

Referee Report:
Efficiency and Equity Impacts of Urban Transportation Policies with Equilibrium Sorting
March 17, 2022

A. Summary

This paper uses a residential sorting general equilibrium model of consumer home and commute transportation choice to compare the equity and efficiency impacts of a number of various policies that are being considered to reduce congestion in Beijing. This model is the first to the knowledge of the authors to account for endogenous congestion spillovers within this context that would in turn impact consumer's home and commute mode choices.

The authors leverage two household level datasets on individual commuter trips and transportation modes and home buyers home and work locations respectively in Beijing to analyse this question. The authors begin their model by first running a discrete choice model with random coefficients to assess consumer's probability of choosing various modes of transportation for their commute. The parameters estimated from this first model allow the authors to estimate a parameter for the expected utility from commuting for specific home/work locations combinations. This calculation of expected utility is then an input into the model for housing demand where home buyers choose their home location conditional on the location of their workplace to maximize their expected utility. Finally, the authors set a number of market clearing conditions to find a unique vector of home prices which denote an equilibrium in the housing market and an equilibrium congestion level. This equilibrium condition allows for households to re-sort following a policy change and thus allows the authors to assess the long term efficiency and equity implications of various congestion-oriented policy counterfactuals.

The authors find that driving restrictions have a net negative impact on welfare for both high and low income consumers as the loss in consumer surplus from the choice restriction outweighs the gains from congestion reductions. Further, they find that congestion pricing leads to gains for all consumers when revenues are recycled lump sum uniformly across individuals. They find that the welfare-optimizing policy is a combination of subway expansion and congestion pricing, although high income consumers benefit more from both.

B. Assessment

Overall I think that this paper asks an important policy related question and answers it well. Congestion costs hundreds of billions of dollars in foregone GDP annually across the world and the most severe impacts are found in the developing world. It is therefore crucial for policy makers to understand the benefits and costs of various congestion-oriented policies, particularly in settings like Beijing. Further, it is important to understand the equity implications of various of policy implementations, and the authors are able to address long term distributional concerns using their model of re-sorting. To add to the fact that this is an important setting, the authors utilize a novel structural model to estimate these policy effects, and their incorporation of endogenous congestion flows can be used in further work in the transportation economics field. Finally, the authors were

able to take advantage of granular, household level data and I thought that the use of a travel API to construct the time and monetary values of various commute options was both costly to the authors and very well applied to this context, I think that future work will benefit from this application as well.

C. Information for the Author

Large Concerns

1. The authors note that they analyze subway expansion as one of their counterfactual policy simulations, but they only compare the 2008 Beijing subway network to that of 2014 after an expansion. It would be helpful for the authors to provide a more general analysis of subway expansion that details the impact of marginal investments in subway infrastructure. This further analysis should investigate both the amount spent on expansion and the impact of expansions in various spatial locations. This analysis would allow policy makers in other cities to understand how they can invest to expand their subway systems in cost-efficient ways.
2. The authors use a static random coefficients discrete choice model to analyze consumer household and transportation mode decisions, and then incorporate market clearing conditions to estimate a general equilibrium. Because buying a home is such a large decision with many future wealth implications, the authors should employ a dynamic discrete choice model to analyze the timing of these decisions. This would allow the authors to understand how subway expansions impact the timing decisions of buying a home and consumers expectations of future home values, particularly in the context of a rapidly urbanizing city.
3. The authors use a transportation survey to analyze consumer choice of commuting methods, but they never mention how weather or fixed costs might impact individual's choice sets. For instance Beijing has a rainy season during the winter months and I would think that consumers would be much less likely to walk or bike to work on a rainy day than they would be when the weather is clear. Weather data is rich and widely available, so I would assume that authors would be able to account for this in their model. At the very least the authors should mention why weather is not a relevant choice-influencing decision in this context. Further, the fixed costs associated with both biking and car travel that the authors do not mention in much detail. For very low income or credit constrained consumers, biking and driving may not be options that are available to them, at least on a day to day basis. Further, the decision to invest in a car or bike is a one-time fixed cost that changes an individuals choice set permanently. The authors should discuss how these fixed costs play into their model.
4. The main threat to identification in the transportation method demand model is the potential for correlations between the variations in comfort of a particular mode of transportation and the time and money costs of that mode. The authors make a convincing argument as to why price and quality shocks might not be correlated as public transportation prices are federally regulated and gas prices are exogenous, but I believe that comfort shocks and the time cost

of various modes of transportation would be correlated. The authors should provide a more thorough explanation of this threat and how its violation would impact the results.

Smaller Concerns

5. On page 15 the authors state that an assumption of their model is that work locations are given and consumers choose their housing locations as a reaction to this condition. They provide three reasons as to why this assumption is valid but I believe that this is actually conditional on the income class of the consumer. For instance a high income consumer working in a competitive field would be more likely to find a job and then choose their home location as a reaction, but a low income consumer who works in a service industry job might be more likely to do the inverse. The authors should discuss how this correlation would bias their results.
6. The authors estimate a value of time parameter that is linear in income. I understand why they might do this, but I believe that there are other considerations that might need to be taken into account in a value of time calculation such as whether or not individuals have children or multiple jobs.
7. On page 18 the authors give an equilibrium condition for travel speed that is based off of road capacities and demand. They do not include the likelihood for accidents and how this would impact traffic. They should include a shock for traffic collision and how this would impact congestion.
8. On page 20 the authors discuss why the absence of positive spillovers such as agglomeration effects is crucial for the uniqueness of a fixed point in their equilibrium. They should provide further discussion as to why agglomeration effects are unlikely in this scenario.
9. On pages 22 and 23 the authors describe their use of the time-varying likelihood of winning a license lottery is correlated with housing prices. They should provide further explanation of the mechanisms at play here and list what the assumptions are for the validity of this instrument.
10. On page 30 the authors use a constant elasticity supply model to model supply in the Beijing housing market. This does not seem reasonable to me. There must be a cap on housing supply, particularly in dense areas. The authors should provide further explanation as to why this model is reasonable or they should provide sensitivities that use various methods of modelling housing supply.

D. Contributions

As stated above, I think that this paper contributes to a number of different literatures, transportation economics in particular. Further, this paper contributes to a growing list of general equilibrium residential sorting methods, most notably began by Bayer et al. (2004). This paper offers novel contributions to the literature and utilizes both novel methods and novel data. Further it asks an important, policy-relevant, question and provides convincing evidence to answer it. I think that upon the revisions listed above this paper would be well suited to publication in the AER.