Our Spatial Paper

Your Name

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Abstract

Please be concise.

1 Introduction

What is the question or policy you want to examine? Although we encourage creativity, our main goal is to make you more familiar with quantitative spatial models and give you some practice. If you have hard time coming up with an implementable idea, you can choose from the following list of topics

paste in jeffrey's motivation from erh meeting We are going to examine the impact of the introduction of autonomous vehicles (AVs) on the spatial distribution of economic activity.

While AVs have not been widely adopted yet, they are no longer a speculative technology. Several cities currently permit their use via rideshare. Several states are currently making decisions about how to regulate AVs (citation XYZ). We are specifically interested in how AVs will differentially affect places with large amounts of high-skill vs. low-skill workers, as AVs will likely be complementary I am not sure complement is exactly the right word to the labor of high-skill people, but more likely ot be a substitute for low-skill labor.

2 Background and Diagnostic

Prompt: (a) Why is the question or policy you want to examine important? (b) Why is a quantitative spatial model the right tool to answer the question? (c) Are there any particular features of the policy/economic environment that are impor- tant for the analysis? Feel free to focus on one or a few aspects that you want to study in depth and identify the underlying mechanisms, which will inform you about the key elements to be included in your model.

The key question we have is: how the reduction in commute costs will differentially affect employment, economic activity and rents, across the country, based on their skill levels. need to sharpen this up a little bit. what's the exact outcome we're interested in?

The widespread adoption of AVs will likely have large effects on the spatial distribution of economic activity. People will be able to work while they commute, and engage in types of leisure that are currently difficult to do while (e.g. watching television). This will permit people to live further from work. Furthermore, there is substantive uncertainty as to how states will regulate AVs. We hope our exercise will inform these regulations.

Our setting lends itself well to quantitative spatial models in the style of (Redding and Rossi-Hansberg, 2017). The key economic change in our model is a change in the cost of commuting. A lack of detailed data on AVs precludes a reduced-form analysis. And even with such data, without explicitly modeling the movement of goods and people, we risk being subject to the Lucas Critique by not factoring in certain margins of adjustment. Our focus on commuting means we will not richly model the choices of, e.g., the housing sector or goods firms This motivates us to begin with the model of (Monte et al., 2018).

The key novel feature of the economic environment we hope to study and shed light on is that AVs will serve as a complementI am not sure complement is exactly the right word for high-skill labor, but as a substitute for low-skill labor. A full treatment of this question will require a model with at least two types of agents, and endogenous wages. In this draft, for tractability, we capture the AVs-as-substitute intuition in a reduced-form way, by modeling the introduction of AVs as reducing bilateral commute costs more for county-pairs with higher skill levels.

3 Model

We begin with the model of (Monte et al., 2018).

3.0.1 Simplifications and Tweaks

In a future draft, we may consider the following simplifications:

1. removing trade (insert Jeffrey's theory stuff here)

In a future draft, we may consider the following extensions:

1. (i) heterogeneity: explicitly model high and low skill types
2. (ii) endogenize low-types' wages.
3. (iii) consider the forward-looking decision of a household to purchase an A.V.
4. (iv) an optimal tax on AVs to incorporate its labor-replacing externality (?)
5. (v) incorporate AVs for *goods* transport!
6. (vi) choices by firms?..

7. (vii) non-constant effects, some surveys on the topic suggest a higher percent gain in utility from longer commutes in AVs (would require solving for $\mathcal{B}_{ni}$)

4 Data and Estimation

We use data on wages (based on place of work), commuting flows, distances, etc.

Estimating ψ
Estimating ϕ
Estimating ϵ
Calculating productivity vector A_i

We do not need to invert the bilateral amenities matrix $\mathcal{B}_{in}$. Instead we can use exact hat algebra for our counterfactuals of interest.

5 Counterfactual

We take as our base economy the one with no AV adoption, and commuting costs are calibrated using existing flows.

We then shock the economy by introducing varied adoption, based on the aggregate skill-level of the county pair.[1]

We model the percent change in bilateral commute costs, $\hat{B}_{ni}$ as follows: We define the skill level of county i, s_i as the share of the population above 25, who have at least a Bachelor's Degree, which we pull from the ACS 2006-2010 5-year estimates. Define the population-weighted college share of county pair ni as

$$s_{ni} = \frac{R_n s_n + R_i s_i}{R_i + R_n}$$

To incorporate time data into the model, we use the alternate interpretation of (Monte et al., 2018), of commuting costs as a loss of work time.

$$\hat{\kappa}_{ni} = s_{ni}\hat{\kappa}^{AV} + (1 - s_{ni})$$

Where $\hat{\kappa}^{AV}$ is the relative reduction in commute time costs relative to human-driven vehicles (HVs), (assumed to be homogeneous across county-pairs).

We calibrate $\kappa^{\hat{AV}}$ as follows. Wwe want total effective labor to be 8 hours, before AVs. And the mean US commute time is 26.7 minutes (ACS), or 0.89 hours. Then assume that, conditional on commuting by AV, an agent is able to work the entire time big assumption , at twice the productivity discount from WFH (to capture e.g. spotty Wifi, motion, etc.). big assumption We get the WFH productivity discount using the midpoint of 13.5% from Gibbs

[1] Computationally, we implement this as a change in B_{ni}, since a given change $\hat{\kappa}_{ni}$ is isomorphic to changing in B_{ni} by $\hat{\kappa}_{ni}^{-\epsilon}$

et al. (2023). Hence we assume workers are able to work at $(1 - 13.5\% \times 2)$ $= 73\%$ productivity while commuting. Then we have, for a county-pair, $\kappa_{ni} = 8.89/(8.89 - 0.89) = 1.11125$, and $\hat{\kappa}^{AV} = 8.89/(8.89 - 0.27 \times 0.89) = 1.0277$ Taking the ratio gives us our calibrated parameter, $\hat{\kappa}^{AV}$ of 0.9248.

5.1 Intuition and Embedded Assumptions

connect it to the distributional effects "story" earlier in the paper

To be transparent: we are shocking commute costs (immobile features of the location pair), rather than wages themselves. So, under what assumptions does this simple exercise capture the intuition of "AVs-as-substitute-for-low-skill labor"? Since we still permit movement in response to the shock (spatial equilibrium), the thought experiment to have in mind is: county-pairs with low-skill residents *prior* to the adoption of AVs will benefit less (from linkage to other places) from adoption. This could be considered capturing fixed features of the industries in the place, rather than actual people.

Thus, this exercise will be more informative about what happens to *places*, rather than *agents*.

Because we impose spatial equilibirum, the exercise will not examine welfare effects by place, as expected utility is equalized across space. We will still be able to study changes in prices (rent, P_n) and quantities (L_i, R_i), however. XX tie this discussion to what we.. actually do in figures etc below

One more potential question is why we modify κ based on features of the pair, rather than of either only the origin or destination.

XX honestly don't have a compelling answer to this, yet

XX to get at this idea/inequality, consider a partial equilibrium, transitional, analysis where we freeze people in place, can just read off from the $\hat{B}$ matrix

XX well. should we shock wages too?

6 Appendix

Painful proofs go here.

References

Gibbs, M., Mengel, F., and Siemroth, C. (2023). Work from home and productivity: Evidence from personnel and analytics data on information technology professionals. *Journal of Political Economy Microeconomics*, 1(1):7–41.

Monte, F., Redding, S. J., and Rossi-Hansberg, E. (2018). Commuting, migration, and local employment elasticities. *American Economic Review*, 108(12):3855–3890.

Redding, S. J. and Rossi-Hansberg, E. (2017). Quantitative spatial economics. *Annual Review of Economics*, 9:21–58.