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Research Statement

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## **1 Overview:**

I am an urban and labor economist. The primary focus of my research is to understand the impact of cities on labor productivity, innovation, and the well-being of the population. My research so far focuses on several aspects of cities:

First, my research analyzes the role of cities as a place for **productivity and innovation**. In my working paper “**Agglomeration [5]**”, we seek to test whether the agglomeration economies of cities have been weakened by the rapid adoption of working from home (WFH) in recent years due to the pandemic shock. We highlight that, on the one hand, the adoption of WFH could potentially lead to an increase in labor supply to large and productive cities, which could boost productivity in aggregate. On the other hand, WFH could reduce interactive activities and prevent knowledge transfers and business relationships from coming into being due to the lack of physical presence. This could potentially lead to weakening of cities’ productivity premium enabled by the agglomeration economies of cities, which are largely based on cities’ ability to foster interactions and knowledge transfers. We present evidence from multiple empirical strategies and data sources, including online job postings, to show that the agglomeration effect was indeed weakened by the adoption of WFH.

Another example of my research on cities and productivity is my working paper “**Rent Seeking [6]**.” In this paper, we test the hypothesis that high local productivity could enable local governments with rent-seeking motives to raise taxes and withhold public goods. The idea is that if governments are non-altruistic and rent-seeking, responses to migration way by local tax base with respect to any potential tax hike would serve as a disciplining force against arbitrary tax hikes. However, if local productivity is high compared to elsewhere, it would raise the desirability of staying in the local jurisdiction and thereby could weaken local residents’ migration response to tax hikes. We empirically test our hypothesis using a large variety of data sources. Furthermore, we argue that productivity-enabled rent-seeking behavior by governments would lower the

nation's aggregate productivity because such behavior reduces the number of workers who are willing to move to places with high local productivity.

Furthermore, some of my research analyzes how **broad technological changes** in the labor markets could **reversely** affect the structures of cities. In my "**Gentrification [1]**" paper, I show that the rising value of time among high-skilled workers, led by skill-biased technological changes, contributed to the rapid gentrification of central-city neighborhoods in the US. In the process of gentrification, the increased value of time served as an exogenous propelling force, which triggered a chain of endogenous amenity changes as a response, leading to profound changes in central-city neighborhoods.

Another example of my work analyzing how broad changes in the labor market affect city structure is my work "**Demand for Density [4]**." Our paper was the *first* such paper to show that after the COVID-19 pandemic started, housing demand suddenly shifted from city centers to the suburbs and from large cities to small cities. We demonstrate that the sudden adoption of working from home and the reduced demand for consumption amenities due to the pandemic contributed to such shift,

I also focus on cities' role as a provider of **amenities** and how it impacts the welfare of residents. My research demonstrates that understanding the disparate access to cities' amenities by different population groups is crucial for measuring well-being inequality. In my paper "**Gentrification [1]**" I show that as high-skilled workers moved into the central cities and gentrified the urban neighborhoods since the 1990s, amenities, including consumption amenities, in central-city neighborhoods endogenously improved, which, in turn, attracted more high-skilled workers to move in, further driving up gentrification and worsening affordability for the low-skilled workers living in these neighborhoods. The paper highlights the importance of accounting for the dynamics of urban amenities when studying inequality.

I have also introduced a new approach to measuring the value of consumption amenities with detailed time-use patterns from the American Time Use Survey (ATUS). In my paper "**Time Use [3]**," I argue that any sound measurement of the welfare value of consumption amenities must correctly address two challenges: 1. The value of consumption amenities diffuses spatially (e.g., a restaurant provides amenity value not only to residents immediately nearby but also to residents living at some distance away.); 2. The marginal values of different types of consumption amenities

are different (e.g., restaurants vs. museums). Hence, the value of different types of amenities must be aggregated with the correct weights. I propose that researchers can use residents' observed travel time and frequency of visits to pin down both the degree of spatial diffusion and the aggregation weights. The paper shows that welfare inequality due to the differential access to consumption amenities accounts for *a small portion* of the increase in amenity inequality since the 2000s.

On how cities impact welfare, I also attempt to document and analyze recent developments in migration and spatial sorting patterns and measure the welfare implications of these new patterns. For example, in my paper “**Great Reshuffle [7]**,” which is currently under revision, using detailed individual panel data from the Federal Reserve Bank of New York Consumer Credit Panel, we document migration patterns by income across finely defined geographic locations. We show that the shift in housing demand toward low-density neighborhoods and cities since 2020 was driven largely by migration by high-income individuals due to their higher likelihood of working from home. Using our documented migration patterns and the estimated impact of migration on local housing costs and job access, we argue that welfare inequality has likely been mitigated due to the migration wave over the pandemic. We are currently revamping the paper and adding new analyses with more data.

Lastly, my research also examines **geographic hurdles** in cities facing workers and how these hurdles affect residents' well-being and wage inequality. For example, in my “**Gender Gap [2]**” paper, we show that the geography of where workers live and where high-wage jobs are located is an important determinant of the size of the gender wage gap. Prior papers show that women are more likely to tradeoff high-wage jobs for a shorter commuting time, which could lead to a wage gap vis-à-vis men. However, we show that the gender wage gap that arises due to such tradeoff would only occur if the shorter commuting time comes with a significant *wage penalty*, which could only happen if workers live far away from high-wage jobs. We empirically demonstrate that the geographic concentration of high-wage jobs creates such wage penalties and significantly contributes to the gender wage gap.

## **1.1 Work in Progress and Future Plan**

I have several ongoing projects and plans for the next few years.

My research agenda in the coming years remains largely focused on the effect of cities on productivity and welfare. Below, I will describe the new perspectives from which I plan to fulfill these agendas.

On how cities affect welfare, I am currently working on a new approach to add to the existing literature on the welfare impact of spatial sorting. In my ongoing project “**Misalignment [8]**,” we point out that many existing papers that analyze the welfare impact of spatial sorting often make a strong assumption about amenities: the amenity values for different cities are measured by a single-dimensional variable, implying that amenity values are perfectly aligned for different population groups. In other words, if city A’s amenities are preferred over city B’s by group x, city A’s amenities are also preferred over city B’s by group y, though the magnitude difference between the amenity values could differ by group. We argue that the single-dimensionality assumption is strong, and allowing preferences for amenities to be misaligned could lead to very different estimates of the welfare impact of spatial sorting. Our project in progress assesses the bias of the single-dimensionality assumption using a revealed-preference approach, in which we allow each population group to have arbitrary preferences for cities’ amenities.

Furthermore, in a very early-stage project, I explore the causes and consequences of the so-called “super-commuting” phenomenon in the US. Over the last few decades, there has been a rapid rise in the fraction of workers who commute to exceedingly far-out locations from where they live and who simply live and work in different metropolitan areas. Is it a natural consequence of the growth of cities? Aging infrastructure? Or, is it the result of rising location-specificity of amenity preferences or job matches? Perhaps it might also be the result of the rise of dual-career households. This new research agenda attempts to address these questions.

Regarding my agenda of studying cities’ effect on productivity, I am working on a few highly preliminary research projects that explore the **agglomeration effects of innovators** (i.e., how geographic clustering affects the innovation process). My research attempts to shed light on **both** the **positive and negative** aspects of the geographic concentration of researchers on innovation productivity.

On the positive side, if researchers are working in institutions that are geographically close by, the proximity between researchers could potentially encourage collaboration and faster knowledge transfers, which may boost research output and quality. I study the citation network data on the

universe of all research papers published in the last 100 years. I intend to empirically understand the agglomeration effect of researchers and see whether geographic isolation holds back research institutions and scholars (see “**Geographic Isolation [9]**”).

While the positive effect of geographic clustering of innovators may be intuitive, the potential cost/negative side of too much concentration may be less obvious to urban economists. In another early-stage project, I attempt to use patent data to identify whether the hyper-concentration of innovators (e.g., Silicon Valley) has a negative side. I hypothesize that a highly geographically clustered innovation ecosystem may lead to an *echo chamber* of ideas, which may encourage more follow-on improvement on existing technologies but could potentially stifle some *breakthrough* innovations compared to a counterfactual. This potential negative side effect clearly needs to be weighed against the overwhelming positive effect of enhanced collaboration and knowledge transfers enabled by geographic clustering. I plan to empirically investigate whether the echo-chambering of ideas is indeed an unfortunate side-effect of clustering. And if so, under what conditions could this negative side effect become on-net detrimental to innovations?

Besides cities’ role in productivity and welfare, another one of my current research interests is to empirically identify the newly emerging socioeconomic **dividing lines** in the United States. Anecdotally, we often hear about the stories of the US “coming apart” between the two sides of the nation and the “big sort” within the US, which refer to the widening inequality and growing unfamiliarity between population groups in the country. Often, economists use traditional household characteristics such as income, education, or race to tag population groups and study the inequality and other observable differences between them. However, in recent years, many new dividing lines may have increasingly been buried within these traditional dividing lines. For example, college-educated White Americans with high income living in West LA may be more different from college-educated White Americans with high income living in the suburbs of Little Rock, Arkansas, in terms of their consumption preferences, skill sets, career prospects, political beliefs, etc, than they are from racial minorities coming from similar backgrounds. The Whites living in different neighborhoods and cities, despite belonging to the same conventional population group, have seen a precipitous decline in inter-marriage rates between each other based on Census/ACS data, signaling the need for a different lens to understand the societal fault line. My goal is to precisely understand the fault line that may be currently dividing America, using a variety

of sources, including trip patterns from cell phone data, individual migration history, the Census data, etc.

Lastly, continuing my previous effort to understand the gender wage gap, I am conducting a project where I assess women's influence in sciences and how it compares with that of men (**"Influence [10]"**). The keyword in this paper is "influence". We use various measures in the network economics literature (such as Katz-Bonacich Centrality) to gauge authors' influence. We attempt to uncover the driving factors behind the very large gender gap in research influence.

## **2 Research Description in Detail**

### **2.1 Papers Accepted by Journals**

#### **The Rising Value of Time and the Origin of Urban Gentrification – Abbreviated as “Gentrification [1]”**

*American Economic Journal: Economic Policy, 2022, 14(1), 402-439*

In this paper, I assemble a variety of data sources to document the rising demand for residential housing in city centers by high-skilled workers in the United States since the 1990s after years of suburbanization and urban decay.

My paper traces one of the origins of this sudden reversal of fortune of U.S. city centers to the disproportionate rising value of time among high-skilled professionals. I find evidence that high-skilled workers in the United States saw an increase in their value of time since the 1990s while low-skilled workers did not. The disproportionate rise in the value of time led to an increase in the opportunity cost of commuting time for high-skilled workers. The increased cost of commuting time drove many high-skilled workers to locate in central city neighborhoods in large metro areas. Their movement into the central cities triggered neighborhood amenities to change for the better. Crime was reduced as a result, and there emerged an increased variety of consumption amenities (restaurants, coffee shops, etc.). The endogenous amenity changes induced by the influx of high-skilled workers created a loop of positive feedback that further drove up the housing demand in central city neighborhoods, squeezing the low-skilled/low-income residents' budget and force some of them out of the neighborhoods. I show that such “gentrification” episode driven by the mechanisms described in his paper led to an increase in inequality of well-beings beyond the conventional measure of income inequality. In other words, once we account for different neighborhood environment and housing cost that people face driven by gentrification, inequality of well-beings increased by more than just the inequality of income over the past three decades.

The key empirical challenge of testing my hypothesis is 1. the measurement of the rising value of time and 2. how to establish causal evidence that a rise in the value of time led to gentrification.

To measure the change in the value of time, I estimate the change the long-hour premium experienced by workers in each occupation, which is the wage return associated with working

more than full time hours. I find that for some occupations like financial managers and lawyers, the long-hour premium has increased significantly since the 1980s while for other occupations, such as teachers, it did not.

I estimate a spatial equilibrium model of residential choice to parse out the causality and quantify the relative importance of the direct effect of rising value of time and the indirect effect of endogenous amenity change on gentrification.

To identify how much the rising value of time directly affects location choice, I exploit the fact that job locations in different occupations are different across space. If the rising value of time leads to workers shortening their commute time, I should see them moving their homes closer to job locations specific to their occupations, all else equal. To think about the strategy more intuitively, consider financial workers and physicians in the New York MSA. Financial jobs are very concentrated in downtown Manhattan while clinics and hospitals are spread throughout the metropolitan area. Therefore, if financial workers and physicians both demand shorter commute time, they should move in different directions according to their respective job locations.

To identify how much the endogenously changing amenities affect location choice, I use the idea that the locations of job sites that a worker does not work at may indirectly affect the worker's migration choice by changing other workers' migration choices and thus changing local amenities. In the previously used example of financial workers and physicians, downtown Manhattan has a high concentration of financial firms but has a smaller concentration of clinics and hospitals. The rising value of time of financial workers would induce an inflow of high-skilled financial workers and thus a rising level of amenities in downtown Manhattan. If I observe that physicians also increasingly migrate into downtown Manhattan, even though physicians do not typically work there, such patterns would reveal their preference for amenities.

I find that the rising value of time among the highly skilled workers over the last three decades is one of the important root causes of gentrification of urban neighborhoods in the U.S. Looking more closely, I find that the rising value of time itself has a modest direct impact on gentrifying the central cities. Its effect on gentrification, however, has been substantially amplified by endogenous amenity change, which makes the overall impact of the rising value of time on neighborhood changes much larger.



Using my model framework, I also evaluate the effect of the changing value of time, amenities, and rents on the welfare of high- and low- skilled workers. I find that welfare inequality between high- and low- skilled workers increases more than just the rise in earnings inequality alone over the past decades, once we account for the changing location choices by each group of workers and neighborhood changes.

### **The Geography of Jobs and the Gender Wage Gap (with Sitian Liu) – Abbreviated as “Gender Gap [2]”**

*Review of Economics and Statistics, forthcoming*

In this paper, my co-author Sitian Liu and I explored how the geographic locations of jobs within cities can affect how women makes their choice of jobs and contribute to the gender wage gap. Prior studies have shown that women are more willing to accept jobs with lower wages for shorter commuting time than men. We demonstrated that this different willingness to trade off wages for shorter commuting time can only lead to a wage gap if workers are faced with large wage penalty for a shorter commuting time. And this would happen if high-paying jobs are geographically concentrated and workers live far from the locations where high-paying jobs are located.

We present a job choice model in which workers tradeoff between wages and commuting time to formally capture the mechanism. The key prediction of the model is that workers who face large wage penalty for a shorter commuting should exhibit both a larger gap in observed commuting time and a larger wage gap.

Using the Census and American Community Survey, we show that both the gender commuting gap and wage gap tend to be smaller near city centers, where the wage return of commuting long (wage penalty of short commuting) tends to be low, which is consistent with the model prediction. However, this empirical finding could be a result of households sorting spatially based on their residential location preferences, which may be correlated with households’ preferences for commuting and labor supply.

To further probe this concern, we examine the geography of the gender commuting and wage gaps across occupations. We exploit the fact that high-wage jobs are geographically concentrated

differently across different occupations. In occupations where high-wage jobs are concentrated in city center, we should see both gender commuting and wage gaps increase strongly with the distance to city center, while in occupations where high-wage jobs are geographically scattered, gender gaps in commuting time and wages should depend less on the distance to city center. Using the geocoded American Community Survey, we show that such heterogeneity is indeed borne out by the data, and thus validating our hypothesis.

Lastly, we highlight that after the gender wage gap narrowed spectacularly since the 1960s, the narrowing of the gender wage gap started to slow in recent years. A sizable gender wage gap persists to this day even as the traditional explanatory factors such as discrimination and education gap disappeared. Using the job choice model we develop, we demonstrate that, as other factors diminish, commuting preferences and the geography of jobs play an increasingly important role in explaining the remaining gender wage gap in the United States. This paper brings forward the discussion of whether city designs and firms' location choices can inadvertently create undue burden facing female workers, forcing some of them to forego high wages for shorter commute.

**Measuring the Value of Urban Consumption Amenities: A Time-Use Approach –  
Abbreviated as “Time Use [3]”**

*Journal of Urban Economics, Volume 132, November 2022, 103495*

Many existing research papers have demonstrated that the level of spatial access to urban amenities, particularly consumption amenities (restaurants, grocery stores, gyms, etc.), not only plays a role in explaining the value of cities, but different skill and income groups' disparate levels of access to these amenities are also an important driver of the inequality of well-beings. High-income population is shown to have access to a larger variety of consumption amenities of higher quality than low-income population.

However, the challenge that prevent researchers from creating a well-defined measurement for the value of access to consumption amenities is that the benefit of consumption amenities tends to be diffused spatially: the benefit of a restaurant is valued not only by the people living right next to the restaurant but also valued by customers who potentially live far away but to a lesser degree. So how do we measure such elusive and spatially diffused value of consumption amenities? Second, different types of amenities are also valued differently. People tend to value proximity to

restaurants and grocery stores a lot more than they value proximity to museums. Therefore, how do we aggregate the amenity values of different types to calculate a welfare number? The goal of my paper is to solve this measurement problem using sound economic theory and feasible data.

I use people's time-use patterns interacting with consumption amenities to recover people's preferences for amenity access and then used the quantified preferences to calculate how people value spatial access to amenities. The basic idea is that we can learn how much the benefit of a restaurant extend over distance by looking at how long people typically spend on traveling to restaurants through time-use data. In addition to travel time, the frequency at which people visit these amenities affects how access to amenities affect well-being of residents, naturally providing the aggregation weights for welfare calculations.

By applying such intuition with an amenity-choice model, I estimate people's preference for consumption amenities using time-use data from the American Time-Use Survey. Using his estimates, I show that the high-income people generally have better access to consumption amenities than low-income people in the United States. The access inequality was also worsening over time, consistent with prior literature. However, my finding shows that correctly measuring the access of amenities is important, as my estimates of access inequality to consumption amenities tend to be smaller than prior estimates.

**The Impact of the COVID-19 Pandemic on the Demand for Density: Evidence from the U.S. Housing Market (with Sitian Liu) – Abbreviated as “Demand for Density [4]”**

*Economics Letters*, Volume 207, October 2021, 110010

In the wake of the COVID-19 pandemic, my co-author Sitian Liu and I studied the rapid change in local housing demand in the United States. We show that housing demand shifted significantly from city centers to the suburbs and from large cities to smaller cities during the pandemic in the United States. We document a large relative increase in housing inventory in neighborhoods near the central cities after the pandemic started and a decrease in housing inventory in the suburbs. We further document that the both house prices and rents soon reflected the outward shift of housing demand.

To test whether the sudden rise in the option to work from home/remote work is a driving force behind this suburbanization of housing demand, we exploit the fact that in some neighborhoods a

large fraction of the local jobs is remote-compatible while other neighborhoods have a much lower fraction of remote-compatible jobs. Since the workers working in those remote-compatible jobs were much more likely to be sent to work from home after April of 2020, we can test whether the shift in housing demand is driven by the work-from-home shock by examining whether neighborhoods with a larger fraction of remote-compatible jobs see a larger decrease in relative housing demand after the work-from-home shock.

Our results suggest that the exodus of housing demand is indeed driven partially by people's new-found option of working from home. The newly found freedom from commuting obligation enabled people to re-locate to cheaper locations with better natural amenities, which generally tend to be in the suburbs or smaller cities.

In addition to the effect of remote working, we showed that part of the exodus of housing demand is also because of pandemic lockdown and reduced attraction of urban amenities such as restaurants and shops, which often rely on density to thrive. The diminished value of these density-dependent amenities due to the fear of COVID transmission further reduced the relative attraction of denser cities and neighborhoods, albeit temporarily.

## **2.2 Complete Working Papers**

### **The Effect of Working from Home on the Agglomeration Economies of Cities: Evidence from Advertised Wages (with Sitian Liu) – Abbreviated as “Agglomeration [5]”**

In this paper, we study the effect of the adoption of working from home (WFH) on the agglomeration economies of cities.

Prior literature has repeatedly shown that interpersonal interactions enabled by close physical proximity in big and dense cities lead to increased knowledge transfers, learning, and networking, which give rise to the productivity premium in large cities (i.e., agglomeration economies). However, the surge in the adoption of WFH after 2020 calls into question of whether the productivity advantage in large cities remains in the absence of person-to-person interactions. Our paper tries to shed light on whether the widespread adoption of WFH changed the agglomeration effect of cities.

To capture the mechanisms through which WFH can affect agglomeration economies and the spatial allocation of labor in general, we present a stylized model. In the model, we allow employers in large cities to offer some remote working options and allow workers to choose work and residential locations between large and small cities. Without the widespread adoption of WFH, the concentration of onsite workers in large cities can boost the local productivity through agglomeration externality. However, the limited housing supply in more productive large cities constrains the number of workers who have access to the high productivity in large cities.

The adoption of WFH (virtual work) can allow more workers to work for the productive large-city employers without having to bear the high housing cost. This could lead to labor re-allocation toward more productive large-city employers, which can raise the aggregate productivity.

On the other hand, the adoption of WFH can lead to a decrease in the number of onsite workers in large cities, which could weaken the strength of the agglomeration economies in large cities and lowers the productivity of firms based in large cities. The reduction in the productivity due to the weakening of agglomeration could not only directly reduce the aggregate productivity of the nation by lowering the productivity of large cities, it could also lead to re-allocation of labor away from productive firms located in large cities to less productive firms located in smaller cities, indirectly further lowering the aggregate productivity.

We derive two empirical predictions to validate the model and to examine whether the adoption of WFH weakens the agglomeration economies. First, the weakening of agglomeration effect in large cities and the increased labor supply enabled by WFH could both drive down the urban wage premium. This means that adopting WFH should lower the urban wage premium regardless of whether agglomeration economies in large cities are weakened. Second, the direction of employment shift between large and small cities depends on the primary driver of the reduced urban wage premium. If the decrease is primarily due to a weakened agglomeration effect in large cities, employment (based on employers' locations) should move from large to small cities. However, if an increased labor supply to large cities is the main cause, employment should shift from small to large cities. Since the labor supply channel brings employment from small to large cities, if we see that employment shift from large to small cities on net, this will necessarily imply that agglomeration economies must have weakened in large cities.

We empirically test these predictions using the episode of the COVID-19 pandemic, during which a large segment of the workforce rapidly adopted WFH. But the surge in WFH adoption was adopted unevenly across occupations and sectors. Some occupations related to computer and finance adopted WFH massively while other occupations such as food and health-related services saw much more muted changes. If the model predictions were borne out by the data, we should see occupations with high levels of WFH adoption over the pandemic exhibit reduced urban wage premium while occupations with low levels of WFH adoption should see the urban wage premium holding steady.

Our empirical method assumes that shocks unrelated to the WFH adoption during the pandemic did not disproportionately affect wages of jobs located in large cities within high-WFH-adoption occupations. We are aware that other pandemic shocks unrelated to WFH adoption could have distinct impacts on high- and low-WFH-adoption occupations. However, if the effects operate at the occupational level, they should not alter the urban wage premium or employment growth differently by city size. Similarly, other pandemic shocks might have affected wages and employment differently in large and small cities. However, our conclusion should hold if these city-specific effects do not differ systematically by occupations' level of WFH adoption.

We test our model's urban wage premium prediction using data on advertised wages from Emsi Burning Glass (now Lightcast). We find a significant decrease in urban wage premium for jobs in occupations that heavily adopted WFH after the pandemic shock. In contrast, for occupations with low WFH adoption, the urban wage premium remained mostly unchanged after the pandemic shock. These findings validate our model's first prediction.

Furthermore, we show that among the occupations that heavily adopted WFH, their employment (based on employers' locations) shifted away from large employment centers. If the agglomeration effect was not affected by WFH, adopting virtual work technology should have enabled firms in large job centers with access to a larger labor pool, driving up the total size of employment at firms based in large cities. The fact that we find a shift in employment away from large job centers along with a decreased urban wage premium in high-WFH-adoption occupations imply that WFH must have mitigated some of the productivity advantage which was benefiting large cities before the pandemic.

Lastly, we move away from empirical model tests and shift our focus to indirectly evaluating the weakening of agglomeration economies using an alternative approach. We employ a Gelbach decomposition exercise, drawing from Gelbach (2016), to identify which skills listed in posted jobs contribute the most to the overall decline in the urban wage premium within high-WFH-adoption occupations. Our hypothesis is that if labor supply to large cities increased due to WFH adoption, we should observe disproportionate decreases in the urban wage premium of skills that are specifically complementary to remote work, such as information technology skills. In contrast, if the weakening of agglomeration economies in large cities plays a more important role, we should anticipate disproportionate decreases in the urban wage premium of skills supportive of knowledge spillovers, network building, or fostering business relationships.

Our decomposition results suggest that several skill cluster families, including “Marketing and Public Relations,” “Customer and Client Support,” “Building Relationship,” “Communications,” “Business Management,” and “Information Technology,” play a crucial role in the decline of the urban wage premium. Notably, skills related to “Marketing and Public Relations,” “Customer and Client Support,” “Building Relationship,” and “Communications” tend to be particularly productive in interactive activities. The relative decline in wage returns to these skills in large cities suggests that there has likely been a decrease in the frequency of productive interactive activities requiring these skills in firms located in large cities. In addition, we also observe a decline in the frequency that these skills are listed in job postings in large cities compared with smaller ones, further suggesting reduced demand for these skills in large-city workplaces.

In contrast, “Information Technology” skills typically involve using electronic tools and applications, which complement the feasibility of remote work. These skills also saw a significant decrease in the urban wage premium. This finding suggests that the decline in the urban wage premium could also be partially attributed to an increase in the labor supply of remote workers to large cities.

In summary, this paper highlights that WFH could potentially lead to two opposing effects on aggregate productivity. The first is that WFH could enable increased (virtual) labor supply to large cities where productivity tends to be higher, which could lead to an increase in aggregate productivity and wages. However, WFH could also potentially reduce the strength of agglomeration economies present in large job centers due to the reduction in interactive work

activities. We present evidence that while WFH has likely increased labor supply to big cities, it has weakened the agglomeration economies of big cities, which could have detrimental effect on aggregate productivity of the country.

### **Spatial Productivity Differences and Government Rent-Seeking (with Sitian Liu) – Abbreviated as “Rent Seeking [6]”**

One of my ongoing research projects is to explore local governments’ finances and how local taxation and public goods provision may be influenced by local residents’ ability to migrate. Prior papers have analyzed the hypothesis that if local governments are not entirely benevolent and instead set their tax policies in a rent-seeking manner, residents’ tendency to move away from the governments’ jurisdictions could act as an important disciplining force preventing the local governments from raising taxes too high or lowering public goods provision too much.

In this paper, we propose that high local productivity premium (vis-a-vis other areas in the nation) could dampen residents’ migration elasticity with respect to local taxation, which, in turn, could enable local governments to rent-seek by raising taxes without providing the corresponding public goods.

Why would high local productivity dampen local people’s migration tendency? The intuition is that high local productivity raises the relative utility of staying versus moving away, which could turn a larger fraction of local residents into *inframarginal* stayers in the events of tax hikes. In other words, a smaller fraction of the local tax base would leave their local jurisdiction in response to taxation. This dampening of migration responses enables a local government with rent-seeking motives to raise taxes without losing as much tax base, thus weakening residents’ ability to discipline the governments.

The model’s first prediction is that if states and local municipalities behave with rent-seeking motives, then jurisdictions with higher local productivity should levy higher tax rates. Using tax data from the Annual Survey of State and Local Government Finances, we show that that the state and local tax burdens tend to be higher in more productive jurisdictions. Moreover, this positive relationship persists even after controlling for various measures for local political preferences, which suggest that the relationship exists even among jurisdictions with similar local politics.



However, the positive relationship between tax rates and productivity could still be driven by alternative (non-political) explanations. For instance, residents in locations with higher productivity may have stronger preferences for public goods, which could lead to a positive relationship between tax rates and productivity without government having rent-seeking motives. Another explanation could be the “Baumol” effect—when private-sector productivity increases while public-sector productivity stagnates, under the assumption that the demand for public goods is income-elastic but highly price-inelastic, the price of public goods may rise if private-sector productivity is higher (Baumol, 1967). Through the Baumol effect, tax rates in more productive locations may be higher without governments’ rent-seeking motives or preference heterogeneity.

To further test for governments’ rent-seeking motives and distinguish them from the alternative explanations, we examine variations in the public-private wage gap across locations. The hypothesis is that rent-seeking governments in high-productivity locations may allocate additional tax revenue toward excess wage compensation for government employees compared with their counterparts in the private sector. To test the hypothesis, we use the CPS data and show that wage gaps are also higher in jurisdictions with higher productivity.

Nevertheless, the spatial relationship between the public-private wage gap and local productivity could still be spuriously generated by the Baumol effect if labor mobility between public and private sectors is imperfect. To further disentangle rent-seeking behavior from the Baumol effect, we examine how the relationship between the public-private wage gap and local productivity differs between states that permit public-sector collective bargaining and states that prohibit it. Following Brueckner and Neumark (2014) and Diamond (2015), we argue that in states where public-sector collective bargaining is permitted, government employees have a lower cost of exerting pressure on governments to extract tax rents for their compensation. Thus, if local productivity enables rent-seeking, the public-private wage gap should be more strongly affected by local productivity in states where collective bargaining is permitted for public-sector workers. Our findings based on the CPS are consistent with this prediction. The heterogeneous spatial relationship between the public-private wage gap and local productivity by collective bargaining legality could distinguish rent-seeking from the Baumol effect because the Baumol effect is caused by the income effect on the demand for public goods, and thus the Baumol effect should have a

similar impact on the public-sector wage regardless of whether government workers can collectively bargain.

In addition to exploiting variations in collective bargaining legality across states, we delve into variations in local governments' financial autonomy and investigate the effect of state-level productivity on the wage premium of local government workers. The idea is that if the wage gap between local government workers and private sector workers is primarily driven by the Baumol effect, we expect that the wage gap should be influenced solely by the productivity of the areas where local government workers serve. However, if government rent-seeking plays a role, the wage premium of local government workers could also be affected by the productivity of the state, especially for local governments that have lower financial independence and rely more on transfers from the state government. This is because state governments may redistribute rents to local governments, resulting in higher compensations for local government workers as well. Consistent with the rent-seeking hypothesis, we find that for local governments with a larger share of revenue derived from tax revenue, the wage gap between local government workers and private sector workers depends more on the local productivity. In contrast, for local governments relying more on state transfers as a share of revenue, the wage gap depends more on the state productivity.

After empirically validating the model, we use the model to quantitatively analyze the impact of spatial variation in tax rates driven by government rent-seeking on aggregate productivity and welfare. Through the model, we show that removing the rent-seeking motives from state and local governments would lead to a sizable increase in the aggregate productivity. The effect on aggregate productivity stems from the fact that rent-seeking motives lead governments to raise taxes and withhold public goods precisely in locations with high productivity (the effect is further exacerbated by the fact that high-amenity locations tend to be more productive in the U.S.) The result of this exercise highlights that the efficiency implications of rent-seeking motives of local governments through spatial misallocation.

Lastly, we highlight that the productivity and welfare gains resulting from the removal of government rent-seeking enabled by the productivity premium are strongly mitigated by spatial variations in housing supply elasticity. Because the most productive areas in the U.S. tend to exhibit low housing supply elasticity, gains from any reduction in tax rates in these areas can be offset by an increase in housing rents. Therefore, the potential gains from eliminating tax rate

variations driven by productivity difference would have been much larger if the housing supply were more elastic in these productive areas.

### **The Great Reshuffle: Residential Sorting During the COVID-19 Pandemic and Its Welfare Implications (with Wenli Li) (revision in progress) – Abbreviated as “Great Reshuffle [7]”**

Using individual-level micro data of location histories, we document a sudden rise of net migration towards suburban neighborhoods and smaller cities in the U.S. during the COVID-19 pandemic. We demonstrate that such migration wave was driven disproportionately by the movement of the high-income population, and, thus, it has “undone” some of the spatial sorting observed over the decades before the pandemic.

We show that, as a result of the migration, housing costs rose much more in the locations receiving the migration influx than the areas experiencing the exodus. Demand for local services and, consequently, local service jobs moved spatially in the same direction as migration. While WFH adoption improved job access by high-income workers much more, the pandemic-era migration also improved job access by low-income workers. Moreover, because the pandemic-era migration moved people from places with low housing supply elasticity to places with high housing supply elasticity, the spatial re-allocation of population over the pandemic alleviated the housing cost burden faced by both high- and low-income people, more for low-income people. In other words, the average spatial movement toward places with high housing supply suggest that housing cost faced by the average person would have been higher had migration toward suburbs and smaller cities not taken place, especially for the average low-income person.

Taking all the equilibrium impact of migration into consideration, we argue that the spatial sorting during the first two years of the pandemic likely reduced welfare inequality between the high- and low-income populations. However, this improvement in equality is small in magnitude relative to the worsening of inequality stemming from the differential WFH availability by worker income.

Currently, we are working on getting a few other local variables such as local consumption spending through the Y14M data. The effort is currently in progress.

## 2.3 Work in Progress

### **The Misalignment of Amenity Preferences and the Welfare Implications of Spatial Sorting: A Revealed-Preference Approach (with Luigi Pistaferri) – Abbreviated as “Misalignment [8]”**

Much attention has been paid to the rising wage/income inequality over the past few decades. In particular, the college wage premium vis-à-vis wages of non-college grads has surged since the 1980s. Over the same period, college-educated workers have been increasingly sorting into high-skilled and high-cost cities while workers without a college degree have been increasingly living in less skill-intensive and cheaper locations. Because different locations have increasingly divergent costs of living and potentially offer different types of amenities, the continued spatial sorting by skills has prompted researchers to question whether the rise in inequality in nominal wages also reflects a rise in inequality in broader measures of welfare.

Moretti (2013) shows that once one adjusts for the differences in the cost of living faced by different skill groups, real wage inequality increases to a lower extent than suggested by a comparison of nominal average wages. In contrast, Diamond (2016) argues that while high-skilled cities are more expensive, these cities are also endogenously supplied with better amenities due to spatial sorting. That implies that high-skilled workers are increasingly compensated by better amenities in high-cost cities which they value greatly. Her estimates suggest that the changing amenity difference entirely offsets the local cost difference and in fact widens welfare inequality. Based on the insight of the two papers, the key to understanding whether spatial sorting increased welfare inequality depends on accurately measuring the difference in local costs of living across cities and the amenities across cities as valued by high- and low-skilled workers, respectively.

In our project, we are motivated by the observation that Diamond (2016) and other related papers adopting the similar approach make progress on this front by assuming that each location’s amenity levels can be summarized by a *single-dimensional* observable proxy and allow workers of high- and low-skills to have heterogeneous valuation of such commonly recognized amenity provision (Su, 2022; Couture et al., 2021; Qian and Tan, 2022).

While the assumption of single-dimensionality vastly reduces the difficulty of analyzing the mechanism of each location’s amenity change, a single-dimensional measure of amenity implicitly

imposes the assumption that preferences for amenities are perfectly aligned across groups. If the single-dimensionality assumption is relaxed and preferences are allowed to be mis-aligned from the single observable index, we show that the welfare result could potentially be different.

There are two reasons why the single-dimensionality assumption could bias the estimates of welfare inequality. First, a single-dimensional index such as a skill ratio may fail to capture some portion of the variation in amenity value or its change over time. If the measurement error of this index is spatially correlated with the direction of spatial sorting, using a single-dimensional index could introduce bias in measuring welfare inequality. For example, if Dallas' amenity value increased by more than what is predicted by the change in skill ratio but San Francisco's increased by less than predicted by the change in skill ratio. The fact that San Francisco has a larger presence of high-skilled workers than Dallas implies that accounting for the such measurement discrepancies will reduce the measured increase in welfare inequality relative to the baseline calculation using the skill ratio as a single-dimensional index.

Second, besides measurement errors, preferences for amenities could be misaligned between the population groups. For example, while high-skilled workers may be increasingly attracted to San Francisco's amenities over Dallas', low-skilled workers may increasingly prefer amenities in Dallas to those in San Francisco. In this case, low-skilled workers sorting into Dallas could actually be welfare-enhancing relative to high-skilled workers, which means the welfare gap might decrease rather than increase, as may have been concluded based on the single-dimensionality assumption.

Our project evaluates the extent to which relaxing the assumption of perfect alignment in amenity preferences, which is (often implicitly) made in the literature, can affect the conclusion on the welfare inequality.

### **Does Geographic Isolation Hold Back Research Institutions? – Abbreviated as “Geographic Isolation [9]”**

In this project, I attempt to understand whether researchers become more productive in terms of both the quantity and quality of their work if they work for institutions geographically located in a clusters of other research institutions.

The U.S., for historical and institutional reasons, established many universities in small cities and remote towns. As universities intensify their role in research over the 20<sup>th</sup> century, remote locations may potentially become a hurdle for attracting researchers and for promoting collaboration among researchers and teams.

I use the data on the universe of all scientific publications to study the relationship between the geographic clustering and researcher productivity and quality of their research. In the data, I am able to identify the titles and the fields of the publications, authors of the publications, years of publications, institutions associated with the authors. For each institution, I am able to identify the name and the location associated with each institution, which allows me to identify and measure institutional clusters.

So far, I have found that geographic clusters of research institutions do see a much larger increase in the number of researchers and the citation count of researchers associated with these institutions located in these clusters since the 1970s.

To separately identify the causal effect of clusters on researchers' productivity and the effect of geographic sorting, I exploit the episodes of migration of researchers across institutions. Since each author is identifiable over repeated publications, I am able to trace out the migration path of researchers. Using the migration path, I examine the changes in productivity, influence, and the types of work researchers produce after their moves to parse out the causal effect from sorting effect.

### **From Periphery to Center: Women's Influence in Sciences (with Sitian Liu) – Abbreviated as “Influence [10]”**

In this project, we attempt to measure the gender gap in research influence in sciences and understand the driving forces behind the gender gap in research influence.

Prior research has documented that the gap in the number of research papers produced between male and female researchers and the number of citations has remained sizable, despite closing in recent decades.

We notice that beyond the count of papers and citations, papers produced by female researchers also tend to be less centrally positioned within the networks of academic literature. In other words,

the gender gap in the “influence” is considerable and exists even holding constant the number of citations.

Our project attempts to thoroughly document the features of this gap in influence. Is the gap closing in recent years? Is the gap more pronounced in certain disciplines but less so in others? If so, why? Is the gap partially the result of different male-female life-cycle choices regarding which types of research to engage in (do we see the gap in influence widening later in the academic life cycle or already wide at the start of the life cycle?) Does gap in co-author networking radius play a role at driving the influence gap? Is there evidence of gender bias in citation as a driver of the influence gap?