Migration and Job Change Decisions in Times of Strongly Rising Energy Prices

–

The Microsimulation Model €LAN

Eva Gerhards, Anna Rauch and Max Bohnet*

June 2012

* We thank Thiago Guimarães and Gesa Matthes and all other members of the €LAN project for commenting and Dinah Schmechel for proof-reading.

Corresponding authors:

Eva Gerhards
Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln (FiFo)
Wörthstr. 26, D-50668 Köln
E-mail: gerhards@fifo-koeln.de

Anna Rauch
Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln (FiFo)
Wörthstr. 26, D-50668 Köln
E-mail: rauch@fifo-koeln.de

Max Bohnet
Institute for Transportation Planning and Logistics
Hamburg University of Technology
Schwarzenbergstr. 95, D-21071 Hamburg
E-mail: max.bohnet@tu-harburg.de

Das diesem Bericht zugrundeliegende Vorhaben wurde mit Mitteln des Bundesministeriums für Bildung und Forschung unter dem Förderkennzeichen FKZ 033L016A-C gefördert. Die Verantwortung für den Inhalt dieser Veröffentlichung liegt beim Autor.

Abstract

How will rural and urban structures look like in the long term if energy related prices rise strongly and permanently? Will households adjust their transport behavior or their residence and workplace locations to rising energy prices? The research project €LAN analyzes those questions and their implications for the Hamburg metropolitan area. In order to provide a tool for long term simulation the €LAN microsimulation model – a comprehensive integrated land use and transportation model that explicitly considers potential policy intervention – was developed. €LAN consists of nine interdependent modules (demography, firmography, transport demand, labor market, housing market, real estate market, public budgets and household budget, macroeconomic background). This paper focuses on the labor and residence modules, which deal with the long-run adjustments of private households in the course of energy price changes. A microeconomic approach is chosen to reflect the actual decision making process. The €LAN microsimulation model explicitly considers that the residence and workplace relocation consists of various decisions: First, the households (or individuals) decide whether to search for a new job and residence at all (decision to move; decision to change jobs), then they have to decide where to search (search area) and finally they have to decide which residence to take or wich job to apply for (residential choice, job choice).

Keywords: land use, transportation, energy price, simulation, workplace location, residence location

1. Introduction

To understand how households and individuals decide, when to move and where to live, and when to switch jobs and where to work has been of major interest to economists, urban planners and politicians for a long time (Pagliara et al. 2010, Hensher and Button 2000, Ben-Akiva and Lerman 1985). Our research focuses on the influence of heavily and permanently rising energy prices on the aforementioned decisions. We develop the €LAN microsimulation model – a comprehensive land use and transport model (LUT) – to provide long term projection of the impacts of rising energy prices on urban and rural structures for the Hamburg metropolitan area.

The trend in the development of urban and rural structures in Germany pinpoints that transport costs – in terms of time and money – effect the workplace and residence decision. In times of low energy prices people moved out of the cities to benefit from cheaper housing prices (economically motivated suburbanization) (Beckmann et al. 2007b, p. 148). This process of suburbanization was favored by benevolent policies (e.g. home owner allowance and commuter tax relief). Commuting time was the constraining factor: average commuting time in Germany is 25 minutes. Only few people accept to commute more than 60 minutes (infas/DLR 2010). During the last years the trend has started to reverse and people are moving back into the city again.

This paper focuses on two modules of the €LAN microsimulation model: the labor and residence modules. The €LAN microsimulation model explicitly considers that the migration process consists of multiple successive steps (see Matthes 2011): First, the households (or individuals) decide whether to search for a new job and residence at all (decision to move; decision to change jobs), then they have to decide where to search (search area) and finally they have to decide which residence or job to take (residential choice, job choice).

€LAN has the following working hypotheses: if prices rise, households will respond more elastically to a change in energy prices than empirical evidence suggests. Nevertheless, the number of households (or individuals) which adapt their behavior as a direct response (budget pressure) to the rise of energy-related prices is limited. However, households (or individuals) searching for a new job or residence due to other reasons (e.g. birth of a child) also take rising energy costs into account. Thus, the growing proportion of energy costs in household budgets will play a role with regard to the residence and workplace location choice even if they are not the trigger.

The remainder of the paper is organized as follows. Section 2 provides background information about the €LAN project and the microsimulation model €LAN. Section 3 and Section 4 explain the underlying factors of the decision process. Section 5 draws some conclusions.

2. More on €LAN

€LAN *Energiepreisentwicklung und Landnutzung* is an interdisciplinary and transdisciplinary research project conducted by the Hamburg University of Technology (TUHH), the FiFo Institute for Public Economics (FiFo Köln) and the Institute of Regional Development Planning (IREUS Stuttgart). The project is funded by the German Federal Ministry of Education and Research. It started in October 2010 and will be completed in September 2013.

The research project €LAN analyzes the impact of strongly and permanently rising energy prices on rural and urban structures. A rise in heating and transport costs affects household, firm and public budgets alike. Our research is particularly interested in the extent to which households adjust their transport behavior, workplace and residence location in response to rising energy costs. In order to adequately answer our research question, we build an integrated land use and transportation (LUT) model for the Hamburg metropolitan area. To use a LUT model is the decisive factor for the project's success since it accounts for interactions and interdependences between the markets involved in these decisions – such as labor market, transport, real estate and residence market. Worldwide there are a couple of well-known and sophisticated LUT models, for example UrbanSim by Waddell et al. (2010) or the Oregon2 Model by Hunt and Weidner (2010) or the DELTA-Model by David Simmonds Consultancy (Simmonds 2010).

To the best of our knowledge, there are only two further LUT models in Germany – one for the Dresden region (Rümenapp et al. 2004) and the IRPUD/ILUMASS-Model for the Dortmund metropolitan area (Wegener 1998, Beckmann et al. 2007a). Most other (simulation) models are only sectorial and simulate either the labor, or the transport, or the real estate market. Many regional transport models focus on travel times and neglect travel costs. This development is understandable considering the rather low energy prices in the past. However, this trend has changed and energy prices will most likely continue to increase (peak oil warnings) (e.g. Capros et al. 2010 and International Energy Agency 2011). Thus, accounting for travel costs is of great importance for long term simulations.

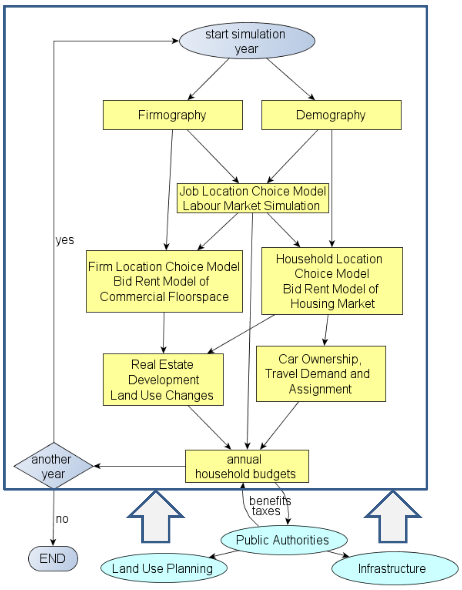
In the beginning of 2012 the impact of rising energy prices on household budgets was a hot topic in the German media, attracting public and political awareness. This pinpoints how urgent our research question is. Hence, €LAN is not only interesting from an academic perspective but of practical importance for German politicians and urban planners.

The unique feature of the €LAN microsimulation model is that it explicitly incorporates monetary costs as well as opportunity costs when analyzing household and individual choices. In addition, it provides a wide range of options regarding long-term projections. Since the project is still ongoing, we will only present a working draft of our model. Further improvements and upgrades are soon to be implemented or planned.

For the base year we created a synthetic population of 2 million households and 100,000 firms by combining different data sources (German Microcensus, local statistics and commercial firm data) using hierarchical iterative proportional fitting (Müller and Axhausen 2011) and Monte Carlo simulation methods, as well as a detailed model of 1 million buildings in the Hamburg metropolitan area (see Meinel 2008).

The €LAN simulation model consists of nine interdependent modules: The demography module projects demographic developments including births, deaths, marriages and separations. The firmography module presents the firms' counterpart to the demography module capturing growth, decline, opening, and closure of business establishments. In the labor market supply (individuals) and demand (firms) meet. The labor market module is rather sophisticated since the matching process considers the economic sectors, skill levels, qualification, occupational status, experience, full time or part time work as well as further characteristics and will be presented in further detail below. Household decisions for car ownership and the commute mode choice of all workers is simulated taking travel costs and times, and income into account. Mode and destination choice for other trip purposes is modeled using a macroscopic travel demand model. Housing demand – determined by the households' willingness to move – meets offered housing in the housing market simulation (see Section 3 and 4). The same applies to demand and supply for commercial floorspace. Increasing demand for floorspace in an area will lead to higher prices in the next simulation period and new urban development in that area – as far as land use regulations allow (denser) buildings.

Figure 1: €LAN microsimulation model structure



Source: Bohnet and Gertz (2011, p. 9).

The tax and transfer system microsimulation module FiFoSiM computes the households' net income – and hence the households' disposable income – taking into account the whole structure of the German tax and transfer system including matrimonial splitting, tax allowances, tax reliefs, tax credits, transfers and social security contributions. Last, we model the public budgets by projecting local, state and federal revenues and expenditures while considering the federal and state fiscal equalization scheme. Most €LAN modules – demography, firmography, labor market, housing market and long term travel decisions – employ a dynamic microsimulation approach. We do not expect equilibrium outcome on all markets (housing, labor, land), however, we capture the interactions between supply, demand, and prices using feedback mechanisms in the subsequent simulation period.

What is special about the €LAN project is that it includes a policy management game with real world politicians, advisors and members of the local, state and federal administration to provide insights into "the black box politics". After simulating 7 years, we present our results to the players of the management game. In order to ease interpretation, understanding and to provide a rather realistic future scenario we use hypothetical regional spatial development reports, newspaper articles and other communication means. The players are asked how they would react to the presented scenario and which kind of policy intervention they would use. There is a variety of potential reactions: For example, politicians could try to ease the effects of rising energy prices (rise commuter tax relief) or to adapt to it (development of public commuter systems). The case is complicated by the fact that there might be winners and losers: While politicians from well-connected suburban areas might face an influx of the population, those from long-commuting towns might face desolation.

The management game will be one of several simulated scenarios (status quo scenario assuming passive reactions, a subsidy scenario and a technological process scenario).[1] What sets this project apart is that we implement political intervention in a long term projection. One important goal is to increase public awareness of the implications of a strong and permanent rise in energy prices considering demographic and economic developments. Being part of this project hopefully increases the players understanding of the impacts of public intervention and helps the players to adapt in the case of rising energy prices.

As outlined above, this research project is of major importance for the political decision makers and the ongoing public debate. Nevertheless, the €LAN microsimulation remains a model. We neither intend nor pretend to make exact projections. As in every model and long term projection, we need to make assumptions and to simplify real world interdependencies. All model developers face the danger of building models which are too complex to handle and explain. This is why assumptions and simplifications have to be made. A review of the related literature showed that different model developers chose very different approaches depending on their primary interest and goals (particularly the

[1] These scenarios are preliminary and might be changed.

models presented in Pagliara et al. 2010). In the following sections we explain our model approach and comment on the choices we had to make to keep the model manageable.

3. Decision to Move and to Change Job

How will rural and urban structures look like in the long term if energy related prices rise strongly and permanently? Will households adjust their transport behavior or their residence and workplace locations to rising energy prices at all? To study the impacts of rising energy prices is of great practical importance in Germany, because transport and heating costs are on the rise. This is a significant change in trend: for decades housing costs rose disproportionately while mobility costs sunk disproportionately to general living costs (oil crises are an exception) (Beckmann et al. 2007b, p. 148).

Today German households spend around half of their income for housing and transport (Statistisches Bundesamt 2010). Rising energy costs – transport and heating costs – have an immediate and significant negative effect on household budgets. If households do not adapt their energy-related behavior, they have to reduce other budgets to cope with the decrease of disposable income. Households face a wide range of options to reduce their energy dependence and energy-related costs (see also Bohnet and Gertz 2011 and Gertz et al. 2009).[2]

When and to which extent households react to a strong and permanent energy price rise is difficult to predict since Germany has experienced a slow but steady rise for the last decades (with the exception of some price shocks: e.g. oil crises in the 1970s and 2008). Empirical evidence suggests that households tend to be rather insensitive to changes in energy prices – at least in the short run.[3] However, all elasticity measures available in literature are derived by analyzing data of the last decades, which experienced a slow constant rise in energy related prices, while the €LAN project assumes a strong and permanent increase. There are a number of reasons (psychological factors, income elasticity of demand and opportunity costs) which suggest that households change their behavior after a certain price limit is exceeded (see also Hautzinger et al. 2004, pp. 186 f.). Hence, simulations which are based on empirical data generally underestimate the effect of household response to a permanent and strong increase in price.

---

[2] Options to reduce transport-related costs: use car more efficiently (more fuel efficient cars, car pool, drive more efficiently), reduce activities, modal shift (public transport, non-motorized modes, tele-working), spatial reorganization (activities close to home, change workplace or residence). Options to reduce heating-related costs: energy-efficient renovation, lower temperature level inside the house, reduce house size or change energy source.

[3] Hautzinger et al. (2004) provide an international literature review of fuel price elasticity studies. According to them short term elasticities tend to be rather low (-0.2 to -0.4) while long term elasticities are significantly higher (-0.6 to -0.8).

€LAN copes with these uncertainties by artificially differentiating between direct and indirect reactions:

- There are a (limited but rising) number of households (or individuals) which adapt their behavior as a direct response to the rise of energy-related prices in the short run (cost-induced reaction). These households aim to reduce their energy-related costs through mode switch, job change or residence change.
- Most households take rising energy costs only indirectly into account when searching for a new job or residence due to other reasons (event-induced reaction e.g. birth of a child).

While the former households decide to move and to change jobs due the rising prices the latter do not. Nevertheless, it is important to understand that the development of energy prices plays a role in both cases. Moreover, travel costs are an important determinant of the search area (see Section 4).

Direct reactions:

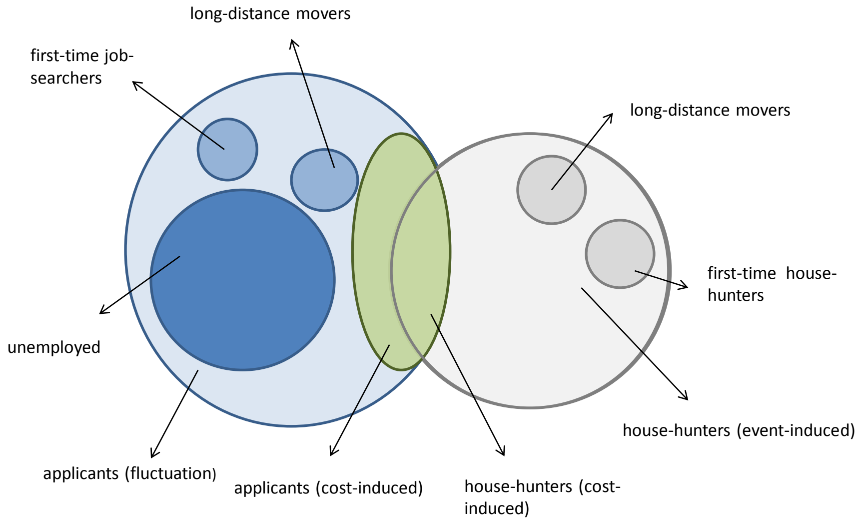
Households (or individuals) react to the rise in energy prices if a certain predetermined acceptance limit is exceeded. The acceptance limit varies across households with different income and other socio-economic characteristics and is restricted by budget shifting possibilities. Furthermore, a relative and absolute acceptance limit is respected. Due to this mechanism, there is no automatic and immediate response but a certain delay. Only if changing the means of transport does not reduce energy-related costs significantly, searching for a new residence or job becomes an option. We see residence or job change as a last resort due to the high transactions and search related costs. €LAN uses a synthetic population whose structure bears a close resemblance to the real population in the microsimulation study area. Hence, there is an extremely heterogeneous household structure with zero, one, and two- worker households.

While modeling cost-induced behavior changes, we had to face the following challenges: first, for multiple-worker households the moving and job change decisions are made on different microeconomic levels. Many contributions to this strand of research circumvent problems restricting their models to one-earner households (e.g. Waddell et al. 2007). Based on the work of Feldman et al. (2010) we deal with this problem by employing the main earner concept. Second, the workplace and residential location choice are not independent from each other. To establish this we follow the approach of Waddell et al. (2007) in its basic idea but developed a more comprehensive model to permit more variation and heterogeneity in the population.

Waddell et al. (2007) consider that some households choose the residence first and the workplace based on the residences while others choose the workplace first and the place of residence afterwards. The decision process follows a three equation model: Initially, depending on household characteristics the probability of choosing the residence or the workplace first is determined. Then, given this probability, the probability of choosing a workplace location (residence location) out of a set of workplaces (residences) is determined.

Following Waddell et al. (2007) discrete choice analysis is employed to determine if it is more likely that one of the household members enters the labor market to start searching for a new job (cost-induced applicant) *or* if the household tries to find a new residence (cost-induced house-hunter) (green ellipsis in Figure 2).

Figure 2: Applicants and house-hunters



Source: own illustration.

The assumption is that a household is either searching for a residence or one of the household members is searching for a job (no simultaneity) to not boost the model. This assumption is reasonable due to the short simulation periods.

Indirect reactions:

The majority of the applicants and house-hunters are searching for new jobs and residence due to other reasons (e.g. dissatisfaction with current job or birth of child) (blue and grey circles in Figure 2):

Long distance movers: each year households move into and out of the microsimulation study area. A scenario of the total yearly inter-regional migration flows was developed based upon the actual migration pattern and a macroeconomic forecast for the Hamburg metropolitan region. The microsimulation then “translates” these flows into synthetic households that leave the study area within each simulation period and into newly arrived households drawn from the German Socio-Economic Panel (GSOEP) sub-sample of long-distance movers (See Wagner et al. 2007 for more on the GSOEP). Some of the in-migrants search a job and do job-anchored residence searches. Other in-migrants join an existing household for personal reasons, and then eventually look for a job or a larger apartment in the subsequent simulation period.

Unemployed individuals: all those individuals who were unemployed in the previous period and did not find a job. Furthermore, the firmography provides information on those who lose their job in this period due to layoffs and bankruptcies. Parameters for the firmography are derived from the Establishment History Panel (Hethey-Maier and Seth 2010).

House-hunters (event-induced): there are many other reasons which induce a move such as birth of a child. The household *decision to move* is modeled as a binary choice (stay versus search new residence), taking demographic triggers (e.g. change of household composition), dissatisfaction with the current home, and job-related reasons into account (Matthes 2011). The underlying parameters are estimated using the GSOEP.

Applicants (fluctuations): we draw a stratified random sample of all employed people to account for further causes of fluctuation in the labor market (e.g. job shopping). Certain characteristics such as economic sector are considered to match the marginal totals of the Establishment History Panel.

First-time job searchers and house-hunters: the demography module provides information on those who are searching for a job for the first time (e.g. after finishing school or university) or move out of their childhood home.

4. Search Area, Residential and Job Choice Model

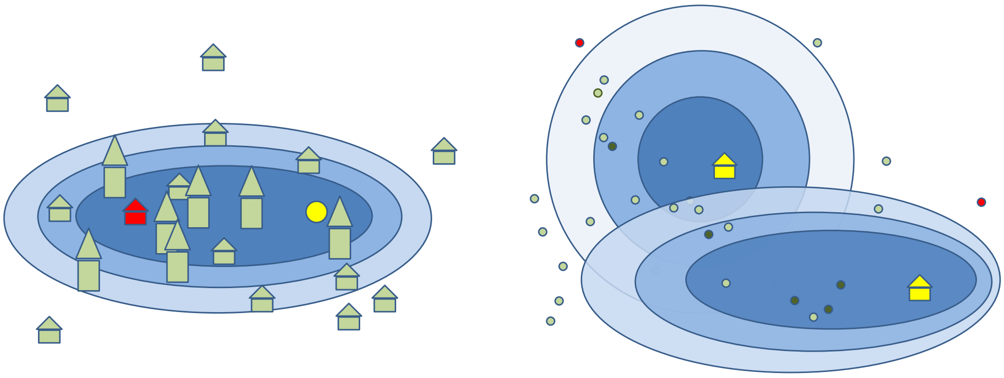
After Section 3 determined the individuals and households who enter the labor and the residential market, this section explains the household relocation process and the matching process between labor supply and demand. One important assumption made in Section 3 is that a member of the household either searches for a job or the household searches for a residence (no simultaneous relocations in one period). Modeling the matching process in the labor and housing market is challenging since a very detailed spatial structure is employed.

Search area:

For each household in search of residence a set of search criteria is defined (based upon analysis of the GSOEP: minimum floor space, for rent or for sale, maximum price and housing type). People often try to find a better residence in close proximity to their current home. An explanation for this behavior is that households want to maintain their social network after a move – large shares of a household's social network are clustered around their residential location.[4] This is why households with working members do a home- and job-anchored search. Households without workers (e.g. pensioners) search around their current home.

[4] According to Frei and Axhausen (2007) the median distance between a person's residence and their social network is 9 km.

Figure 3: Search area for house-hunters (left) and applicants (right)



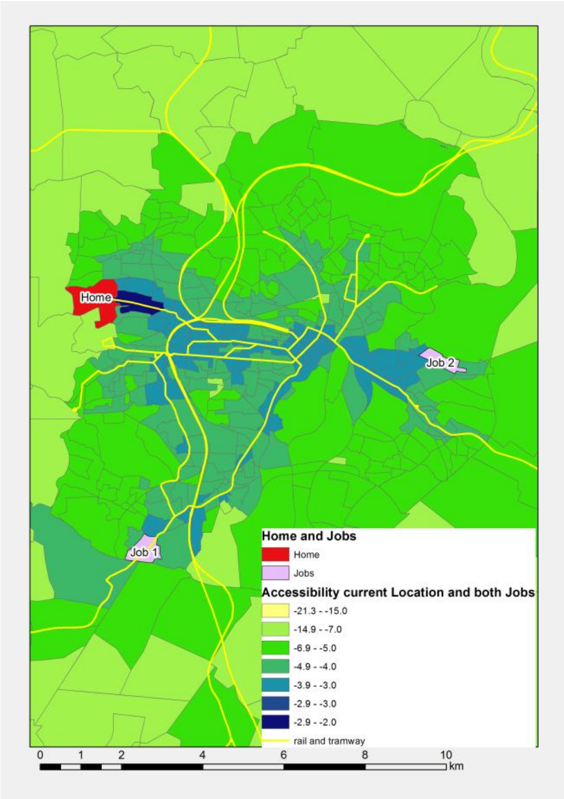
Source: own illustration.

Considering the two anchors (home and job) a search area that limits the overall travel time and costs to work and social network takes the form of an ellipsis (in a homogeneous space). The household only considers offers that match the pre-defined search criteria within in the initial search area (dark blue area in Figure 3). The search area is defined by the accessibility of the current residence and the job(s) of the household members in a way that the overall accessibility exceeds a certain threshold. As an accessibility measure acc_{iz} for household h to reach activity location i from zone z, the logsum of the mode choice model is used: $acc_{iz} = ln(\sum_{m \in M} e^{V_{izm}})$ (see Ben-Akiva and Lerman 1985, pp. 300ff.) i can be the current residence r or the job location *job1* or *job2*. V_{izm} is the systematic utility for the household to travel from zone z to activity location i with mode m. M is the set of available modes of transport. So all zones z are within the search area where $\mathrm{acc}_{r\_z} + \mathrm{acc}_{job1\_z} + \mathrm{acc}_{job2\_z} \geq \mathrm{acc}_{min}$.

If there are no suitable homes in the initial search area, the household widens the search area (to the light blue area in Figure 3 by decreasing the minimum accessibility acc_{min}) or loose the search criteria (accepted maximum price or minimum size). However, the household is constrained by certain absolute thresholds (in the simulation a household cannot spend more of its income than the 90%-percentile of its household type does, or live in smaller housing than the 10%-percentile).

For a household without a car and 2 jobs, Figure 4 shows the search area (blue area) which is clustered around the current residence (red) and along the transit lines that link the current residence with the job locations. The derivation of the search area is similar for job applicants. However, there is only one anchor (house) since the individual does not consider its former job location (see Figure 3 right).

Figure 4: Accessibility of jobs and current home



Source: own illustration.

Residential choice model:

In the first simulation period households apply for up to 20 residences that meet the search criteria within their search area (dark blue ellipsis of the Figure 4). The vendor or landlord offers the residence to the household with the highest income. Households that are offered several residential units that match their search criteria, have to decide which one to choose. This decision among the up to 20 units is modeled with a multinomial logit model. The probability of choosing a residence is based upon a utility function that includes variables such as: floor space (with a decreasing marginal utility of an additional area unit), accessibility to the household members' jobs and the current home, local or regional accessibility to shops and relevant services (e.g. schools for households with children), housing type, housing condition, noise (distance to major roads and railways), parks and open space (distance to green areas) and remaining income (available income minus housing and commuting costs).

Based upon the choice probabilities each household selects one residence; non-chosen residences are offered to the next household. If demand is larger than supply non-lucky households adapt their search criteria in the next simulation period. If the demand is smaller than the supply, unattractive residences stay vacant and landlords and vendors cut prices in the next period. The model parameters are estimated using a survey of nearly 1,000 recently moved households in Hamburg, which also provides information about the search process (Vallée et al. 2012). The estimation of the residential choice model also requires information on non-chosen alternatives which are sampled from real estate data provided by F+B Research in Hamburg.

Job choice model:[5]

While the determination of the supply side of the labor market – individuals searching for a job (applicants) – was explained in Section 3, the demand side – which derives from the firmography module – is not directly subject to this paper. While the firmography provides the number and characteristics of vacant jobs, the €LAN microsimulation model offers the following information regarding applicants and vacant jobs:

- *Applicant:* skill level, full or part time position[6], occupational status and economic sector of the previous employment (if available), age and years of work experience, duration of unemployment (if unemployed) and place of residence.
- *Vacant job:* required skill level for the job, full or part time, occupational status and economic sector as well as the firm's location.

The €LAN microsimulation model uses a innovative strategy to match labor supply and demand – finding the best match between applicants and jobs under consideration of frictions and incomplete information. The matching procedure is based on the idea of *distance functions*, which is a method frequently applied in statistical matching.[7]

The matching process consists of three steps: The first step checks if the job fits the applicant's interest. However, two restrictions apply: an applicant is only interested if the job is in the required search area and if the new wage is not significantly below the previous one (if existing). Second, the dissimilarity[8] between applicant and vacant jobs is calculated based on the variable occupational status. Finally, the distance between applicant and job is measured by adding penalties for "negative" or "unfavorable" characteristics such as limited professional experience, advanced age or progressed unemployment to the dissimilarity measure.

A firm offers the job to the applicant with the lowest *distance* according to the distance function given the *distance* is below a pre-specified limit. Hence, a

---

[5] Eva Gerhards and Anna Rauch would like to thank Eric Sommer for all his help regarding the labor market design. We are looking forward to cooperating on a more technical paper with him.

[6] The extensive and intensive labor supply decisions are simulated by the microsimulation model FiFoSiM (for more information see Peichl and Schaefer 2009, 2006).

[7] The search for statistical twins is known as statistical matching. The idea is, to assign a person g with a statistical twin g*. Those twins have a series of variables x (e.g. age, gender, education, and job) with the identical (or similar) variable attributions (e.g. Bacher 2002). Matching is, for example, employed to estimate or impute missings (e.g. Rubin 1973), to merge data (Rässler 2001) or determine a control group (Lechner 1999 and Gerfin and Lechner 2000).

[8] The dissimilarity measure is a simple matching coefficient for nominal variables (see Bacher 2010).

job might remain vacant. An applicant who receives only one offer accepts it immediately. If an applicant receives more than one offer the one with the highest net benefit is accepted (the number of offers is restricted). After accepting an offer, applicant and job exit the labor market. Since it is not very realistic that a firm submits only one job offer, the final steps (sending the offer and acceptance) are repeated a couple of times. The procedure, certainly, is an abstraction from normality, but it is a rather good imitation of an application procedure. Due to computing time constraints the labor market is separated according to skill level and part and full time jobs (interdependences are accounted for).

5. Conclusion

The research project €LAN studies the implications of permanently and constantly rising energy prices on rural and urban structures. By building the €LAN microsimulation model – a comprehensive integrated land use and transportation model for the Hamburg metropolitan area – we provide a tool for long term simulation which accounts for interdependences and rebound effects in the markets concerned. What is special is that €LAN considers potential policy interventions (e.g. regional planning) and explicitly models them.

Rising transport and heating prices have and immediate effect on household budget. This is why it is essential to adequatly model how households adjust their transport behavior, residence and workplace locations. This paper focused on the labor and residence module of the €LAN microsimulation model. The goal is to model all underlying process as realistic as possible while ensuring that the model design remains comprehensive despite all complexity. The €LAN microsimulation model explicitly considers that the migration process consists of multiple successive steps: In a first step the decision process is modeled (households (or individuals) decide whether to search for a new job or residence at all) (Section 3). Then the area in which the households (or individuals) search for a new job or residence is determined. Last, the matching of labor and housing supply and demand is modeled (residential choice, job choice (Section 4)). €LAN explicitly incorporates monetary costs as well as opportunity costs when analyzing household and individual choices.

Due to the fact that we are currently half-way through the project this paper only presents a working draft of the €LAN model. Comments on the model design are very welcome since parts of the models will be adjusted and improved throughout this year. The management game takes place between August 2012 and April 2013, thus, first simulation results can be expected mid-2013.

.

References

Bacher, Johann (2002): Statistisches Matching- Anwendungsmöglichkeiten, Verfahren und ihre praktische Umsettzung in SPSS. In *ZA- Informationen* 51, pp. 38–66.

Bacher, Johann (2010): Clusteranalyse. Anwendungsorientierte Einführung. München: Oldenbourg.

Beckmann, Klaus J.; Brüggemann, Ulrike; Gräfe, Jürgen; Huber, Felix; Meiners, Hans (2007a): ILUMASS - Integrated Land-Use Modelling and ransportation System Simulation. Endbericht. Available online at http://www.spiekermann-wegener.de/pro/pdf/ILUMASS_Endbericht.pdf, checked on 29/05/2012.

Beckmann, Klaus J.; Witte, Andreas; Driessen, Kathrin Blotevogel Hans H. Münter Angelika (2007b): Akteure, Beweggründe, Triebkräfte der Suburbanisierung. Motive des Wegzugs – Einfluss der Verkehrsinfrastruktur auf Ansiedlungs- und Mobilitätsverhalten. Edited by BMVBS/BBR (BBR-Online-Publikation, 21). Available online at www.bbsr.bund.de/nn_322000/BBSR/…/DL_ON212007.pdf, checked on 22/05/2012.

Ben-Akiva, Moshe; Lerman, Steven R. (1985): Discrete choice analysis. Theory and application to travel demand. Cambridge, Mass: MIT Press.

Bohnet, Max; Gertz, Carsten (2011): Simulating the impact of increasing oil prices on land use and mobility in the Hamburg Metropolitan Region. In John D. Hunt, John E. Abraham (Eds.): CUPUM 2011. 12th International Conference on Computers in Urban Planning and Urban Management. Proceedings CD-ROM. Lake Louise. Calgary (CD ROM).

Capros, Pantelis; Mantzos, Leonidas; Tasios, Nikos; Vita, Alessia de; Kouvaritakis, Nikolaos (2010): EU energy trends to 2030. Update 2009. Luxembourg: Publications Office of the European Union.

Feldman, Olga; Mackett, Roger; Richmond, Emma; Simmonds, David; Zachariadis, Vassilis (2010): A Microsimulation Model of Household Location. In Francesca Pagliara, John Preston, David Simmonds (Eds.): Residential location choice. Models and applications. Berlin: Springer, pp. 223–241.

Frei, Andreas; Axhausen, Kay W. (2007): Size and structure of social network geographies. Edited by IVT. ETH Zürich (Arbeitsbericht Verkehrs- und Raumplanung, 439).

Gerfin, Michael; Lechner, Michael (2000): Microeconometric Evaluation of the Active Labour Market Policy in Switzerland. In *IZA Discussion Papers* (154), pp. 1–75.

Gertz, Carsten; Altenburg, Sven; Hertel, Christof; Bohnet, Max (2009): Chancen und Risiken steigender Verkehrskosten für die Stadt- und Siedlungsentwicklung unter Beachtung der Aspekte der postfossilen Mobilität. Edited by BMVBS/BBSR. Available online at http://www.bbsr.bund.de/cln_016/nn_23582/BBSR/DE/Veroeffentlichungen/BBSR Online/2009/ON062009.html, checked on 29/05/2012.

Hautzinger, Heinz; Mayer, Karin; Helms, Maja; Kern, Christine; Wiesenhütter, Marc; Haag, Günter; Binder, Jan (2004): Analyse von Änderungen des Mobilitätsverhaltens - insbesondere der Pkw-Fahrleistung - als Reaktion auf geänderte Kraftstoffpreise. Forschung Mobilität Transport Verkehr (IVT); ProgTrans AG; Steinbeis-Transferzentrum angewandte Systemanalyse (STASA). Available online at http://ivt-institut.de/pdf/Kraftstoffpreise_und_Mobilitaet.pdf, checked on 14/02/2012.

Hensher, David A.; Button, Kenneth (2000): Handbook of transport modelling. Vol. 1. New York: Pergamon.

Hethey-Maier, Tanja; Seth, Stefan (2010): Das Betriebs-Historik-Panel (BHP) 1975-2008. Handbuch Version 1.0.2. Institut für Arbeitsmarkt- und Berufsforschung (IAB). Nürnberg (FDZ-Datenreport, 04/2010).

Hunt, J.D. Abraham J.E; Weidner, T.J (2010): Household Behavior in the Oregan2 Model. In Francesca Pagliara, John Preston, David Simmonds (Eds.): Residential location choice. Models and applications. Berlin: Springer, pp. 181–207.

Institut für angewandte Sozialwissenschaft GmbH; Deutsches Zentrum für Luft- und Raumfahrt (2010): Mobilität in Deutschland 2008. Methodenbericht. Bonn.

International Energy Agency (2011): World energy outlook 2011. Paris: IEA, International Energy Agency; OECD.

Lechner, Michael (1999): Identification and Estimation of Causal Effects of Multiple Treatments Under the Conditional Independence Assumption. In *IZA Discussion Papers* (91), pp. 1–18.

Matthes, Gesa (2011): Explaining Reurbanization. Empirical Evidence of intraregional migration as a long-term mobility decision from Germany. In : European Transport Conference 2011. Proceedings. Glasgow, October 2011. Association for European Transport.

Meinel, Gotthard (2008): Automatische Ableitung von stadtstrukturellen Grundlagendaten und Integration in einem Geographischen Informationssystem. Abschlussbericht. Bonn (Forschungen / Bundesministerium für Verkehr, Bau und Stadtentwicklung, Heft 134). Available online at http://www.gbv.de/dms/zbw/574682066.pdf, checked on 6/06/2012.

Müller, Kirill; Axhausen, Kay W. (2011): Hierarchical IPF. Generating a synthetic population for Switzerland. In : 51st European Congress of the Regional Science Association International. ERSA 2011. Barcelona. European Regional Science Association.

Pagliara, Francesca; Preston, John; Simmonds, David (Eds.) (2010): Residential location choice. Models and applications. Berlin: Springer.

Peichl, Andreas; Schaefer, Thilo (2006): Documentation FiFoSiM: Integrated tax benefit microsimulation. In *FiFo-CPE Discussion Papers* (No. 06-10), pp. 1–36.

Peichl, Andreas; Schaefer, Thilo (2009): FiFoSiM - an integrated tax benefit microsimulation and CGE model for Germany. In *International Journal of Microsimulation* 2 (1), pp. 1–15.

Rässler, S. (2001): Alternative Approaches to Statistical Matching with an Application to Media Data (Alternative Verfahren der Datenfusion mit einer Anwendung auf Media-Daten). Habilitationsschrift, Nürnberg.

Rubin, Donald B. (1973): Matching to Remove Bias in Observational Studies. In *Biometrics* 29 (1), pp. 159–183.

Rümenapp, Jens; Gutsche, Jens-Martin; Kutter, Eckhard (2004): Die Einflüsse des Leitprojektes intermobil auf die Mobilitäts- und Verkehrsentwicklung in der Region bis 2015: Ergebnisse von Wirkungsermittlungen und Simulationsuntersuchungen.

In : Tagungsband zum wissenschaftlichen Kolloquium des BMBF-Leitprojektes intermobil Region Dresden und des Alcatel SEL Stiftungskollegs für interdisziplinäre Verkehrsforschung an der TU Dresden am 9, und 10. Dezember 2004. Dresden.

Simmonds, David (2010): The DELTA Residential Location Model. In Francesca Pagliara, John Preston, David Simmonds (Eds.): Residential location choice. Models and applications. Berlin: Springer, pp. 77–97.

Statistisches Bundesamt (Ed.) (2010): Wirtschaftsrechnungen Einkommens- und Verbrauchsstichprobe Einnahmen und Ausgaben privater Haushalte (Fachserie 15, 4).

Vallée, Dirk; Witte, Andreas; Bruns, André; Beran, Fabian; Benden, Jan; Manz, Wilko et al. (2012): Chancen des ÖPNV in Zeiten einer Renaissance der Städte. Feldbericht. Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS) (BMVBS-Online-Publikation,, Nr. 2/2012).

Waddell, Paul (2010): Modeling Residential Location Choice in UrbanSim. In Francesca Pagliara, John Preston, David Simmonds (Eds.): Residential location choice. Models and applications. Berlin: Springer, pp. 165–180.

Waddell, Paul; Bhat, Chandra; Eluru, Naveen; Wang, Liming; Pendyala, Ram (2007): Modeling Interdependence in Household Residence and Workplace Choices. In *Transportation Research Record: Journal of the Transportation Research Board* 2003 (-1), pp. 84–92.

Wagner, Gert G.; Frick, Joachim R.; Schupp, Jürgen (2007): The German Socio-Economic Panel Study (SOEP). Scope, Evolution and Enhancements. In *Schmollers Jahrbuch (Journal of Applied Social Science Studies)* 127 (1), pp. 139–169.

Wegener, Michael (1998): Das IRPUD-Modell: Available online at http://www.raumplanung.tu-dortmund.de/irpud/pro/mod/mod.htm, checked on 29/11/2011.