments to foster modal choice are of key importance.

Our analysis further confirms that transport policy instruments that directly and substantially affect the price of transportation reduce transport volume and number of trips. Moreover, these instruments promote environmentally friendly passenger transport and thus lead to a significant shift in modal split in favour of public transport, cyclists and pedestrians. However, transport (pricing) policy hardly influences residential location choice and choice of workplace.

We conclude that land prices are a major driving force of households’ residential choice, while transport costs are of minor importance. One reason can be found in the cost structure of mobility services: Households, in their location choice (and choice of work-place), focus on just a fraction of real transport costs, i.e. on variable costs such as fuel costs and road charge. Other cost elements such as insurance or wear and service costs are often not sufficiently taken into consideration. Another reason can be found in the time frame of decision making and discounting: Households do not consider the long-term impact of transport costs within location choice which implies high discount rates of transport costs.

The methodology used in this study has limitations and caveats. The first one concerns the level of resolution: I.e. location choice within a region is not modelled within the RCM. Second, other factors such as neighbourhood amenities (e.g. a viable landscape or air quality), influencing residential choice and the intention to move, are not considered due to data limitations and the simplified structure of the NEG framework.

As for future research, we intend to incorporate transport choice in the RCM in order to simulate transport policy on a finer level of resolution. This may change the results and is expected to lead to a higher efficacy of transport policy. We might further incorporate additional factors that drive residential choice in urban-rural environments such as a regional index for living quality (a methodological base for such an extension has been laid by Bednar-Friedl et al., 2011, in a two-region framework). Nevertheless, the present results do show the explanatory value of NEG based CGE analysis in practical policy advising.
References


Statistics Austria (2005), Großzählung 2001 - Ausgewählte Maßzahlen nach Gemeinde, Vienna.

Statistics Austria (2006), Austrian Household Consumption Survey 2004/05, Vienna.