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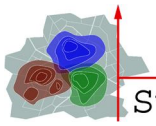
EUROPEAN POLICYBRIEF



SustainCity: Policy brief: New behavioural insights; Estimation results for selected case studies

This Policy Brief makes part of the WP5 of the SustainCity Project.

SUMMARY

Objectives of the SustainCity research	To advance the state of the art of urban simulation models and to improve their diffusion among planners and decision-makers. To develop a European-adapted version of the urban micro-simulation tool UrbanSim and to implement it in three European cities (Paris, Zürich, Brussels).
Scientific approach / Methodology of this deliverable	The object of this Policy Brief is to highlight key behavioural aspects relevant for land use and transport policies, estimate the corresponding models and quantify their consequences. In this context, we examine a series of decisions made by individuals or households, focusing, besides individual preferences, on constraints and within-family interactions affecting those decisions. We show that taking into account such constraints or interactions plays a significant role in decision making and considerably affects policy assessment.
New knowledge and/or European added value	There is a wide literature on household decisions related to transport or urban policies. However, this literature devotes too little attention to three key aspects of these decisions: 1) the heterogeneity in individual and household behaviour, 2) the constraints preventing individuals or households to select their preferred alternative in most of their decisions, and 3) the within-family decision process and its consequences on household choices. This policy brief highlights the policy implications of these three key aspects.

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Key messages for policy-makers, businesses, trade unions and civil society actors

Policy evaluation requires a consistent prediction of individual and household reactions to any policy related to transport or urban development, as well as the measurement of welfare or redistributive effects of such policies. We show on three examples applied to the Paris case study that heterogeneity in behaviour, constraints and within-family decision process play a central role in determining individual reactions to public policies, as well as welfare effects of these policies.

The first example concerns heterogeneity in individual choices of job type, job location and residential location. This heterogeneity implies that accessibility is an individual-specific rather than a universal notion. As a consequence, the benefit of any public policy such as the improvement in public transportation network should be evaluated separately on each segment of the population. For example, a better access to locations with a high concentration of white collar jobs would improve more the accessibility of highly educated workers than that of low educated workers.

The second example relates to credit constraints preventing some households to buy their dwelling. Alleviating credit constraints would not only increase the fraction of owners, it would also change the residential location of formerly constrained households. We show that this would have dramatic effects on the local social mix of the population.

The third example relates to the within-family decision process. We show that the household members' bargaining power is a significant determinant of household residential choices, and that ignoring it would lead to significantly biased estimates of the values of time and, as a consequence, of the benefit of any transport infrastructure.

Objectives of the SustainCity research

The objectives of the SustainCity research are to advance the state of the art of urban simulation models, to develop an European-adapted version of the urban micro-simulation tool UrbanSim, to implement it in three European case studies (Paris, Zürich, Brussels), and eventually to improve the diffusion of the urban simulation models among planners and decision-makers.

The modelling platform adapted for the context of European cities will be based on the existing software UrbanSim, which was originally developed for cities in the United States. (In the project reports, the adapted platform is referred to as "UrbanSim-E".)

UrbanSim-E, developed within SustainCity, will provide the means to evaluate the impacts of policy measures in European cities. With the sustainable development objective in mind, UrbanSim-E will provide a quantitative assessment of the trade-off between economic, environmental or social objectives.

Scientific approach / methodology

The aim of this project is to address the modelling and computational issues of integrating modern mobility simulations with the latest micro-simulation land use models. The project intends to advance the state-of-the-art in the field of the micro-simulation in prospective integrated models of Land-Use and Transport (LUTI). On the modelling side, the main challenges are to integrate a demographic evolution module, to add a firmographic module (birth and death of firms), a module representing the decision process in households with two active members, with regard to the household location choice, to add an environmental module, to improve the overall consistency and, last but not least, to deal with the multi-scale aspects of the problem: several time horizons and spatial resolutions are involved.

The SustainCity project includes also three case studies to take advantage of the achievements of the other tasks in order to undertake an empirical analysis on three European urban regions (Paris/Ile-de-France, Brussels and Zurich).

Reports (project deliverables) and working papers describing in more details the methodological approach are available on the project website www.sustaincity.eu.

1. Introduction

Across Europe, cities face the challenge of reaching a sustainable development, i.e. to maintain economic growth while taking into account environmental and social aspects of a globalized world, in order to improve the quality of life in urban communities.

In the scope of this challenge, the SustainCity research project aims to develop an urban modelling platform for European cities, based on UrbanSim. This platform will be tested in three case studies: Paris, Zurich and Brussels.

The object of this Policy Brief is to highlight why and how land-use/transport (LUTI) models are helpful for policy making. The next section of this Policy Brief is dedicated to the interactions acting in a city and notably the interactions between land-use and transport within a city. Then some topical issues in relation with the future of cities are highlighted, issues which can effectively be analysed with the help of LUTI models. More generally, we review the possible impacts of different policy measures on several economic, social and environmental aspects and show that many of them can be assessed using these models. To illustrate how LUTI models can help in assessing policies (against pre-defined targets) and in building a consistent package of policies, results of former research projects are also presented.

We analyse below the policy implications of three key behavioural aspects.

2. Heterogeneity in individual preferences and behaviour: Residential location, job location, job type & individual-specific accessibility

We analyse here the joint, or nested, decision of residential location (upper level), job location (middle level) and job type (lower level), with a special focus on the heterogeneity of these nested decisions, and on their policy implications.

Job type and job location are strongly interrelated decisions because the geographical distribution of jobs by type is very uneven across the region. Similarly, job location and residential location are strongly interrelated decisions because they jointly determine commuting time and commuting cost.

Lowest level of decision tree: job type choice

Depending on their education, gender, age and number of children, individuals have different preferences for job types, and therefore different probabilities of selecting different job types. Note that job type choice reflects not only worker preferences (labour supply), but also employer's preferences (labour demand) and equilibrium on the job market (various sources of unemployment). All these considerations are combined in the individual job type choice.

Compared to low educated workers, highly educated workers are more attracted by (or more likely to choose) white collar jobs. Similarly, low educated men are particularly attracted by blue collar jobs, whereas low educated women are particularly attracted by employee jobs. Based on job type preferences, we compute an individual-specific attractiveness measure, which

proves to be more relevant and more significant than the total number of jobs, to explain job location choice. Our attractiveness measure corresponds to a weighted average of the (log-)number of jobs of each type in the potential job location. The individual-specific weights of the different job types correspond to the individual-specific probability of choosing a specific job type.

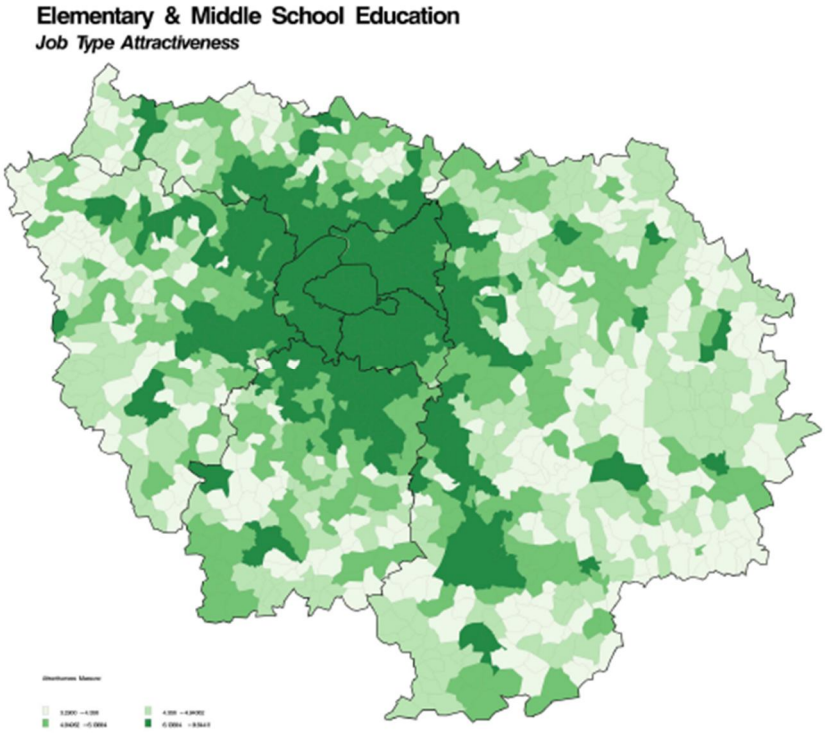

Figure 1: Attractiveness for the lowest education level

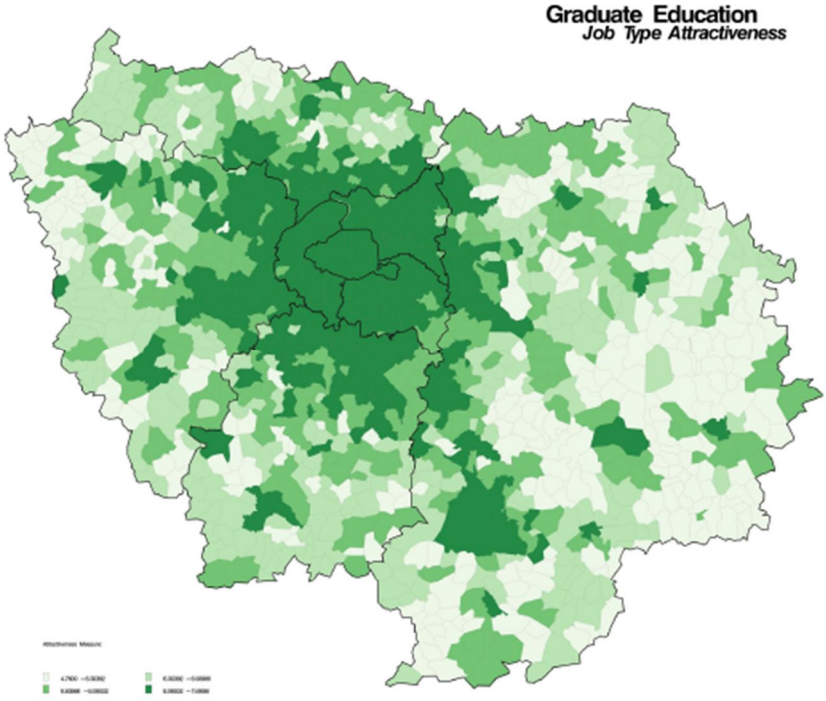

Figure 2: Attractiveness for the highest education level

The comparison of Figure 1 and Figure 2 shows that, in the far

east of the region, attractiveness is worse for the more educated workers than for the less educated ones. More generally, attractiveness is more unevenly distributed for highly educated workers than for low educated workers, which is consistent with the fact that high level jobs are more concentrated the low level jobs.

Intermediate level of the decision tree: job location

Conditional on residential location, job location results from a trade-off between job attractiveness (availability of jobs suited for the worker) and commuting cost. Commuting cost is determined by commuting time and Value Of Time (VOT), which varies a lot depending on individual characteristics such as age, education, gender, age and number of children (especially for women).

Heterogeneity in VOT and in perceived attractiveness of the different job locations results in heterogeneity in the perceived accessibility to jobs from alternative residential locations, which implies to define an individual-specific accessibility measure.

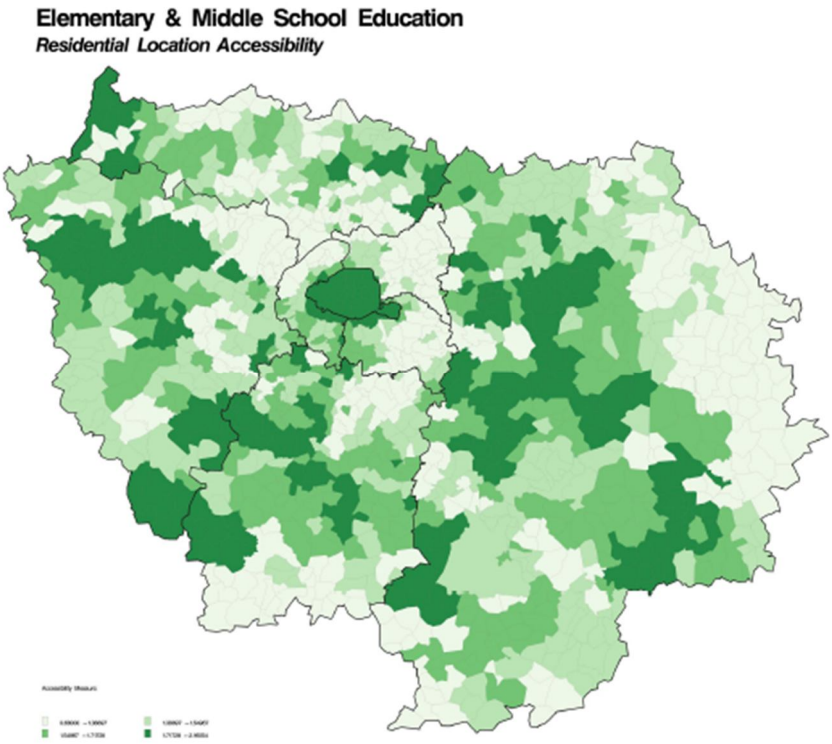

Figure 3: Accessibility for the lowest education level

This individual-specific accessibility measure varies a lot with individual characteristics such as education or gender. For the lowest education level (see Figure 3), accessibility is high inside Paris, in the large secondary centers, and along the RER lines, but it is rather low in the close suburbs (inner ring). On the opposite, for the highest education level (see Figure 4), accessibility is large in the inner ring, especially on the west, and accessibility is more concentrated than for the lowest education level.

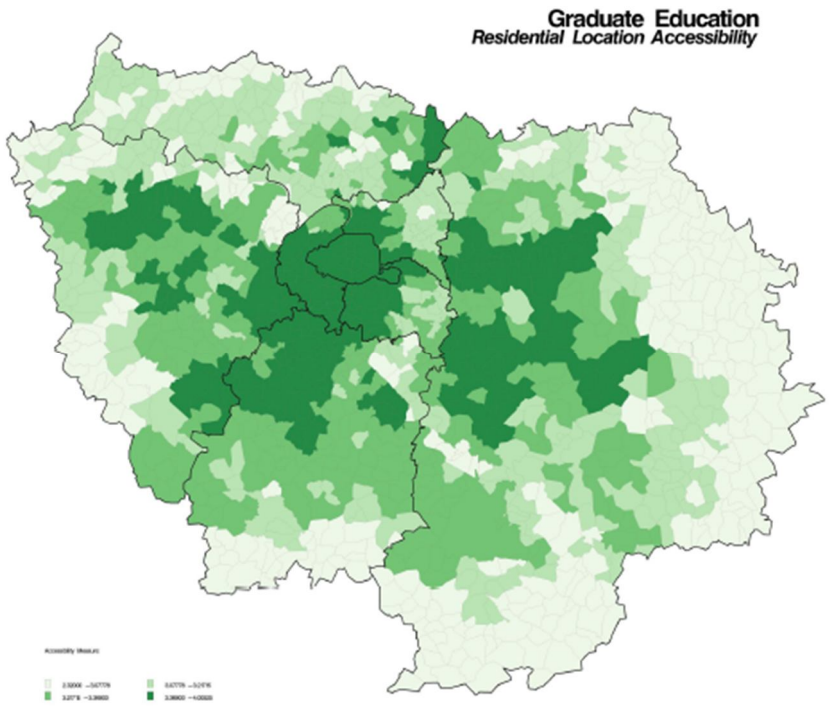

Figure 4: Accessibility for the highest education level

Highest level of the decision tree: residential location

Going up the decision tree, residential location is more sensitive to our individual-specific accessibility measure than to the usual universal accessibility measure. In addition, residential location is subject to a rich taste heterogeneity for local amenities, price elasticity and sensitivity to (individual-specific) accessibility to jobs.

Policy implications

The fact that accessibility varies a lot as a function of education, gender, age or number of children implies that the benefit of any transport infrastructure would vary significantly depending on these individual characteristics, which induces **redistributive effects**. This gives the opportunity to target transport infrastructure investments to specific population subgroups. The fact that households value this individual-specific accessibility rather than a universal accessibility measure implies differentiated **behavioural effects** of the infrastructure depending on individual characteristics of household members.

The redistributive effects of a transport infrastructure may either add to or oppose to its general effect of improving accessibility. If this infrastructure improves more accessibility of low educated workers than that of highly educated workers, this infrastructure will have desirable redistributive effects. If, on the opposite, the infrastructure improves more accessibility of highly educated workers than that of low educated workers, it will exacerbate inequalities and should be considered a socially regressive investment.

The heterogeneity of behavioural effects implies that any large transportation infrastructure would have differentiated effects on household residential location by educational level of household head and other members. An infrastructure improving access to highly qualified jobs would attract highly educated workers in a quite large sub-region made more accessible from the point of view of highly educated workers. On the opposite, an infrastructure improving access to low qualified jobs would attract poorly educated workers in the sub-region made more accessible from the point of view of poorly educated workers. Estimation results suggest that this sub-region is generally smaller and closer to public transport lines than in the case of highly educated workers.

3. Tenure status, dwelling type, residential location & credit constraints

In this section, we analyse the policy implications of the joint household decision of buying or renting a dwelling (tenure status), of selecting a single dwelling unit (house) or a flat (dwelling type), and of residential location. For this analysis, we focus on the role of credit constraints in this nested decision.

Credit constraints prevent specific sub-populations from getting access to credit, which would be needed for them to buy a dwelling. Constrained households only have the possibility to rent, whereas unconstrained households can choose between buying and renting their dwelling

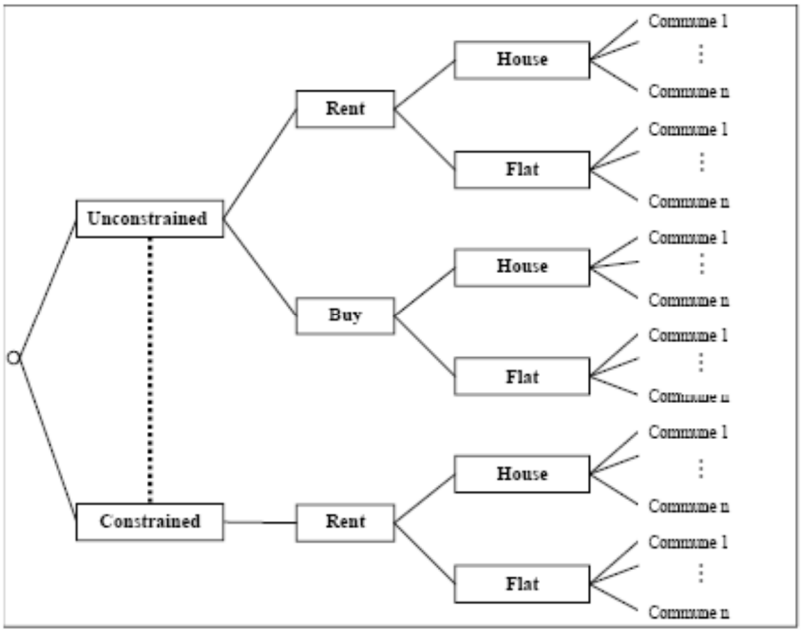

Figure 5: Nested residential decision tree with credit constraints

After estimating this nested model, we analyse its policy implications. The approach, mainly normative, aims at recovering the characteristics of the constrained households, and predicting

what they would like to do if credit constraints were alleviated. Our results are not descriptive of what the households would actually do, since we do not analyse the equilibrium effects of alleviating credit constraints. We simply state what a given household would do if credit constraints were alleviated for this specific household, but not for the other ones. In this sense, we propose a purely normative approach to assess the extent of credit constraints.

Measuring the extent of credit constraints

The idea underlying this section is that financial institutions tend to lend money only to rich and active people. To reflect this idea, we estimate the nested decision tree assuming that the probability that a household is constrained depends on its income and number of active members within the household. Household per capita income is divided in 3 equal-size categories (about one third of the households each), which defines rich, middle-income and poor households categories.

Our results show that household income per capita actually has a tremendous effect on the probability that this household is credit constrained, as illustrated on

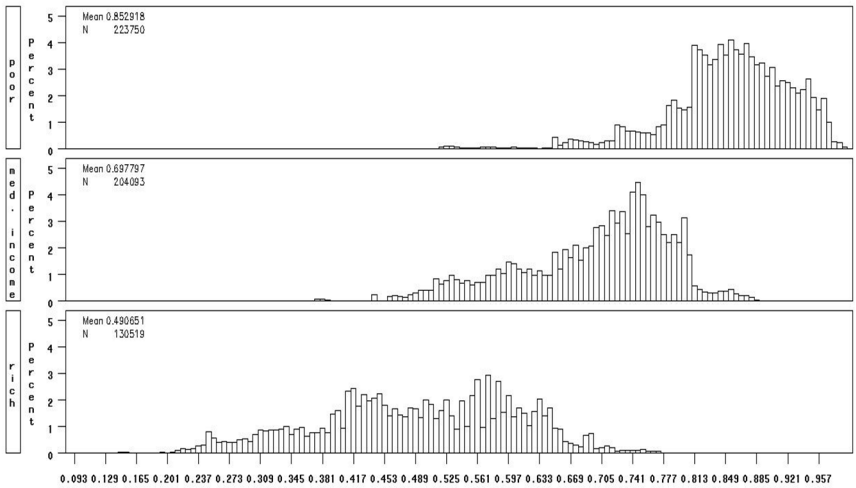

Figure 6.

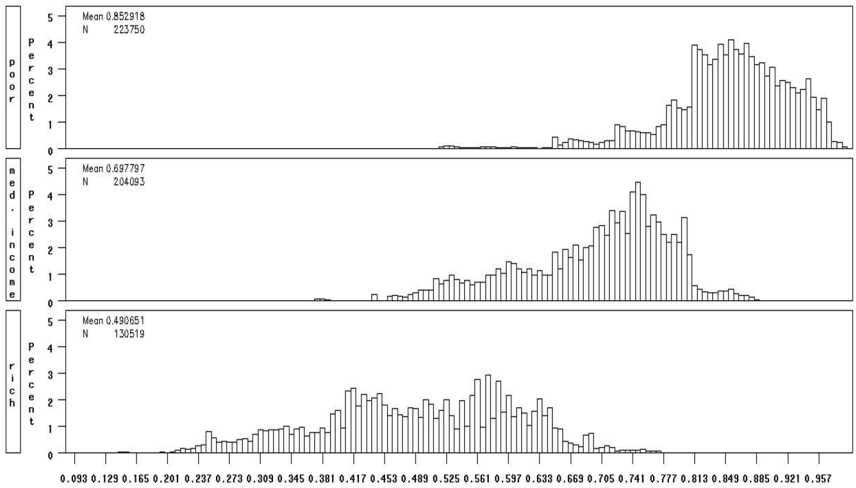

Figure 6: Distribution of the probability to be constrained among rich, medium-income and poor households

For the poor households, the probability to be constrained mainly ranges from 65% to 98%. For the middle-income category, the probability to be constrained mainly ranges from 45% to 80%. For the rich households, it mainly ranges from 20% to 70%.

In addition to be highly correlated with income, the probability to be constrained also significantly varies across the region, as illustrated on Figure 7.More than 70% of the households living in Paris central city are credit constrained, except in the rich western parts of the city. In the inner ring, the fraction of constrained households is also over 70%, except in the rich western parts, and also rich eastern parts ("Bords de Marne"). In tsuch suburbs, very rich households can afford buying a house. Credit constraints are less severe in the outer ring because intermediate income or moderately rich households can afford buying a dwelling there.

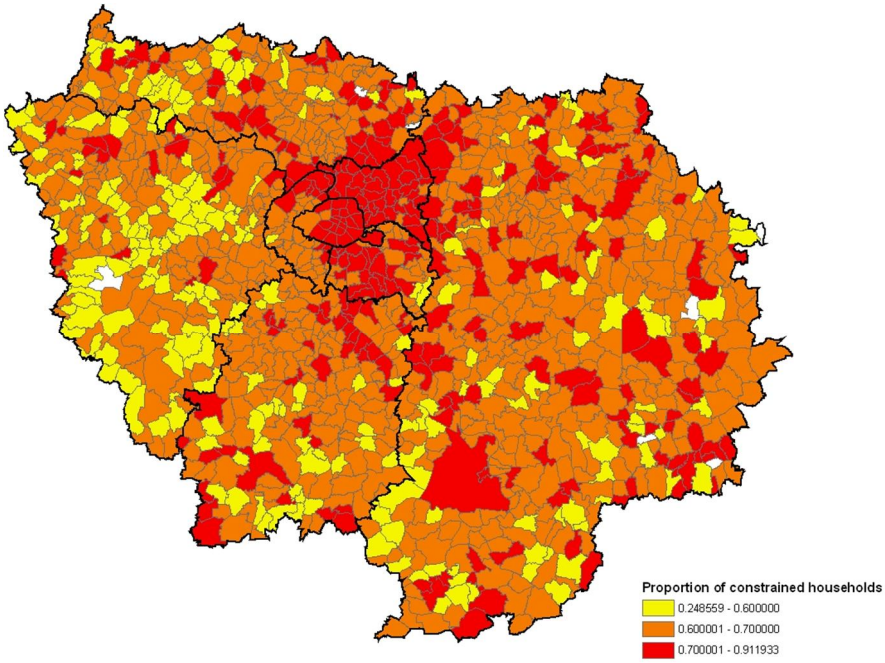

Figure 7: Proportion of households credit constrained

Where would credit constrained households like to go?

If credit constraints were alleviated, a huge fraction of households (up to 58%) would like to leave Paris or western inner ring, as illustrated on Figure 8. The comparison of the left-hand-side and right-hand size parts of Figure 8 reveals that a significant fraction of the households concerned is poor, since there would be a trend to leave Paris even if credit constraints were alleviated only for the poor households. However, there would be no tendency to leave the very center of Paris or some communes located in the western inner ring if credit constraints were alleviated only for the poor households.

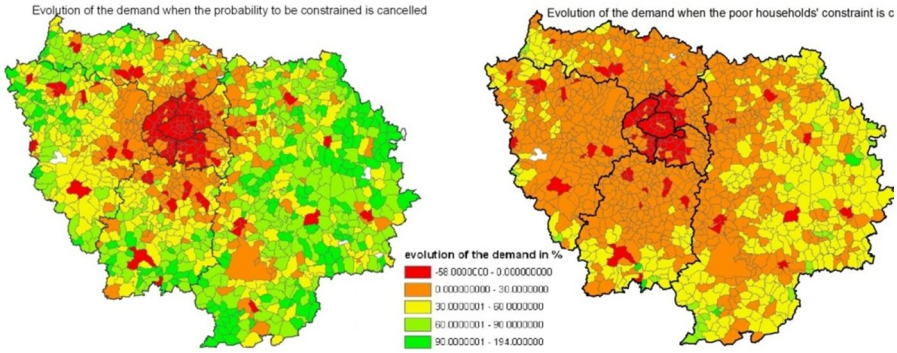

Figure 8: Change in demand if credit constraints were alleviated

If the households currently living inside Paris or in the western inner ring were given access to credit, the richest part of them would typically like to buy a dwelling in the outer ring or in the less expensive eastern parts of the inner ring. The intermediate income part of this population would typically buy a small dwelling in the far away suburbs, and the poorest ones would typically buy in the eastern outer ring or in the farthest away western parts of the outer ring.

More generally, alleviating credit constraints would make households willing to move farther away from Central Paris city and from the west to the East, that is from the most expensive parts of the city to the least expensive ones.

The reader should keep in mind that this is not a measure of what households would actually do if they could borrow, but rather a measure of what they would like to do in this case. Since a very large number of households would like to move in the same direction, simultaneously alleviating credit constraints on a large number of households would necessarily have significant effects on local prices, and the actual location of population resulting from this reform would not correspond to Figure 8.

What is the influence of credit constraints on the social mix?

4. Couple Residential location, spouses workplaces and bias in the VOT

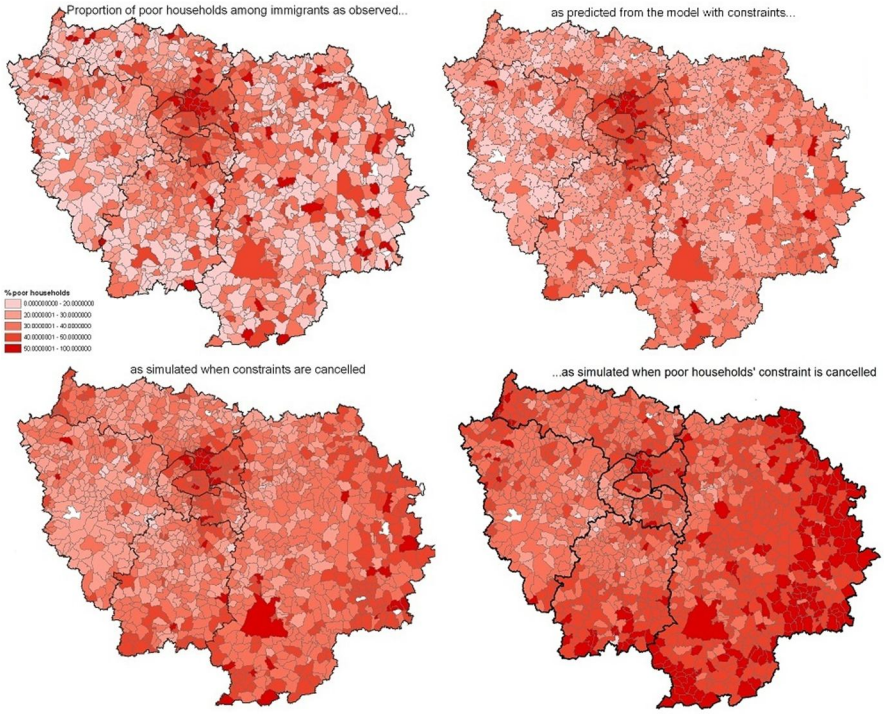

Figure 9: Change in the fraction of poor households if credit constraints were alleviated

Before computing the effect of alleviating credit constraints on the social mix of the population, we check that this social mix is accurately predicted by the model. This corresponds to the upper part of Figure 9, which looks very similar on the left-hand part (observed) and on the right-hand side (predicted by the model in the current situation).

The lower part of Figure 9 shows that poor households would be more concentrated in the eastern outer ring without credit constraints (left-hand side), especially if credit constraints were alleviated only for the poor households (right-hand side). This means that credit constraints tend to limit social segregation by retaining some fraction of poor households in the central and western parts of the region. In other words, alleviating credit constraints on the poor households would have detrimental consequences on social segregation since this would induce poor households to concentrate in the farthest away and cheapest parts of the region. This socially regressive aspect of this specific policy has to be balanced with its other (generally progressive) effects, which are usually taken into account in policy evaluation.

In this section, we open the black box of the within-family decision process and show that the household members' bargaining power is a significant determinant of household residential choices. More importantly, we show that ignoring within-family bargaining process would lead to significantly biased estimates of the values of time and, as a consequence, of the benefit of any transport infrastructure.

A large fraction of the benefit of any transport policy aiming at reducing travel times is determined by the individual benefit of the reduction in commuting cost. This individual benefit is jointly determined by the change in commuting time and the individual-specific value attached to travel time. Our first example showed that this value significantly varies across individuals. We now question the accuracy of the measurement of this value in the case of dual earner families.

In dual earner families, conditional on spouses' workplaces, residential location results from the trade-off between husband's commuting cost, wife's commuting cost, local real estate prices and local amenities. The idea here is that the weight associated to woman's (resp. man's) commuting cost in this trade-off depends on the spouses respective bargaining powers. In this case, neglecting bargaining power implies to incorrectly assign to commuting costs what actually corresponds to bargaining powers.

In order to correct the resulting bias, we have developed and estimated a model allowing to disentangle commuting cost from bargaining powers in a residential location choice model estimated among dual earners couples. This allows to correct the bias in the estimation of individual-specific values of time, and therefore to consistently estimate the benefit of transport policies.

Our estimation results show that the wife's bargaining power increases with her age faster than it decreases with the husband's age. This implies that the wife gains more and more bargaining power when the couple ages.

The husband's bargaining power is significantly lower when he is a foreigner, whereas the woman's nationality has only a marginal impact on her bargaining power.

The spouses bargaining power also depends on their respective education level and on their number of children.

We have estimated a quadratic function for the disutility of commuting time, which allows the marginal VOT to depend on commuting time. The resulting function would be non-monotonous for very large commuting times (typically more than 4 hours), but this is out of the range of observed commuting times, and the disutility of commuting time is increasing in the range of observed commuting times, as expected.

The estimated spouses values of time are significantly different when bargaining power is taken into account. In typical cases illustrated below, the magnitude of the bias, which depends on spouses' characteristics, is larger than the real (unbiased) husband-wife difference in VOT.

Consider the example of a 40-year-old couple illustrated on Figure 10. The unbiased VOT of the first minute commuting time (marginal VOT at the origin) corresponds to 9.34€ per hour, whereas the biased estimate (neglecting bargaining power) is 7.45€ per hour. This means that the VOT of a 40-year-old man is under-estimated by more than 20% when within-family bargaining

power is neglected. By contrast, the VOT of a 40-year-old woman is over-estimated by more than 15% (8.11€ per hour instead of 7.02). As a result, biased estimates suggest that the woman's VOT is larger than the man's VOT (8.11€/h and 7.45€/h, respectively) when both are 40 years old, whereas the real figures show the opposite (7.02€:h and 9.34€:h).

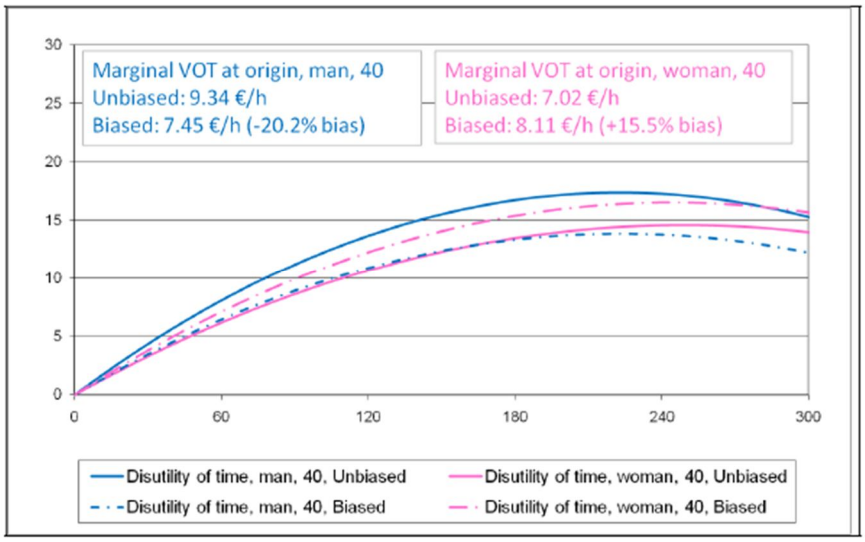

Figure 10: Biased and unbiased VOT for a 40-year-old couple

The bias goes the other way for a 20 year-old couple. The biased estimates correctly predict that the man's VOT is larger than the woman's VOT when both are 20 years old, but the biased estimates predict a 4€/h differences at the origin, whereas it is only 2.6€/h in reality.

Our results show that neglecting within-family bargaining power would lead to under-evaluated the benefit of transport infrastructures for older men, whereas it would lead to over-estimate it the benefits of transport infrastructures on younger people, and on women of any age.

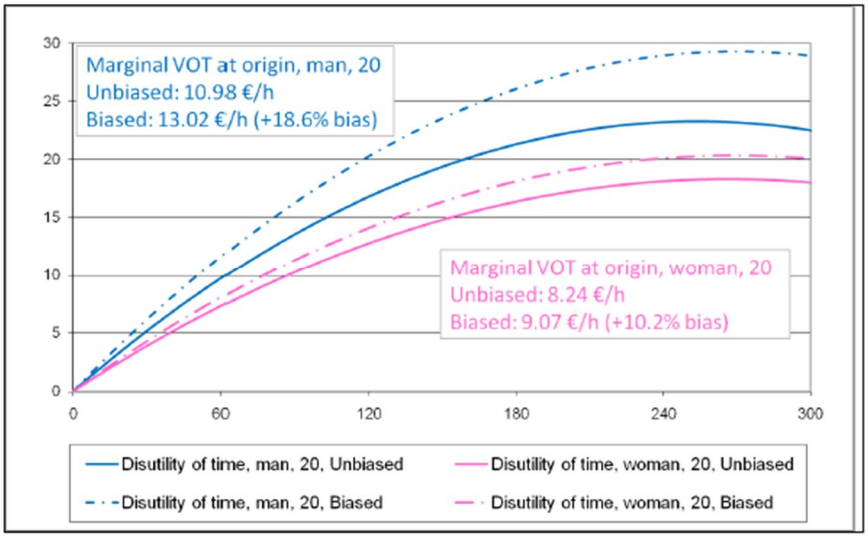

Figure 11: Biased and unbiased VOT for a 20-year-old couple

As a result, neglecting within-family bargaining power would incorrectly induce to target transport policies too much in direction of young people, whereas efficiency of transport policies would require to target them more to older workers, especially men, who actually value most their commuting time, and would have a higher willingness to pay for reducing commuting time than younger men or women.

Conclusion - Key messages for policy-makers, businesses, trade unions and civil society actors

The evaluation of transport or urban development policies requires an accurate measurement of the behavioural and redistributive effects of such policies.

In order to be accurate enough, this measurement should rely on sophisticated econometric methods and on consistent economic models.

Three aspects deserve specific attention when evaluating transport or urban development policies.

1. Individual behaviour and reactions to any policy are highly heterogeneous, and the effects of policies are to be evaluated separately on each relevant sub-population. This differential evaluation should be a key element in targeting policies.

2. Individual behaviour results not only from preferences but also from different constraints, such as credit constraints preventing households to buy their dwelling and leading them to locate in a place different from the one they would have selected if they had access to credit. Taking into account such constraints is required to consistently the redistributive and behavioural effects of any transport or urban development policy, and therefore to efficiently target policies.

3. Household behaviour depends not only on individual preferences but also on the respective bargaining powers of household members. Neglecting the role of bargaining power would lead to incorrectly affect to preferences the effect of bargaining power, inducing a bias in the measurement of preference parameters such as the Value Of Time. The resulting bias in the individual benefit of transport or urban development infrastructures would lead to an inefficient targeting of these policies.

PROJECT IDENTITY

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Budget	2'695'652

PROJECT IDENTITY

Website	www.sustaincity.eu
Further readings	Dantan, S. (2013) " Intergenerational transmission of inequalities: the role of public policies ", PhD dissertation under the supervision of A. Lefranc and N. Picard, University of Cergy-Pontoise, France. de Palma, A., I. Inoa, N. Picard (2013). « Discrete Choice Decision-Making with Multiple Decision Makers within the Household", in Handbook of Choice Modelling, Hess and Daly Eds, forthcoming. de Palma, A., K. Motamedi, N. Picard, and P. Waddell (2005): "A Model of Residential Location Choice with Endogenous Housing Prices and Traffic for the Paris Region," *European Transport*, 31, 67-82. de Palma, A., K. Motamedi, N. Picard, and P. Waddell (2007a): "Accessibility and Environmental Quality: Inequality in the Paris Housing Market," *European Transport*, 36, 47-74. de Palma A., K. Motamedi, N. Picard, P. Waddell (2007b). "Accessibility and environmental quality: inequality in the Paris housing market", *European Transport*, 36, 47-74. de Palma A., N. Picard, P. Waddell (2007). "Discrete choice models with capacity constraints: an empirical analysis of the housing market of the greater Paris region", Journal of Urban Economics, 62(2), 204-230. de Palma A., N. Picard, A. Ziegelmeyer (2011). "Individual and couple decision behavior under risk: evidence on the dynamics of power balance", Theory and Decision, 70(1), 45-64. Inoa, I., N. Picard, A. de Palma (2013). "Effect of an Accessibility Measure in a Model for Choice of Residential Location, Workplace, and Type of employment, Mathematical Population Studies, forthcoming. Waddell, P. (2002) UrbanSim: Modeling Urban Development for Land-Use, *Transportation and Environmental Planning: Journal of the American Planning Association*, 68 (3) 297–314.
Related websites	www.urbansim.org
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