Work from Home and Urban Structure

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Abstract

The sustained increase in working from home in the wake of Covid has the potential to reshape the U.S. urban landscape. This article describes the big picture of pre-2020 remote work in the U.S., and summarizes how that picture changed during the subsequent three years. It then introduces a mathematical model designed to calculate the possible long-run impacts of increased remote work on where and how Americans work and live.

This model predicts that the increased prevalence of remote and hybrid work arrangements will induce workers with remote-capable jobs to find housing farther away from their job locations, increasing the length of the average commute while cutting the time actually spent commuting. Jobs that produce goods and services which must be consumed locally will follow the bulk of the population to suburbs and smaller cities, while jobs producing tradable output will increase both in low-cost and high-productivity locations, at the expense of the middle.

In the long run, the reallocation of demand to lower density locations with fewer legal restrictions on housing development should reduce the real price of housing by at least 1%, but these changes depend on adjustments to the housing stock, both through new construction and through re-purposing commercial real estate in city centers.

The model predicts a partial reversal of the decades-long concentration of talent and income in the centers of the biggest cities. Data on changes 2019-2022 suggest that some of this reversal is already happening.

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1 Introduction

Built by large-scale organizations coordinating the efforts of millions to common goals, the modern city is a collection of places to live and places to work, tied together by the daily commute. Telecommunications offer the promise that many might keep the coordination, but cut the commute, and work where they live. After the crash-course in remote work offered by Covid, this idea appears to be taking the form of a sustainable reality. What shape then will our cities take?

In this article, we will identify and quantify several characteristic patterns of the current move towards work from home, based on a recent study by Delventhal and Parkhomenko (2023). This study combines a quantitative theory of urban location choice with data on how people in the United States worked from home in 2019, and how their behavior has changed 2020-2023.

We will also attempt to put the current episode into a broader context of previous trends of decentralization, and centralization, of the U.S. urban landscape. In particular, we will compare the projected impact of work from home on housing affordability with that of post-World War Two suburbanization.

Finally, we will attempt to place our U.S. based findings into a more international context, discussing similarities and differences between the U.S. work from home experience post-Covid and other countries around the world. We will find that the U.S. is not as exceptional as one might think. For completeness, we also present a short case study of South Korea, a country which is exceptional in having low adoption of work from home since 2020.

2 U.S. Home-Based Work Before Covid

In 2019, remote work represented between 5 and 10% of all paid full work days in the United States. These days were distributed unequally across workers with different education levels, working in different types of industries.

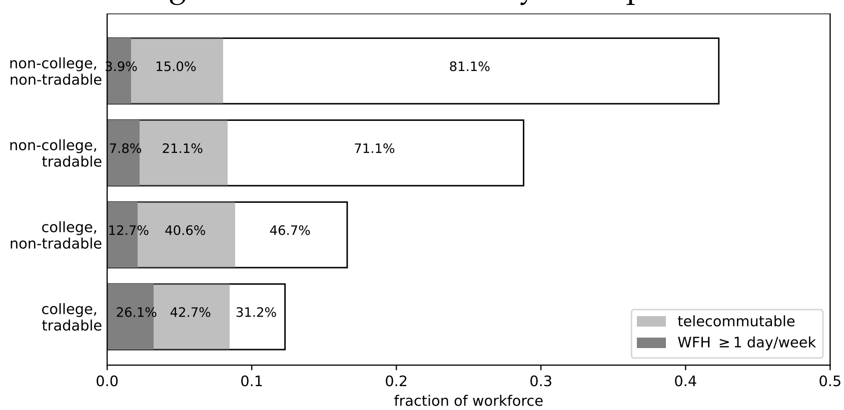
Workers with a college education were more likely to have a remote-capable or "telecommutable" job than those without a college education. They were also more likely to take advantage of that opportunity if they had it.[1]

[1]Telecommutable jobs are classified as those belonging to occupations "able to be done entirely or mostly from home" by Dingel and Neiman (2020). These authors base their classifications on an analysis of Bureau of Labor Statistics occupation descriptions. We may also note that these classifications are to some extent based on a 20th-century conception of what types of work can be done from home. As is documented by Holliss (2021) inter alia, prior to the industrial revolution people belonging to a much broader set of

In this context it is also important to consider two types of economic output. "Non-tradable" output consists of goods and services that must be consumed close to where they are produced–such as restaurant meals or dentist work. "Tradable" output consists of goods and services that can be consumed far from where they are produced–such as television sets and financial advice. Not surprisingly, those who work in an industry producing primarily tradable goods and services are more likely to have a remote-capable job, and to work remotely if they do, than those who work in a non-tradable industry.[2]

Figure 1 summarizes these facts quantitatively. It is interesting to note that although the *relative* prevalence of remote work is greatest among college-educated workers in tradable industries, the absolute number of workers with remote-capable jobs is roughly equal across the four intersected worker categories. This fact underlines the importance of considering the impact of home work opportunities for all types of workers, rather than only a narrow notional "laptop class."

Figure 1: Telecommutability and uptake



Note: Bar length corresponds to the share of each worker type in the labor force. Dark-gray areas represent workers who report at least one paid full day/week worked from home from Survey of Income and Program Participation (SIPP). Light-gray represents those with telecommutable professions who do not work remotely. White areas represent those in non-telecommutable occupations. Numbers in each color area report the fraction with each commuting status.

Prior to Covid, "hybrid" working arrangements were relatively rare. Workers were much more likely to either work five days per week in the office (91% of all workers), or

occupations lived where they worked, and it may be possible for this scope to be expanded again.

[2]Following Delventhal and Parkhomenko (2023), the BEA 2012 NAICS categories are divided as follows. *Tradable:* Agriculture, forestry, fishing and hunting, and mining; Manufacturing; Wholesale trade; Transportation and warehousing, and utilities; Information; Finance, insurance, real estate and rental and leasing; and Professional, scientific, management, administrative, and waste management services. *Non-tradable:* Educational, health and social services; Arts, entertainment, recreation, accommodation and food services; Other services (except public administration); and Public administration. *Excluded:* Armed Forces.

five days per week from home (5.5%), than to follow a middle path.[3] Table 1 presents work from home frequencies for each intersected worker type.

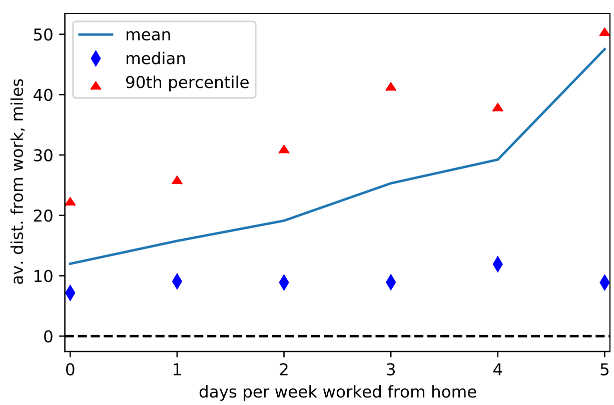
Table 1: Frequencies of working from home, 2018

		College		Non-college	
WFH frequency	Overall	Tradable	Non-Tradable	Tradable	Non-tradable
5 days per week	5.6%	15.0%	6.7%	5.2%	2.7%
4 days per week	0.2%	0.5%	0.5%	0.2%	0.1%
3 days per week	0.3%	0.9%	0.4%	0.3%	0.1%
2 days per week	0.7%	1.9%	1.4%	0.5%	0.3%
1 day per week	2.3%	7.8%	3.7%	1.6%	0.7%
<1 day per week	90.8%	73.9%	87.3%	92.3%	96.2%

Note: The table summarizes the share of all workers, as well as workers in each education-industry group, that report having a certain number of paid full days a week worked from home from SIPP. Self-employed workers are excluded.

Finally, in the "before-times," remote work exercised a measurable, but *not* a decisive, influence on worker location choice. As Figure 2 shows, workers who work from home more live farther away from the location of their employer, on average. This is consistent with the observation that a long commute is less inconvenient when it is less frequent. Even so, even for those who regularly worked from home 5 days per week, more than half lived within 10 minutes of their employer–no farther than those who work full time on-site.

Figure 2: Telecommute frequency versus distance to workplace



Note: Calculated from NHTS. 5 days/week: worked from home more than 90% of the days in a 21.67 day average work month; 4 days: between 90% and 70%, 3 days: between 70% and 50%, etc.

[3]This evidence is based on SIPP. Some other sources, such as the American Time Use Survey and the General Social Survey, show somewhat higher numbers for hybrid work pre-2020. See Delventhal and Parkhomenko (2023) for a discussion of the differences in work from home data between these surveys.

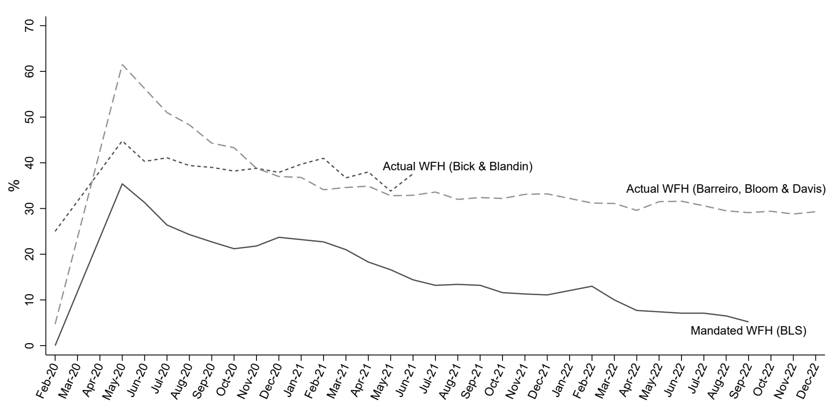
3 The Covid Shock

Remote work had been championed by some techno-utopians for decades, but even after steady improvements in technology it remained relatively rare through 2019. Then in early 2020 Covid-19 swept the globe, and social distancing policies directed workers in the United States and across the world to work from home on an emergency basis. Combined with the emergency closure of many businesses that could not feasibly "socially-distance," this meant that in May 2020 a full 60% of all paid work-days were done from home–a stark statistic without modern precedent.

The sudden move of such a large fraction of the workforce to a remote setting brought confusion and, out of necessity, innovation. There were big investments in software and equipment, new policies were developed and tested, and individuals learned by doing how to make home work, work. Finally, as Barrero, Bloom, and Davis (2021) document, attitudes shifted. Workers found there were some things about home work they liked, and organizations found ways that it could be compatible with their goals.

It is this change in attitude which is most indicative of where home work will go in the future. As we can see in Figure 3, government-mandated social distancing policies covered less than 10% of the workforce by the end of 2022, shortly before ending completely as fear of the virus subsided. Yet the fraction of actual paid days work from home remained over 30%, and representative surveys conducted by Barrero, Bloom, and Davis (2021) indicate long-run plans that would add up to 25–30%, permanently.

Figure 3: Work from home during the Covid-19 pandemic



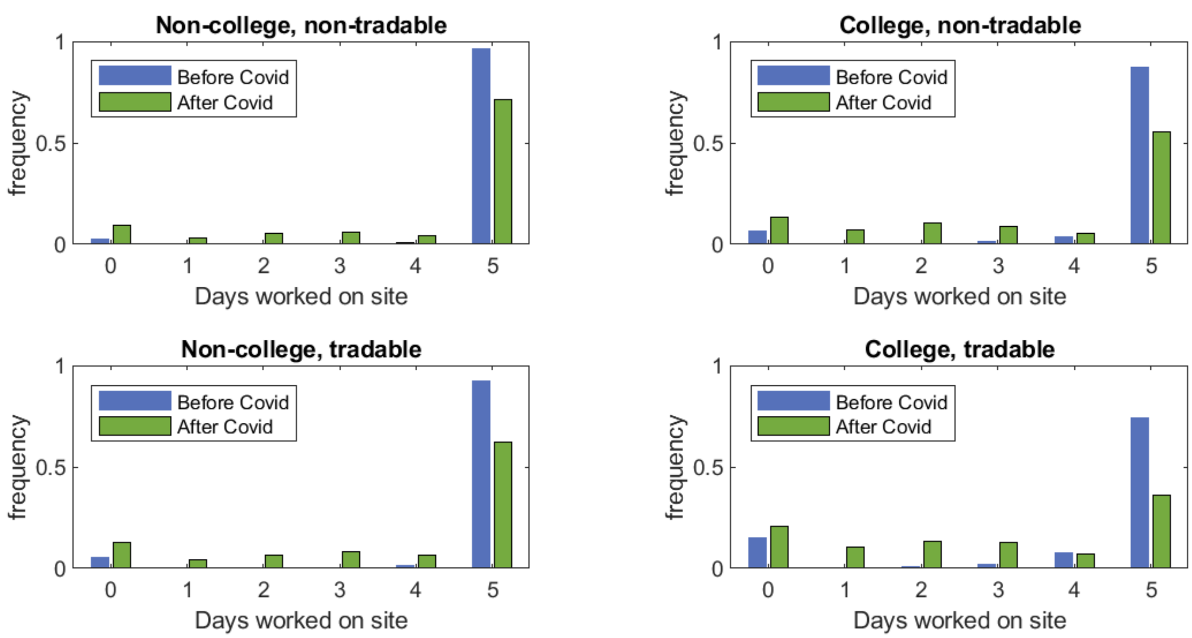
Note: Solid line: the fraction of employed persons who worked remotely for pay during the last 4 weeks because of emergency mandates, per a Bureau of Labor Statistics survey. Short-dashed line: the fraction of persons who work at home at least some of the time, per the Real Time Labor Market survey by Bick and Blandin (2021). This survey was discontinued in June 2021. Long-dashed line: the fraction of paid full days worked at home, per the survey by Barrero, Bloom, and Davis (2021).

4 The Hybrid Future

What will the details of future home work arrangements look like? As is shown in Figure 4, the most common type of arrangement will not be full-time remote work, but *hybrid*, with each work week split between some days worked at home and some on-site. This may reflect the fact that this middle ground gives workers most of the convenience they value, while still giving them a regular opportunity to coordinate and collaborate face-to-face.

Thus, the fraction of workers with fully remote jobs, who could in principle live *any*where and work *any*where, will remain relatively small. Most workers will still need to live somewhere in the general vicinity of a shared office space, which most employers will still have to maintain. Nonetheless, the average commute is likely to get longer and the average office smaller, with possibly large implications for the structure of cities.

Figure 4: Work from home frequency, before and after



Note: "Before" calculated from 2018 Survey of Income Plans and Participation (SIPP). "After" from surveys conducted by Barrero, Bloom, and Davis (2021).

5 A Mathematical Model

5.1 Workers, employers, developers

Because the current rise in remote work is unprecedented and may affect the urban environment in complicated ways, a mathematical model may be useful to understand both what may happen in the future, and why. Delventhal and Parkhomenko (2023) construct of model of the United States, dividing it into 4,502 urban neighborhoods and rural counties.[4] The model is based upon a set of equations that describe and predict the choices made by three types of actors.

First, workers choose which location to reside and which location to work in, based on the price of housing, available neighborhood amenities, the wages on offer, and the commuting distance between each house-employer pair. If the worker has a remote-capable job, they also choose how often to work at home.

Second, employers decide where to offer jobs, based on the price they can receive for their output, the price they must pay for real estate, and the wages they must pay to workers with different types of skills.

Third, real estate developers decide where and how much to build, given the prices they can receive for residential and commercial properties in each location.

To shed light on how different firms and workers are affected by the rise of work from home, the model incorporates differences across firms and workers described in Section 2. For instance, a firm produces either tradable or non-tradable output. Workers can have an occupation that allows them to work remotely or not. The ability and propensity to work from home also depends on whether a worker has a college degree or not and what type of firm she works at.

Figure 5 summarizes the various actors, their possible characteristics, and their roles in the economy.

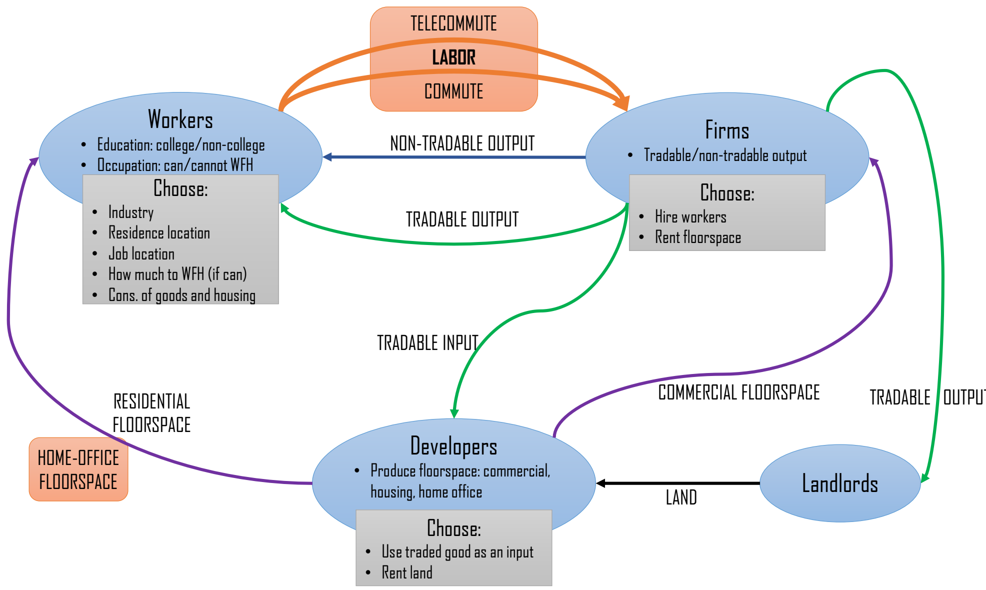
5.2 Long-run equilibrium

It is clear from this description that the choices of each actor in this model depend on the choices made by all of the actors as a whole. For example, a developer will only want to build houses if enough workers want to buy them, and if too many workers want to buy a limited number of houses, high prices will force some workers to look elsewhere. The model's predictions are pinned down using a concept called "equilibrium"–a set of choices by all the actors, together with a set of wages and market prices for real estate, goods and services in each location, such that no single actor can get a better deal by making a different choice.

In this particular model, this equilibrium is permanent, and so is best thought of as a representation of what will happen in the long-run.

[4] Delventhal, Kwon, and Parkhomenko (2022) conduct a more limited study which imposes an exogenous increase in work from home on an isolated metropolitan area with no worker choice of whether or how much to work from home, and no worker or firm heterogeneity. Other quantitative spatial studies of work from home include Davis, Ghent, and Gregory (2022), Monte, Porcher, and Rossi-Hansberg (2023), and Brueckner, Kahn, and Lin (2023).

Figure 5: Summary of model structure



Note: Summary of the characteristics of workers, firms and developers, and the roles they play in the economy. Passive absentee landlords are included for accounting purposes–they receive the income due to land rent and consume it in the form of tradable goods. To avoid the need to model and calculate an additional full set of location decisions for a small group whose choices are unlikely to be especially affected by increased work from home, it is assumed that landlords do not consume (local) non-tradable goods or housing.

5.3 Calibrating parameters

There is a set of location-specific parameters that make some locations more productive to work in and/or more pleasant to live in than others, representing in a simple way the diversity present in the real-world counterparts of the 4,502 model locations. These parameters are calibrated so that what the model predicts as an equilibrium is the same as the average choices made by actors in the real-world data 2012-2016, given real-world wages and real-estate prices.

There are some other parameters that are built into the model to allow it to represent key aspects of remote work realistically. For example, there is a set of parameters determining both the productivity of remote work and the stigma and organizational obstacles that make workers less likely to choose it. These are calibrated so that, in the initial equilibrium, the frequency of working from home for college and non-college educated workers, in tradable and non-tradable industries, matches what is observed in the pre-Covid data.

The Covid shock is represented as a reduction in the stigma and organizational obstacles to remote work. These parameters are reduced so that the average frequency of remote work for each type of worker matches the one foretold by the Barrero, Bloom, and

Davis (2021) surveys. Then a new long-run equilibrium is calculated, reflecting how the choices of where to build, where to live, and where to work have been affected.

5.4 Testing the model

It is all well and good to build a mathematical model, but how can we know whether it is doing a "good" job of describing reality, and whether its predictions are relevant? The authors of Delventhal and Parkhomenko (2023) establish the credibility of their model in two primary ways. First, as we have just described, they structure the model in a way that it is able to be calibrated to match key aspects of the pre-Covid U.S. economy. Second, they show that its long-run predictions in the increased work-from-home scenario are highly correlated with data on where people moved and how real estate prices changed between 2019 and 2022.[5]

A more detailed description of the model, its calibration, and validation exercises can be found in Delventhal and Parkhomenko (2023). An interactive visualization of some of its main results can be found at https://mattdelventhal.com/project/telecommute_viz/. For the remainder of this article, we will discuss its predictions for our work-from-home future.

6 Driving Farther, but Less

One of the most important predicted effects of increased remote work is that the length of the average commute will increase by 52%, from 48 minutes to 1 hour and 13 minutes. In spite of this, the average time *spent commuting* should go down by over 20%. This is possible, of course, because remote-capable workers choose longer commutes thanks to being able to come to the office less often. Importantly, the average commute length of workers who cannot work remotely is also reduced slightly, as they take advantage of reduced demand for houses closer to major centers of employment.

Commute lengths increase because remote-capable workers are now freer to seek out a better-paying job and a home with a better price that is more in line with their personal preferences, even if these two are relatively far apart. About 5% of all workers choose a new residence location, and about the same proportion choose a new job location. What is interesting is the prediction that most of these moves are not workers choosing a location in the *same* city, but rather making a move to a *different* city entirely–two thirds of the

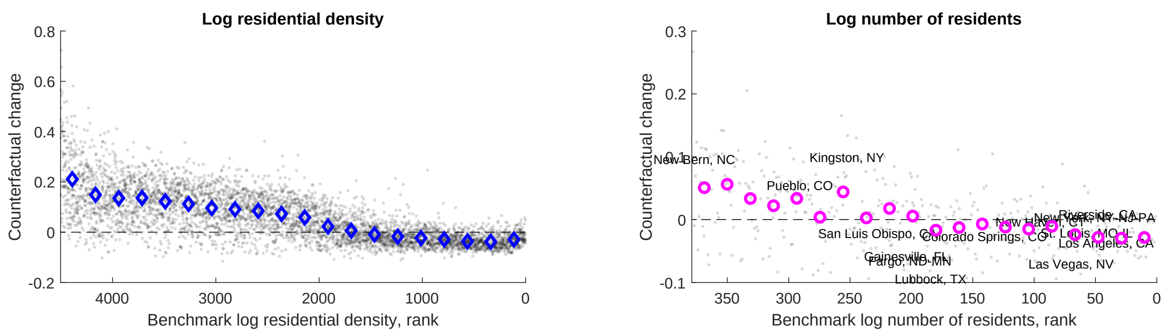
[5] See Van Nieuwerburgh (2023) and Duranton and Handbury (2023) for summaries of the evidence on migration and changes in real estate prices during the Covid pandemic.

predicted relocations are *across*, rather than *within*, metro areas.

Which locations and cities gain, and which lose residents? As shown in Figure 6, big cities and dense locations lose residents on average to smaller cities and suburbs, though there is a lot of variation driven by each location's unique characteristics. The New York metro area, in spite of being the largest of all, is forecast to have small gains in population. This is because workers can now enjoy high pay at a top firm based in Manhattan while also enjoying lower housing costs in a farther-out suburb, making the metro area overall more attractive.

Figure 6: Change in Residents

Panel (a): All residents Panel (b): All residents, metropolitan areas



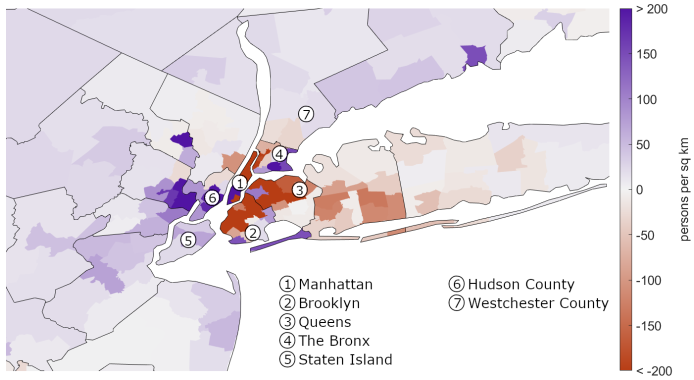
Note: Panel (a) shows the relationship between residential density rank for model locations and change in log residential density. Panel (b) shows the relationship between total resident rank for metro areas and change in log total residents. Scatterplots in gray show individual model locations or MSAs, while diamonds or circles represent averages by ventile: i.e. below the 5th percentile, from the 5th to the 10th, etc.

7 Donut Cities

One home-work-induced pattern predicted by the model has already been documented by Ramani and Bloom (2021) and dubbed the "donut effect." Residents depart the city, leaving a hole, while the population of a ring of outward-lying suburbs inside the same metro area increases. Figure 7 shows the model's donut-like predictions for the New York metro area.

A likely consequence of this pattern is to reinforce the tendency of American households to live in large single-family houses. Rappaport (2022) estimates that greater demand for single-family homes in response to the shift to more frequent remote and hybrid work could nearly double single-family home construction in 56 largest U.S. metropolitan areas from its level just prior to the pandemic, by about 427,000 units per year. In order to work productively from home, those houses will need to be bigger on average, as Stanton and Tiwari (2021) document. Suburbs have played an outsized role in the evolution of the American urban landscape in recent decades, and may now become even more important.

Figure 7: New York metro area, predicted changes in residents



Note: The map shows model-predicted absolute changes in the number of residents in the New York metropolitan area.

8 The Importance of Flexible Real Estate

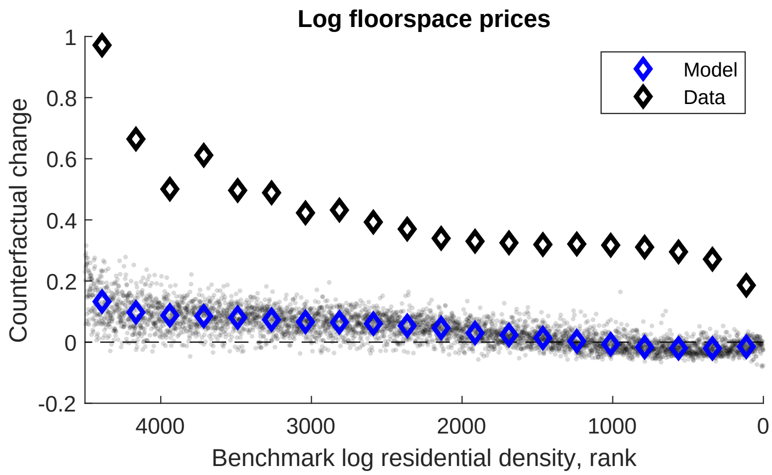
In the long run, after new construction and commercial-to-residential conversions have allowed for adjustments to the stock of real estate, we predict that the real price per square foot will decline by 0.8%. There are two sources of cost reductions here: first, the less dense areas that average resident will now live in have lower land costs. Second, those same areas also have, on average, less red tape that developers must overcome before getting permission to build.

An alternative simulation in which there is no adjustment of the real estate stock yields starkly different predictions. The average real price of residential real estate shoots by 16%, while commercial prices fall more than 16%. Qualitatively, this matches what happened between 2019 and 2022, with sharp increases in house prices and commercial properties in dire straits.[6] Three years is a short time in which to make large adjustments to the stock of real estate, so these model predictions, and the reality that they align with, can be thought of as a short-term phase on the road to the long-term equilibrium. These results also highlight the potential negative effects of barriers to adjustment, such as building codes preventing commercial-to-residential conversions.[7]

[6] Mondragon and Wieland (2022) estimate that work from home accounts for about 1/2 of the increase in housing prices during the pandemic.

[7] Badger (2023), writing in the New York Times, documents the difficulties faced by some developers in New York City.

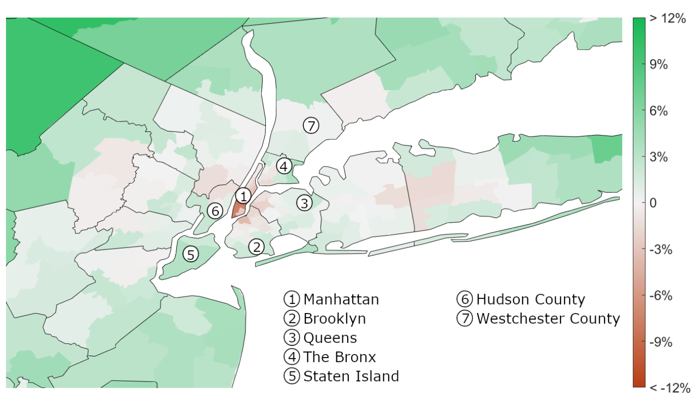
Figure 8: Housing prices: Observed from 2019-22, versus long-run predicted by model



Note: Each black diamonds represents the change in prices from December 2019 through December 2022, measured using data from Zillow, for a 5% quantile of 2012-16 model location population density (i.e., zero to the 5th percentile, the 5th to the 10th percentile, etc.). The blue diamonds represent average long-run model projections for the same set of quantiles. The small black dots represent predictions for individual model locations, ordered along the x-axis from least to most dense.

Figure 8 compares data on housing price changes between 2019 and 2022 sorted by population density (black diamonds), against long-run changes predicted by the model. The overall trend is the same both in the Covid-ear short-run and the long-run projections: more positive changes in less dense locations, and less positive (or more negative) changes in central, dense locations. In the long run, the overall real price level is predicted to be lower, and the negative effect on demand in the most central locations is predicted to be less severe.

Figure 9: New York metro area, predicted changes real estate prices



Note: This map shows model-predicted percentage changes in real estate prices in the New York metropolitan area.

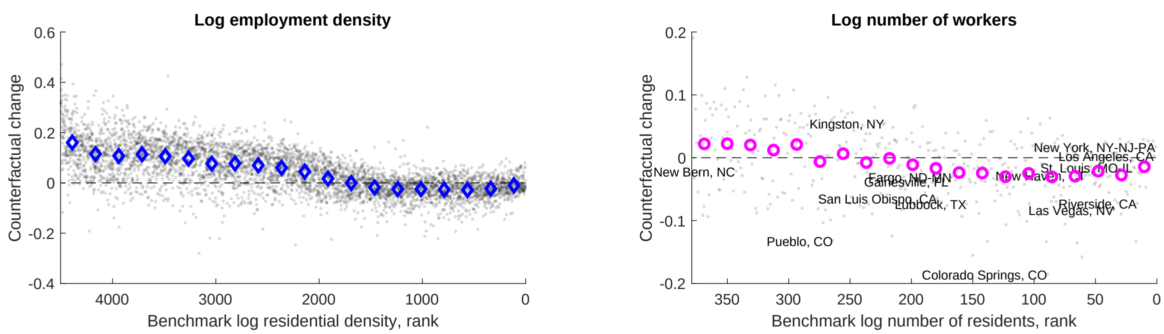
Figure 9 shows the model's long-run predictions for real estate prices in the New York metro area: up to 6% decreases in Manhattan, with sizeable increases in some suburban and rural counties.

9 A Tale of Two Types of Economic Output

While the average effect on residence choices is clear, with a dominant trend towards decentralization, the change in the average job location, visualized in Figure 10, is not as clear.

Figure 10: Change in Employment

Panel (a): All jobs　　Panel (b): All jobs, metropolitan areas



Note: Panel (a) shows the relationship between residential density rank for model locations and the change in log job density. Panel (b) shows the relationship between total resident rank for metro areas and the the change in log total jobs. Scatterplots in gray show individual model locations or MSAs, while diamonds or circles represent averages by ventile: i.e. below the 5th percentile, from the 5th to the 10th, etc.

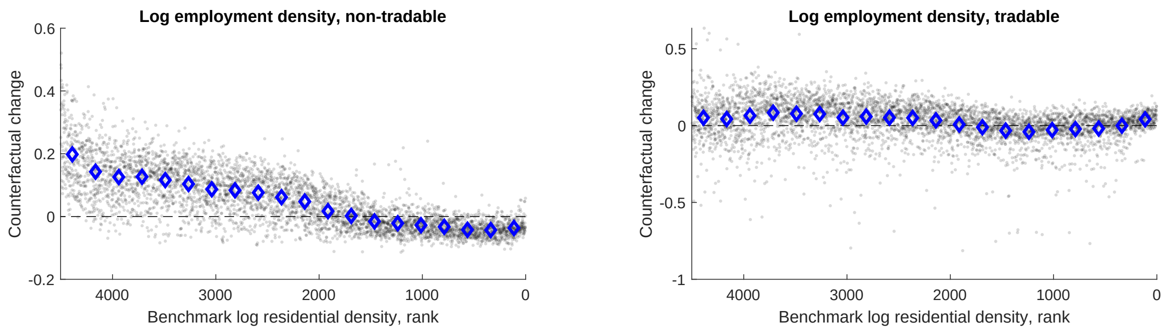
Overall, it seems that more peripheral locations and smaller cities gain a bit at the expense of the middle, but near the top the trend reverses and the highest-density locations don't lose at all. It turns out that this muddled average effect is the composite of two clearer but contradictory patterns occuring at the level of output type. Jobs with companies that produce non-tradable output, which must be consumed in the same place it is produced, strongly decentralize, following the bulk of the population which is their source of demand. Jobs with companies producing tradable output, unencumbered by the location of their demand, exhibit a double-peaked pattern, shown in the right-hand panel of Figure 11.

This is because remote work improves the conditions in the competition for talent for two types of locations. The first is low density and has affordable real estate, and was previously isolated. With remote work, these low-cost locations are now easier to commute to. The second type represents the very most central locations in the top cities, which have very productive, high-paying firms. These locations are now also easier to commute to, and the cost of real estate there, while still high, is now lower with the reduced demand for office space and downtown living space. Locations somewhere in the middle, with neither very low costs nor very competitive firms, lose out in this geographically broader contest.

Figure 11: Change in Employment, by Industry

Panel (a): Non-tradable

Panel (b): Tradable



Note: Panel (a) shows the relationship between residential density rank for model locations and the change in log job density, only for jobs in industries producing non-tradable goods and services. Panel (b) does the same, only for jobs in industries producing tradable goods and services. Scatterplots in gray show individual model locations or MSAs, while circles represent averages by ventile: i.e. below the 5^{th} percentile, from the 5^{th} to the 10^{th}, etc.

10 A Tale of Two Classes of Workers

In the model's simulation, the new norm of working from home more frequently is a boon for those able to take advantage of the opportunity. These workers earn about 3% higher wages on average, as they are able to match to more productive jobs and see their own personal productivity increase slightly due to increased flexibility.[8] These workers also enjoy reduced commuting time and reduced housing costs, though they also access a somewhat lower quality of residential amenities due to living in lower-density areas than before. Once the value of these two additional factors is taken into account, the average remote-capable worker would be willing to give up between 2 and 4% of their income to keep their new work arrangement, depending on worker type.

The model also includes a mathematical feature, called "random idiosyncratic preference shocks," which helps to account quantitatively for the individual factors which lead people to choose one particular residence or work location over another for individual

[8]Informed by observed earnings of remote and non-remote workers pre-Covid, the model calibration implies a slight productivity bonus for workers able to work at least some of the time at home. This is consistent with randomized experiments showing productivity increases under a hybrid work schedule, such as Bloom, Han, and Liang (2022) and Choudhury, Khanna, Makridis, and Schirmann (2022).

reasons not reflected in wages or prices or the average worker's valuation of non-pecuniary amenities. This feature also allows us to put a value on the increase in personal choice afforded by increased remote work flexibility, though such calculations should be treated with caution as they are not directly tied to anything tangible and measurable. If we were to consider the model's valuation of this increased ability to choose home and job in line with personal preferences, then the value of the change would be several times larger than the 2-4% mentioned above.

The average outcome for a non-telecommutable worker, however, is a different story. Depending on worker category, their income either changes little or actually declines. This is because the overall productivity of firms and organizations declines due to the lost value of learning and coordinating through face-to-face interactions, at the same time that non-remote workers face increased competition from remote and hybrid workers for the best-paying jobs. They take advantage of lower overall housing prices to move slightly closer to centers of employment, enjoying very slightly shorter commutes as well as a small improvement in residential amenities. Before accounting for the relative loss in freedom to choose individually-pleasing locations–the flip-side of remote workers' increased flexibility–non-remote workers would be willing to pay 1-2% of their wages to go back to the old way of things. After accounting for idiosyncratic preference shocks, these workers would be willing to pay 1.5-3.5% of their wages.

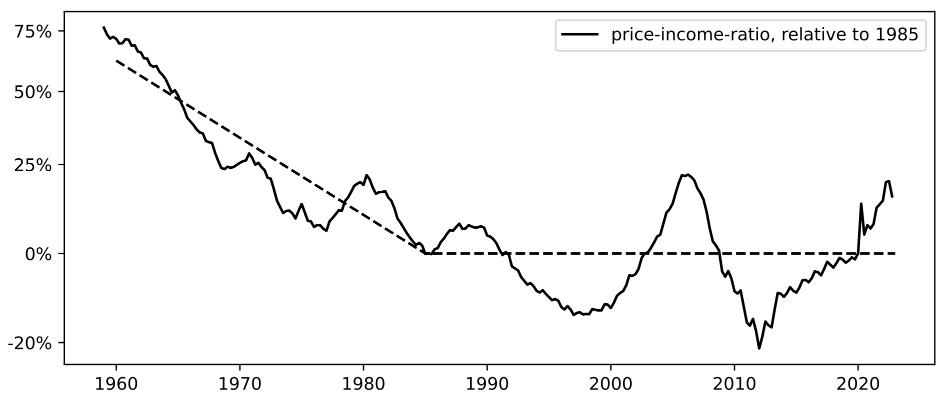
As we have just said, a part of the negative outcome for non-remote workers depends on the assumption that remote work will not contribute to the kinds of "knowledge spillovers" that have traditionally been associated with face-to-face interaction, and so the overall productivity of the companies they work for, and ultimately that of their non-remote colleagues, will suffer. If we make the opposite assumption and suppose there is no difference between face-to-face and remote interaction, things for non-remote workers look slightly better–they go from small but significant losses in welfare to being almost unaffected. The great inequality of benefit remains.

11 Highways and the Price-Income-Ratio

Post-covid work from home is not the first time the commuting tie has been loosened in American cities. Auto-powered mobility drove a revolution in urban structure in the post-World War Two era. Between 1950 and 1980, ever more far-flung suburbs sprouted, and housing became ever more affordable in the United States and other developed countries. Beginning in the 1980s the sinews began to tighten again as the "Great Divergence" between top cities and the rest progressed. High-paying jobs became more concentrated in major city centers, traffic congestion increased, and housing affordability gains slowed, then reversed.

Could a sustained increase in home work upset cities as much as highways did? One way to assess the relative magnitude of the current new normal is to look at its impact on the house-price-to-income ratio. The simulation suggests that real house prices will decline by 0.8%, while average income goes up by 1.6%–overall an approximately 2.4% decline in the price-to-income ratio. As shown in Figure 12, from 1985, the house price-to-income ratio in the United States fluctuated strongly but has not declined. In other words, there has not been a sustained increase in housing affordability in the United States for almost 40 years. In that context, a permanent decline of 2.4% seems significant.

Figure 12: Historical evolution of U.S. house price-income-ratio



Note: House price data from Shiller (2015). Income is measured as personal consumption per capita and is taken from U.S. Bureau of Economic Analysis (2018).

During the 25 years from 1960 to 1985, however, the house price to income ratio declined by about 2% per year. Compared to that, a one-time drop of 2.4% seems significant, but small. It may be that not all of the 2% per year is attributable to mobility improvements. It also may be that a the current model misses some dynamic mechanisms which could turn to 2.4% into something bigger. Still, it seems unlikely that the post-Covid remote work boom will have nearly as large an impact as car-driven post-WW2 suburbanization did.

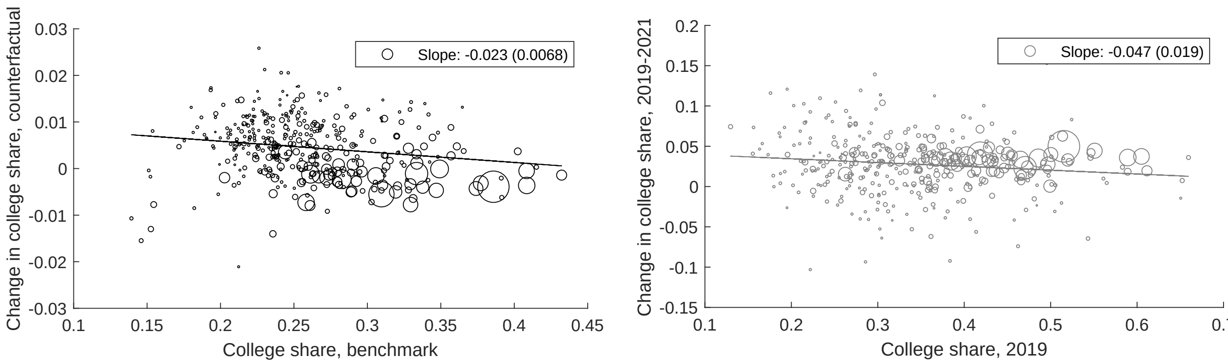
12 The Great Reconvergence

One important effect of increased remote work may be a partial reversal of the decades-long increasing concentration of talent and income in the very top metro areas. This phenomenon has been called the "Great Divergence" and many economists believe that by concentrating housing demand in places where it is difficult to expand housing supply, it has been largely responsible for the long stagnation in housing affordability.[9] Our model predicts that key aspects of this divergence will reverse. Not only that, but data from the past two years suggest that this reversal may already be underway.

Figure 13: Reversal of the sorting across metro areas

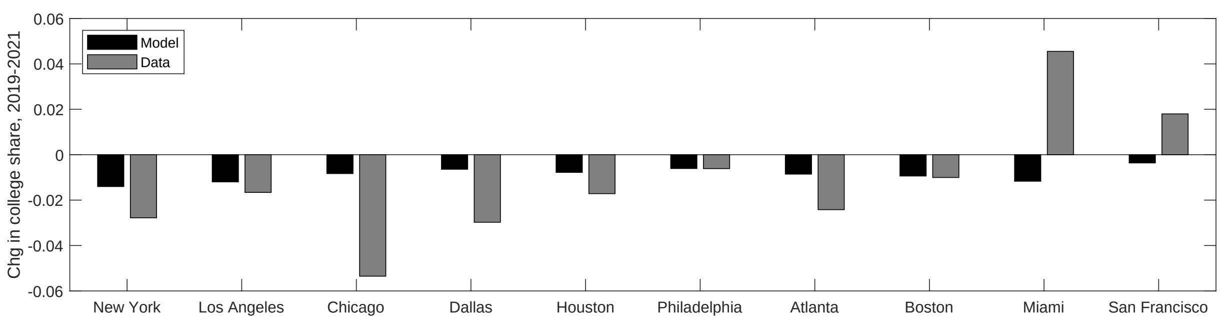
Panel A: Model

Panel B: Data



Note: Panel A plots the share of college graduates in a metro area in the benchmark economy and the change in the college share in the counterfactual economy. Panel B shows the same relationship for the 2019 ACS sample and the change in the 2021 ACS sample. Circle size is proportional to MSA population in the benchmark economy. The legend shows slope coefficients and their standard errors.

Figure 14: Reversal of the urban revival



Note: The figure shows the percentage-point change in the college share in a 10 km ring around centers of ten largest metro areas in the counterfactual economy (black bars) and in the data between 2019 and 2021 (gray bars). Data changes are adjusted to account for the nationwide increase in the college share. Center of a metro area is defined as the location of the city hall of the largest municipality.

12.1 Talent sorting

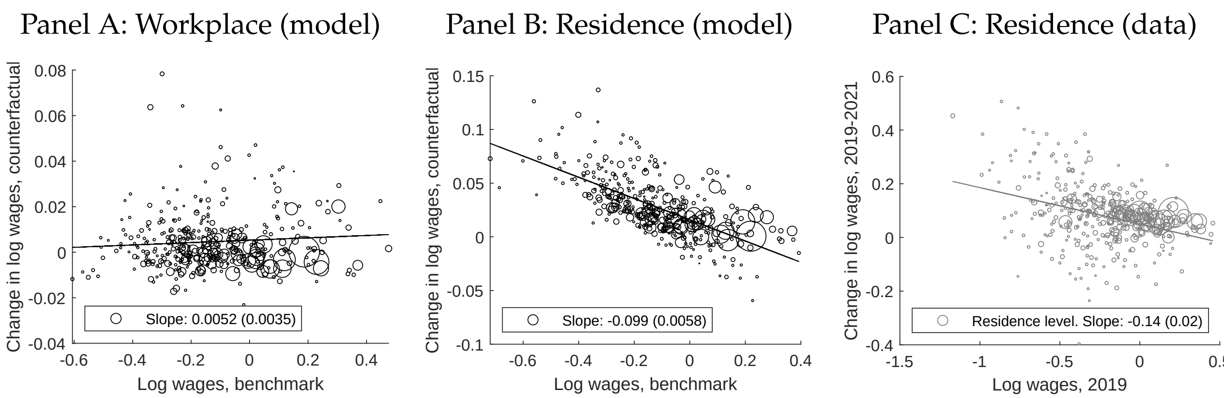
As shown in Panel A of Figure 13, the model predicts that the share of college-educated workers will shrink in large, highly-educated metro areas as they move to smaller cities. In

[9] The "Great Divergence" was first summarized in Moretti (2012). The period from 1980s follows decades of regional convergence, as documented in Blanchard and Katz (1992).

Panel B we see that this is consistent with what is already taking place in the data.[10] This points towards a partial reversal of the trends documented by Berry and Glaeser (2005), Moretti (2012), and Diamond (2016), inter alia.

College-educated workers also move away from city centers in 8 out of the 10 largest metro areas, as shown in Figure 14.[11] Couture and Handbury (2020) had previously documented growing concentration of college graduates around the centers of U.S. cities since 2000 and linked this yuppie-led urban revival to increased consumption of non-tradable services. As discussed in the previous section, the model suggests that some of these services may follow predominantly college-educated remote workers out of the urban centers. Combined with less frequent commuting, this makes city centers less attractive for college graduates.

Figure 15: Changes in wage inequality across metro areas



Note: Panel A shows the relationship between demeaned log average wages paid to individuals who work in a given MSA in the benchmark economy and the log change in wages in the counterfactual. Panel B shows the same relationship for wages earned by individuals who live in a given MSA. Panel C shows the relationship for wages earned by residents of an MSA in the 2019 ACS sample and the change in wages in the 2021 ACS sample. Circle size is proportional to MSA population in the benchmark. The legend shows best-fit slope coefficients and their standard errors.

12.2 Income sorting

Another point of divergence across cities over the last few decades has been in wages (Moretti, 2013; Gaubert, Kline, Vergara, and Yagan, 2021; Giannone, 2022). Here, the model predictions are split, in a way that is due to the peculiar nature of remote work.

[10]The results in panel B have somewhat different magnitudes than model predictions for at least two reasons. First, it uses 1% ACS samples and our model uses a 5% sample. Second, panel B compares 2019 with 2021, while the model is calibrated to 2012–2016.

[11]Li and Su (2021) and Ding and Hwang (2022) also find evidence of disproportionate out-migration of high-income residents from city centers and gentrified neighborhoods.

Wage inequality between people with *jobs* in different metro areas should not change much, as shown in Panel A of Figure 15. Cities that were previously more productive will continue to offer high wages. But as remote work broadens access to employment in high-wage locations, wage inequality by city of *residence* should decline, as shown in Panel B. Inequality by city of residence is the only aspect that we can track reliably using publicly-available data, and it does indeed appear to have declined in a way similar to what the model predicts, as shown in Panel C.[12]

12.3 House price convergence

A final type of divergence to consider is in house prices (Van Nieuwerburgh and Weill, 2010; Albouy and Zabek, 2016). The model predicts a reversal of the trend of recent decades, with convergence in prices both across and within metro areas (Panels A and C of Figure 16). The reason is straightforward–the increased prevalence of home work reduces the demand for formal office space in central parts of cities, while at the same time also reducing the demand for residential housing close to those central areas, while remote and hybrid workers are free to explore more distant options, driving up demand in peripheral areas.

The data show strong evidence of such convergence *within* metro areas, as we can see in Panel D. This is not the case, however, across metro areas, at least not yet–Panel B shows no clear pattern or trend.[13]

12.4 The upside and downside of reconvergence

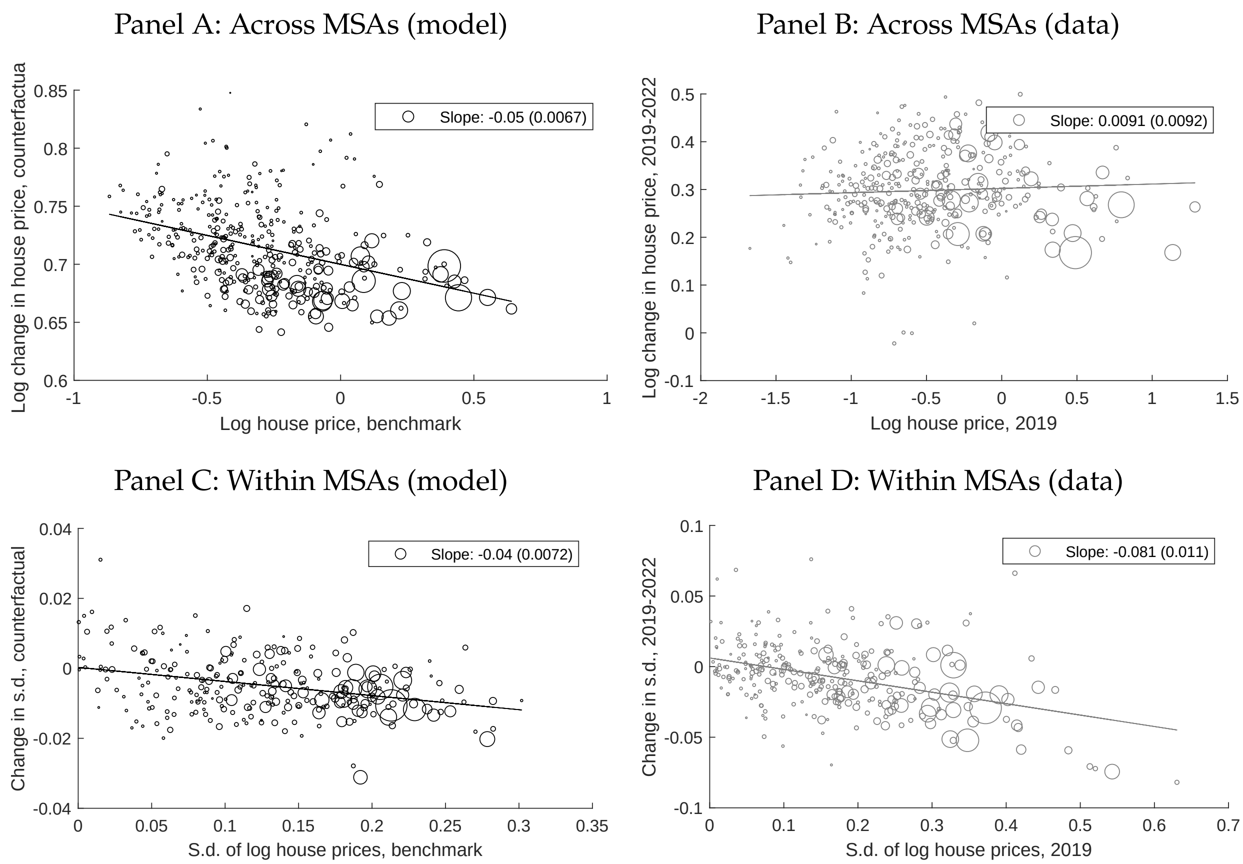
Some aspects of this apparent reconvergence are clearly positive. It is clearly socially beneficial for a wider range of people to have access to high-paying jobs, and to be able to do so without paying high housing costs. The reduction in residential segregation by income and education may also reduce concerns about unequal access to education and cultural amenities.

Yet there may also be some difficulties. The suburbanization of the post-war era drained many U.S. urban cores of their tax base, and the recent return of young urban professionals played a key role in revitalizing them. If these younger educated workers will now be

[12]The results in panel C have somewhat different magnitudes than model predictions for at least two reasons. First, it uses 1% ACS samples and the model uses a 5% sample. Second, panel C compares 2019 with 2021, while the model is calibrated to 2012–2016.

[13]The results in panels B and D have somewhat different magnitudes than model predictions for at least two reasons. First, they use Zillow data, while our model uses ACS data. Second, panels B and D compare 2019 with 2021, while our model is calibrated to 2012–2016.

Figure 16: Reversal of house price divergence



Note: Panel A shows the relationship between demeaned log average house prices at the MSA level in the benchmark economy and the log change in prices in the counterfactual. Panel B shows the same relationship using prices from Zillow in Dec. 2019 and the change between Dec. 2019 and Dec. 2022. Panel C shows the relationship between the population-weighted standard deviation of log house prices across model locations within an MSA in the benchmark and the change in the st. dev. in the counterfactual. Panel D shows the same relationship using prices from Zillow in Dec. 2019 and Dec. 2022. Circle size is proportional to MSA population in the benchmark. The legend shows best-fit slope coefficients and their standard errors.

drawn to smaller cities and to suburbs, at the same time that the demand for centrally-located office space has fallen sharply, some city centers may be in for a very bumpy ride over the next several years.

13 American Exceptionalism?

In this article we have used a quantitative model, carefully calibrated to represent the economy of the United States, to paint a picture of how home work may change the urban landscape in the future. Which is all well and good–but what of the rest of the world? Rare as it was, remote work already had unusually high acceptance in the United States before Covid (Hansen, Lambert, Bloom, Davis, Sadun, and Taska, 2023), and the larger size of the average U.S. house, even compared to similarly affluent countries, may also make a home work model easier to adopt.

It turns out that when we look at home work data, especially post-Covid, the U.S. is actually not exceptional. Surveys of workers in 27 countries conducted by Aksoy, Barrero, Bloom, Davis, Dolls, and Zarate (2022) show the United States barely over the mean both in terms of current home work and planned future home work. The results of these surveys are also interesting in that, although there is variation across countries and some places, such as Taiwan and South Korea, have clearly rejected the idea of remote work, it also shows countries from every region and income level that (e.g. India, Egypt) where home work has gained apparently durable acceptance. Hansen, Lambert, Bloom, Davis, Sadun, and Taska (2023) find that among Anglophone countries, the U.S. went from the clear leader pre-Covid to middle of the pack in 2023 when it comes to jobs advertised as having a remote option.

We might also note that the U.S. is also not exceptional when it comes to broad trends in housing affordability. Data compiled by Knoll, Schularick, and Steger (2017) show that the U.S. trend of falling house price-to-income ratios in the post-WW2 era, followed by stagnant or rising ratios since the 1980s, is not uncommon, at least among developed countries. While the urban structure of each country has some peculiarities, in a globalized world there are many common trends.

Research does clearly show that the overall prevalence of work from home is strongly tied to occupation and income level. So the impact of home work on a country with a relatively low share of college educated workers and a relatively large manufacturing sector will certainly be smaller. And the specific steps that business leaders and public authorities might take to adapt work schedules and urban plans will surely differ based on the peculiarities of each location. But the evidence of the continued popularity of remote work across a diverse set of countries suggests that quantitative studies like this one, though focused on a single economy, may still give leaders elsewhere a good idea of what to look out for.

14 Korean Exceptionalism

South Korea is one country that stands out as being slow to take up work from home, working only 0.5 days from home on average in early 2022, compared to 1.6 days in the United States (Aksoy, Barrero, Bloom, Davis, Dolls, and Zarate, 2022). Understanding the reasons for this exception may help shed light on why adoption succeeded elsewhere, and what obstacles home-based work might face in the future.

The reason is not occupational composition. Applying Dingel and Neiman's (2020) methodology to data from the 2020 Korean Occupational Workforce survey (Ministry of Employment and Labor, 2020a), as shown in Table 2, indicates that between 37.5% and 41.43% of South Korean jobs can be performed remotely–a share scarcely different from the U.S. But a survey of South Korean managers and executives conducted by the Korea Enterprises Federation (2022) reveals one key difference: Only 29% of managers surveyed believed that remote work was at least 90% as productive as on-site work. This is in contrast to the 70% of U.S. managers who believe remote work is at least 90% as productive, according to Bloom, Barrero, Davis, Meyer, and Mihaylov (2023). If South Korean managers believe work from home is that bad, then why, indeed, would they allow it?

The precise reasons for this gap in perception are not entirely clear. Part of it may be differing cultural expectations: South Korea has a work culture which emphasizes hierarchy and teamwork (Kim, 2019), while valuing face-to-face interaction and visible signs of work effort (Rashid, 2023). The manufacturing sector is also much larger in South Korea than the U.S. (≈25% versus ≈10% of GDP). An August 2020 survey by the Ministry of Employment and Labor (2020b) found that many managers expressed "fairness concerns"–i.e., a belief that it is unfair to allow some occupations to work from home while others, such as those directly involved in assembling products, cannot.

The South Korean government has made some efforts to promote home-based work, even subsidizing remote-enabling equipment purchases for small and medium businesses to the tune of about 3,000 U.S. dollars per employee. But without more buy-in from managers and corporate leaders, such efforts will have limited effect.

15 In Conclusion: Whence Downtown?

To conclude, let us shift our focus back from the global view and questions of international applicability, and turn to a question at the heart of the matter. Namely, what will happen to the heart of the city, the downtown? While our quantitative results throw cold water on more extravagant fantasies about the end of cities and the rise of digital nomadism, they do support concern about the near-term health of employment-focused city centers. The model predicts a fall in both residents and in-person employment downtown–hence the "donut cities" of Section 7. It also predicts that commercial real estate that is unable to be converted to alternative uses could see large declines in value (Section 8). This raises the spectre of a fiscal "doom loop" as warned of in Gupta, Mittal, and Van Nieuwerburgh (2022), as falling property tax revenues hit municipal budgets, degrading the quality of public services downtown, further reducing its attractiveness as a place to live and work.

How should cities respond to this challenge? A recent study by researchers at Mastercard suggests one way forward.[14] This study shows that while daytime spending in New York restaurants has declined since 2019, nighttime spending has more than doubled. How is this possible? City centers are not only places to work. They are also places to enjoy, offering restaurants and bars, parks, shopping streets, temples and museums. Even if the demand for centralized workspace remains lower, downtowns which also offer attractive spaces for inspiration and relaxation will likely come through okay.

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[14]See https://www.mastercardservices.com/en/reports-insights/economics-institute/nycs-economic-clock.

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A South Korean Occupational Composition Calculations

Table 2 demonstrates the calculation of remote-capable jobs in South Korea in 2020, using occupation telecommutability classifications from Dingel and Neiman (2020).

Korean Occupational Workforce Survey (2020)						
(1) Code	(2) Occupation	(3) Emp.	(4) Emp. Share	(5) Code	(6) O*NET-derived Share WFH	(4)*(6)
	All	12,515,581				
01	Management Occupations (Executives, Department Managers)	155,410	1.242%	11	0.87	0.0108
02	Business, Administrative, and Office Occupations	2,681,829	21.428%	13,42	0.65-0.88	0.1886
03	Finance and Insurance Occupations	333,631	2.666%	13	0.88	0.0235
11	Humanities and Social Sciences Research Occupations	17,609	0.141%	19	0.54	0.0008
12	Natural and Life Sciences Research Occupations	46,743	0.373%	19	0.54	0.0020
13	Information and Communication Technology Research and Engineering Occupations	360,545	2.881%	15	1	0.0288
14	Construction and Mining Research and Engineering Occupations	323,040	2.581%	17	0.61	0.0157
15	Manufacturing Research and Engineering Occupations	643,087	5.138%	17	0.61	0.0313
21	Education Occupations	456,056	3.644%	25	0.98	0.0357
22	Legal Occupations	45,749	0.366%	23	0.97	0.0035
23	Social Welfare and Religious Occupations	396,073	3.165%	39	0.26	0.0082
24	Police, Firefighters, Correctional Officers	621	0.005%	33	0.06	0.0000
25	Military Personnel	0	0.000%	33	0.06	0.0000
30	Health and Medical Professionals	732,321	5.851%	29	0.05	0.0029
41	Arts, Design, and Broadcasting Professionals	179,486	1.434%	27	0.76	0.0109
42	Sports and Recreation Professionals	72,049	0.576%	27	0.76	0.0044
51	Beauty and Bridal Services Occupations	40,979	0.327%	39	0.26	0.0009
52	Travel, Accommodation, and Entertainment Services Occupations	40,492	0.324%	27	0.76	0.0025
53	Food Service Occupations	421,923	3.371%	35	0	0.0000
54	Security and Guard Occupations	264,791	2.116%	39	0.26	0.0055
55	Care Services (Caregiving, Childcare) Occupations	303,255	2.423%	39	0.26	0.0063
56	Cleaning and Other Personal Services Occupations	418,272	3.342%	39	0.26	0.0087
61	Sales and Retail Professionals	973,826	7.781%	41	0.28	0.0218
62	Driving and Transportation Professionals	626,059	5.002%	53	0.03	0.0015
70	Construction and Mining Professionals	463,797	3.706%	47	0	0.0000
81	Machinery Installation, Maintenance, and Production Professionals	652,509	5.214%	51	0	0.0000
82	Metal and Material Installation, Maintenance, and Production Professionals	285,214	2.279%	51	0	0.0000
83	Electrical and Electronic Installation, Maintenance, and Production Professionals	505,557	4.039%	51	0	0.0000
84	Information and Communication Technology (ICT) Installation and Maintenance Professionals	72,082	0.576%	51	0	0.0000
85	Chemical and Environmental Installation, Maintenance, and Production Professionals	206,445	1.650%	51	0	0.0000
86	Textile and Apparel Production Professionals	80,235	0.641%	51	0	0.0000
87	Food Processing and Production Professionals	119,253	0.953%	51	0	0.0000
88	Printing, Woodworking, Crafts, and Other Installation	120,330	0.961%	51	0	0.0000
89	Manufacturing General Laborers	454,752	3.633%	51	0	0.0000
90	Agriculture, Forestry, and Fisheries Workers	21,561	0.172%	45	0.01	0.0000
Sum		12,515,581	100%			0.4143

Table 2: Share of jobs that can be done at home, by occupation group