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The impact of the COVID-19 pandemic on the demand for density: Evidence from the U.S. housing market

Sitian Liu^a, Yichen Su^{b,*}

^a Queen's University, Canada

^b Federal Reserve Bank of Dallas, United States of America

ARTICLE INFO

Article history:

Received 11 April 2021

Received in revised form 18 July 2021

Accepted 19 July 2021

Available online 22 July 2021

JEL classification:

R2

R3

I1

Keywords:

COVID-19

Pandemic

Density

Housing

Telework

Amenity

ABSTRACT

We study the impact of the COVID-19 pandemic on the location demand for housing. We find that the pandemic has led to a shift in housing demand away from neighborhoods with high population density. The reduced demand for density is driven partially by the diminished need for living close to telework-compatible jobs and the declining value of access to consumption amenities. Neighborhoods with high pre-COVID-19 home values also see a greater drop in housing demand. Moreover, we find a significant shift in housing demand away from large cities, though the magnitude is smaller.

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1. Introduction

After the outbreak of the COVID-19 pandemic, many office workers started to work from home (Bartik et al., 2020; Bick et al., 2020). Consumption amenities such as restaurants saw a sudden drop in visits (Cox et al., 2020). As a result, the desirability of dense neighborhoods and large cities, where jobs and consumption amenities are spatially concentrated, may have declined.

We find that the pandemic has indeed led to a strong shift in housing demand from central cities and dense neighborhoods to the suburbs and neighborhoods with lower population density. We use various local housing indicators such as inventory, home price, and rent to track spatial differences in the change of housing demand, and document a strong divergence in growth trajectories in these indicators in central and dense neighborhoods versus suburban and remote neighborhoods.

We make several conjectures for the reasons behind the shift:²

1. Dense neighborhoods tend to be close to job centers, which tend to have a greater share of telework-compatible jobs. With the rise of remote arrangements, the need for living in these neighborhoods could diminish.
2. Dense neighborhoods tend to have more consumption amenities. Because of the drop in visits to amenities during the pandemic, the value of living closer to premium locations could decline.
3. Dense neighborhoods tend to have higher costs of housing due to the lower housing supply elasticities (Baum-Snow and Han, 2020). As the need for living in these locations diminishes, the value of bearing such high housing costs to be in these locations could decrease.³

We present empirical evidence that lends support to all of the conjectures. We find that home inventory growth is higher in neighborhoods with a greater share of telework-compatible jobs, a larger per-capita number of restaurants, and higher pre-COVID-19 home prices, indicating a spatial shift in demand from these

* Corresponding author.

E-mail addresses: sitianliu@econ.queensu.ca (S. Liu), Yichen.Su@dal.frb.org (Y. Su).

¹ The views expressed in this article are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

² Appendix A1 presents a stylized model to capture the underlying mechanisms.

³ Table A1 confirms such correlations.

(a) Inventory (Within MSAs)

(b) Inventory (Across MSAs)

(c) HPI (Within MSAs)

(d) HPI (Across MSAs)

(e) Rent (Within MSAs)

(f) Rent (Across MSAs)

Fig. 1. Shift in housing demand within and across MSAs.

Note: The figures present the growth of the housing market outcomes relative to the 2019 averages. Figures (a), (c), and (e) plot the changes at the ZIP Code level by distance to downtown for the 25 largest MSAs. Figures (b), (d), and (f) plot the changes at the MSA level by the size of MSA.

neighborhoods. Home price and rent growth picks up some of the spatial variation. We also find a shift in housing demand away from large and expensive cities, although the magnitude is smaller than the shift from central cities to the suburbs.

This paper contributes to the literature on how city structures change in the presence of the dispersion forces of diseases (Davis et al., 2021; Delventhal et al., 2021). Recent papers have documented migration and bid-rent curve patterns consistent with our findings (Ramani and Bloom, 2021; Althoff et al., 2020; Gupta et al., 2021). We are the first to examine the effect of the pandemic on neighborhood-level variation in housing demand and to test the underlying driving forces.

2. Data

For housing market outcomes, we use (i) monthly home sales, new listings, and inventory from Redfin Data Center since January 2016, (ii) the monthly repeated-transaction home price index (HPI) from CoreLogic, and (iii) monthly rent data—the Zillow Observed Rent Index.

We use the 2016 ZIP Code Business Patterns (ZCBP) and an industry-to-occupation crosswalk to calculate the number of jobs by occupation and ZIP Code based on job locations. We then assign a telework indicator developed by Dingel and Neiman (2020) to each occupation, and compute the share of telework-compatible jobs within a 3-mile radius of each ZIP Code. We also

Fig. 2. Visitor traffic to Points-of-Interest.

Note: The figures plot the average number of visits to offices (NAICS 51, 52, and 54) and restaurants (NAICS 722511) located by distance to downtown in the 25 largest MSAs, normalized by the first week of 2020, using data from SafeGraph Inc.

Table 1
Effects of COVID-19 across ZIP Codes.

	Log (Inventory) (1)	Log (HPI) (2)	Log (Rents) (3)
Panel A: Baseline			
After $\times$ Log (Distance to Downtown)	−0.157*** (0.0227)	−0.00964** (0.00381)	0.0213*** (0.00361)
After $\times$ Log (Density)	0.00636 (0.0164)	−0.0135*** (0.00495)	−0.0101* (0.00513)
Observations	624,204	359,104	143,879
Panel B: Neighborhood Characteristics			
After $\times$ Log (Distance to Downtown)	−0.0676*** (0.0147)	−0.00338 (0.00357)	0.00808 (0.00488)
After $\times$ Log (Density)	−0.0365*** (0.00972)	−0.00288 (0.00390)	−0.0100*** (0.00378)
After $\times$ Log (Jobs per capita)	0.00142 (0.0176)	0.0118*** (0.00318)	−0.00435 (0.00361)
After $\times$ Log (Share of Telework-Compatible Jobs)	0.159*** (0.0349)	−0.0343*** (0.00725)	−0.0242*** (0.00765)
After $\times$ Log (Restaurants per capita)	0.0673*** (0.0175)	−0.0247*** (0.00390)	−0.00645* (0.00341)
After $\times$ Log (Pre-COVID Home Value)	0.231*** (0.0380)	0.0136 (0.00984)	−0.0239*** (0.00728)
Observations	572,607	356,500	142,872

Note: The sample comprises all ZIP Codes between January 2016 and April 2021 (up to March 2021 for HPI), except April 2020. The specification is described in Section 3.1. We also control for After $\times$ Log (Income) and After $\times$ Log (Share of Whites). Observations are weighted by the ZIP Code's population in columns 1–2, and the ZIP Code's renter population in column 3.

***Standard errors are clustered at the MSA level: $p < 0.01$.

**Standard errors are clustered at the MSA level: $p < 0.05$.

*Standard errors are clustered at the MSA level: $p < 0.1$.

compute the per-capita number of restaurants within a 3-mile radius of each ZIP Code.

We obtain local population characteristics from the 2013–2017 American Community Survey (Manson et al., 2020). We obtain weekly visit patterns data from SafeGraph Inc., and county-level COVID-19 case rates from the Opportunity Insights Economic Tracker.⁴

3. Empirical analysis

Figs. 1(a), 1(c), and 1(e) show the growth of inventory, home prices, and rents relative to the 2019 average for each month

by distance to downtown for the 25 largest metropolitan statistical areas (MSAs). After the pandemic started in March 2020, the growth of home inventory in central cities far outpaced the growth in the suburbs. The strong diverging trends can be also observed in rental prices. Home price growth also exhibits a diverging trend between central cities and the suburbs, but the gap is smaller. The vast divergence in inventory and rent growth between central cities and the suburbs constitutes strong evidence that the demand for housing has shifted toward the suburbs.

In addition, we examine differential effects of the pandemic on housing demand across cities. Figs. 1(b), 1(d), and 1(f) show the growth of inventory, home prices, and rents relative to the 2019 average for each month by the size of MSAs—the 25 largest

⁴ <https://opportunityinsights.org>.

MSAs vs. others. The figures present evidence of a shift in housing demand from larger cities to smaller ones, but the magnitude is smaller compared with the shift from central cities to the suburbs.⁵

3.1. Regression analysis

To unpack the driving forces behind the large shift in housing demand within cities, we estimate the following regression at the ZIP Code (neighborhood) level:⁶

$$\log(s_{ncmy}) = \beta_1 \text{After}_{my} \cdot x_{nc} + \beta_2 \text{After}_{my} \cdot \log(\text{CaseRate}_{nc}) + \delta_{myc} + \pi_{nc} + \epsilon_{ncmy}, \quad (1)$$

where s_{ncmy} is a local outcome, such as inventory, home prices (HPIs), and rents in neighborhood n within city c in month m of year y . After_{my} indicates months after March 2020. x_{nc} denotes a neighborhood characteristic of interest, such as density. We control for various characteristics interacted with After_{my} , including CaseRate_{nc} , the average case rate between April 2020 and February 2021 of the county that neighborhood n belongs to. We control for local case rate because of the concern that the change in housing demand may be driven by the fear of local infection risk per se, confounding our main estimate. δ_{myc} denotes city-time fixed effects, which absorbs differential effects of the pandemic across cities. π_{nc} denotes Zip Code fixed effects. The coefficients of interest are β_1 , which represent differential effects of the pandemic across various x_{nc} within cities.

Table 1 presents the estimates of β_1 at the ZIP Code level.⁷ Panel A confirms that there is a reduced demand for central cities and dense neighborhoods. Panel B shows that neighborhoods with a greater share of telework-compatible jobs, more restaurants per capita, and higher pre-COVID-19 home prices witnessed a relative increase in inventory and a relative decline in home and rental prices.⁸ The results confirm the conjectures presented in Section 1.⁹

Appendix A4 presents MSA-level regression results, which suggest that housing demand has shifted away from cities with higher pre-COVID-19 home values.

3.2. Changes in traffic patterns

To corroborate that there is a diminished value of visiting prime city locations for work or amenities, we show in Fig. 2 that the number of visits to offices and restaurants plummeted after the pandemic, and the drop is greater for the establishments located in central cities.¹⁰

⁵ Different effects of the pandemic on rents and HPIs can shed light on the long-run effect of the pandemic on the shift in housing demand. Appendix A3 details the discussion.

⁶ Appendix A2 presents the county-level analysis.

⁷ Table A2 presents the estimates at the county level, which are consistent with the results in Table 1.

⁸ Table A3 presents the results with sales and new listings as outcome variables.

⁹ Table A4 presents the estimates by month, which suggest that the changed demand for different neighborhood characteristics such as access to telework-compatible jobs and restaurants kicked in gradually. Table A8 presents a robustness check where we account for seasonal variation of the outcome variables at ZIP Code level. For robustness, Table A9 presents the estimates without controlling for $\text{After}_{my} \cdot \log(\text{CaseRate}_{nc})$. The findings in Table 1 are robust.

¹⁰ Figure A2 presents the number of visits to schools, parks, and gyms.

4. Conclusion

We find that the pandemic reduced the housing demand in central city neighborhoods and neighborhoods with higher population density. The decreased demand for density is partially driven by (i) the diminished need for living close to telework-compatible jobs, and (ii) the dwindling attraction of consumption amenities. Moreover, cities and neighborhoods with higher pre-COVID-19 home values witnessed a greater decline in housing demand.

Our findings suggest that COVID-19 has re-introduced disease transmission as a dispersion force in the urban spatial equilibrium, certainly in the short run. The smaller divergence in home price growth relative to that in inventory and rent growth between central cities and suburbs suggest the market anticipates that future demand for central locations could bound back to some degree in the long run.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.econlet.2021.110010>.

References

- Althoff, L., Eckert, F., Ganapati, S., Walsh, C., 2020. The Geography of Remote Work. Working Paper.
- Bartik, A., Cullen, Z., Glaeser, E., Luca, M., Stanton, C., 2020. What jobs are being done at home during the COVID-19 crisis? Evidence from firm-level surveys. *Harv. Bus. Sch. Work. Pap.* 20, 138.
- Baum-Snow, N., Han, L., 2020. The Microgeography of Housing Supply. Working Paper.
- Bick, A., Blandin, A., Mertens, K., 2020. Work from Home After the COVID-19 Outbreak. Federal Reserve Bank of Dallas Working Paper No. 2017.
- Cox, N., Ganong, P., Noel, P., Vavra, J., Wong, A., Farrell, D., Greig, F., 2020. Initial Impacts of the Pandemic on Consumer Behavior: Evidence from Linked Income, Spending, and Savings Data. *Brookings Papers on Economic Activity*, Conference Draft.
- Davis, M., Ghent, A., Gregory, J., 2021. The Work-from-Home Technology Boon and its Consequences. NBER Working Paper, 28461.
- Delventhal, M., Kwon, E., Parkhomenko, A., 2021. How do cities change when we work from home? *J. Urban Econ.* 103331.
- Dingel, J., Neiman, B., 2020. How many jobs can be done at home? *J. Publ. Econ.* 189.
- Gupta, A., Mittal, V., Peeters, J., Van Nieuwerburgh, S., 2021. Flattening the Curve: Pandemic-Induced Revaluation of Urban Real Estate. Working Paper.
- Manson, S., Schroeder, J., Van Riper, D., Ruggles, S., 2020. IPUMS National Historical Geographic Information System: Version 14.0 [Database]. Minneapolis, MN: IPUMS. 2019.
- Ramani, A., Bloom, N., 2021. The donut effect: How COVID-19 shapes real estate. *SIEPR Policy Brief*.