Jessie Handbury

Research Statement

October 2021

1. Overview

I am an urban economist interested in the interplay between spatial and socio-economic inequality. My research focuses on the spatial distribution of consumption amenities: the goods and services that are available to consumers in different neighborhoods. I ask how access to these amenities varies over space depending, in particular, on local demographics. I also measure the implications of these spatial disparities on real income inequality (income differences adjusted for gaps in purchasing power). Finally, I study how household and firm decisions interact to generate this varied landscape of consumption opportunities and how these decisions respond to policy.

My research shows that consumption amenities play an important role in where households choose to live, resulting in systematic differences in household purchasing power that exacerbate real income inequality. Ultimately, I establish that policymakers could design better solutions to reduce inequality in the U.S. by taking into account the variation in the availability and prices of goods and services across space.

My work recognizes that consumption amenities change over time and, in particular, in response to individual location decisions. The central equilibrium concept in urban economics is that individuals choose where to live by maximizing utility. Utility depends on where an individual lives because different locations afford them access to different jobs, housing costs, and amenities. A long literature has engaged with the fact that wages and housing costs adjust to local market conditions: workers are more productive in densely-populated areas and housing costs are higher in locations where demand growth is met with inelastic supply. In contrast, urban economics models typically assume that most amenities are fixed. This assumption might be reasonable for some amenities, like a place's natural landscape or its weather. But the retail sector is dynamic, so consumption amenities respond to changes in the density and mix of local residents. My research examines how consumption amenities arise endogenously, and I find that the resulting feedback effects are important for understanding spatial sorting patterns.

1.1 Takeaways There are four main takeaways from my research to date. First, there is substantial variation in the consumption opportunities available across and within U.S. cities, with large differences in the number and types of goods and services offered across locations. In **"Goods Prices [1]"**, we estimate that a doubling in city size is associated with a 20% increase in the number of available products, but find very little variation in the prices that chains charge for the same good across outlets in different cities. **"Non-Homotheticity [5]**" further shows that the types of products sold in a city or neighborhood

varies with local resident income and, like the local prices, is determined by which chain stores operate in a location.

Second, the availability of consumption amenities improves household purchasing power. In **"Non-Homotheticity [5]**", I estimate that, relative to low-income households, high-income households get 40 percent higher utility per dollar spent on groceries in wealthy cities, relative to poor cities, accounting for the fact that wealthy cities offer more of the products that high-income households prefer to consume. In **"Spatial Sorting [6]"**, we show that from 1990-2014, access to neighborhoods in gentrifying downtowns drives the purchasing power of the wealthy up by 3 percentage points above the purchasing power of the poor, amplifying the growth in income inequality in real terms by more than 15 percent of its growth in nominal terms.

Third, consumption amenities matter for where people decide to live. "**Urban Revival [3]**", for example, shows that access to non-tradable services is as important in determining location decisions as other well-studied factors such as proximity to jobs, school quality, and housing costs. In fact, the draw of non-tradable services, such as restaurants, bars, and gyms, is a primary factor in explaining why young college graduates reversed decades of suburbanization in the early 2000s, sparking a wave of gentrification across U.S. cities.

Meanwhile, access to amenities – particularly food – is not an important factor in determining what households consume. **"Food Deserts [2]"** shows that gap in access to grocery stores between high- and low-income neighborhoods explains only 10 percent of the gap in the healthfulness of purchases between high- and low-income households. That said, we do find that low-income households have limited access to retail, with real costs (e.g., low-income households travel further to buy food). The nature of retail supply offers an opportunity for correction through policymaking. Such policies could aim to either reduce aggregate welfare inequality or improve the opportunities accessible to the lowest-income households.

The fourth main takeaway from my research is that policies that encourage firm entry and lower living costs across all locations are more promising avenues for resolving welfare inequality than place-based policies that attempt to resolve spatial inequality by encouraging change in only low-income neighborhoods. **"Spatial Sorting [6]"**, for example, shows that policies that treat all locations equally (either loosening development constraints or taxing luxury developments to cover affordable housing subsidies) better relieve the negative welfare impacts of urban gentrification on the poor better than policies aimed at stopping the local neighborhood change downtown, which continues in the suburbs instead. In **"School Lunch [7]"**, we also find evidence that private sector responses to place-based policies extend beyond the targeted area: when the federal government subsidized universal free school meals in low-income neighborhoods, retail chains responded by lowering prices in all of their retail outlets, propagating the indirect benefits of the program to a broader population.

1.2 Approach I use rich, geo-coded microdata to directly measure the prices and availability of goods and services offered in local markets.[1] The microdata includes scanner data describing store sales and household purchases, cell-phone location data, and survey data, much of which is proprietary and accessed via agreements with government institutions and private companies.

I marry this data with economic theory, applying industrial organization methods and price index theory to make novel spatial price comparisons. I summarize the data into measures that answer the question: how much are people willing to pay to be close to one set of consumption opportunities versus another? The resulting indexes can also be used to compare local consumption opportunities over time. Distinct from the Bureau of Labor Statistics and Bureau of Economic Analysis local indexes, the indexes I calculate account for a rich set of characteristics describing the changing retail landscape, including (i) proximity to establishments, (ii) the heterogeneity in the amenities, products, and prices that these establishments offer, and (iii) the differences in how households of different incomes value those offerings.

My approach to testing the relevance of consumption amenities is also guided by economic theory. I estimate models that allow for general equilibrium responses across interconnected markets, such as housing and retail. These general equilibrium responses can be large in the context of supply constraints and scale economies, where they yield non-negligible feedback effects.

Finally, I use the detail in my data to estimate the elasticities that govern how consumers respond to amenity supply and how firms respond to amenity demand. Credibly identifying these elasticities is difficult. Households might move to neighborhoods with amenities because they value the proximity to consumption opportunities or because these consumption opportunities are co-located with high-quality schools and/or employment opportunities. Firms offering these amenities make entry decisions in response to local changes in demographics and often in expectation of future demographic changes. To identify how consumer decisions respond to changing local supply, I use differences in the susceptibility of different locations to national cost shocks to predict changes in firm entry that are independent from changes in local demand. Conversely, I exploit differences in the susceptibility of different locations to aggregate demand shocks to identify how supply responds to adjustments in demand.

My three "best" papers were chosen to illustrate the breadth of my interests and signature components of my research approach: 1) **"Non-Homotheticity [5]**" distills rich, geo-coded micro datasets into theoretically-founded spatial price indexes that characterize how much households are willing to pay for the choice set available to them in one location relative to another; 2) **"Food Deserts [2]**" employs innovative reduced-form research designs to isolate the role of differences in amenity supply from differences in demand in generating socio-economic disparities in household food purchases; and 3) **"Spatial Sort-**

[1]The alternative is to infer the level of endogenous consumption amenities by backward induction: as residual components unexplained by wage and house price differentials under the assumptions of spatial equilibrium (Albouy, 2008) or logit demand for locations (Diamond, 2016).

ing [6]" uses a quantitative model to predict the response of amenity supply to observed macroeconomic shocks, as well as counterfactual policies, and to measure the associated welfare implications.

My body of research has led to opportunities to serve the profession through journal editorial boards and associate editor roles at the *Review of Economic Statistics*, the *Journal of International Economics*, the *Journal of Urban Economics*, the *Journal of Housing Economics*, and the *Journal of Economic Geography*. In addition, I am regularly asked to serve on conference program committees and referee over 25 articles each year for the top economics journals. At Wharton, I have served on multiple department-level and school-wide committees and advise numerous Ph.D. students.

In Section 2, I discuss my eight completed papers and various on-going projects, dividing them into four categories: estimating demand for and measuring spatial differences in consumption amenities in Section 2.1, the role of these amenities in household location decisions in Section 2.2, and my work on food retail supply in Section 2.3. Section 2.4 discusses work in which I apply elements of my approach to consumption amenities to measuring inflation and social contact.

2. Research

My research agenda encompasses consumption amenities, spatial sorting, and inflation measurement. My completed projects focus on access to retail amenities, with a particular interest in food retail. In my on-going and future work, I plan to expand this agenda applying similar methods to studying disparities in other important aspects of the urban experience: social exposure and housing affordability.

2.1 Measuring Consumption Amenities

Consumers spend a significant share of their income at retail establishments. In fact, the average U.S. household spends more on products in brick-and-mortar stores than they do on housing and takes more trips to purchase goods and services than to commute to work.[2] A large literature in macroeconomics documents and studies how the prices of these goods change over time. My research instead investigates how the cost of getting those goods varies over space. This variation is crucial for measuring the purchasing power of households that earn the same wage but reside in different locations.

In **"Goods Prices [1]"**, David E. Weinstein and I use information on household purchases collected via barcode scanners to establish basic empirical facts about the spatial distribution of goods prices and variety across U.S. cities. Our first result overturns the conventional wisdom that prices are higher in bigger cities.[3] We show that the correlation between existing price indexes and city size is almost entirely

[2]In 2019, the average expenditure share on goods and services was 52% of which 85% of which is purchased in brick and mortar stores (e-commerce accounted for less than 15% of total retail trade), while the average expenditure share on housing was 28%. The remaining 20% is on insurance and financial contributions (U.S. Bureau of Labor Statistics). In 2009, under 18% of trips were to or from work vs. over 20% were to go shopping (U.S. Department of Transportation).

[3]The goods and services price indexes provided by the Council for Community and Economic Research (formerly the American Chamber of Commerce Research Association (ACCRA)), for example, are positively correlated with city size across

attributable to heterogeneity in product and store quality across cities: the same good in the same store is actually sold at the same average price across cities of different sizes.[4] We then demonstrate that this evidence of uniform pricing does not imply that the retail environment is identical across cities. Our analysis reveals dramatic differences in the availability of products across cities.

To quantify the relevance of these variety differences for consumers, we calculate the first cross-sectional spatial price indexes that account for variety differences in a theoretically-founded manner (analogous to the Feenstra (1994) and Broda and Weinstein (2010) variety-adjusted inflation indexes). We find that cross-city differences in product availability yield economically-significant variation in the price indexes consumers face across cities of different sizes: on average, consumers spend less to get the same amount of consumption utility in larger cities because they have more products to choose from.

Our results provide the first empirical support to an otherwise largely theoretical literature in trade and urban economics that emphasizes product variety as a source of agglomeration economies. In Krugman's New Economic Geography (NEG) and a recent wave of quantitative spatial equilibrium models, large markets allow greater product variety and lower costs to firms and consumers: firms are more likely to open in locations proximate to a wider variety of inputs and a greater mass of consumers. Consumers are drawn to locations with a greater variety of goods and services, where they can economize on the trade and/or travel costs associated with obtaining them. When this theory of agglomeration economies was introduced in Krugman (1991), it stood at odds with existing empirical work showing that the quality-of-life was lower in larger cities (Blomquist, Berger, and Hoehn, 1988; Gyourko and Tracy, 1991). At the time, economists did not have access to data on local product variety or non-housing costs so instead relied on wage and house price data, along with theoretical assumptions, to infer city-specific amenities.[5] **"Goods Prices [1]"** provided the first evidence that larger markets indeed offer greater product variety and that these differences in the proximity to variety are sufficient to lower costs (and improve quality-of-life) for consumers.

In **"Goods Prices [1]"**, we assumed that the consumption benefits of cities do not vary systematically across consumer types. This assumption precludes the possibility that consumption benefits play a role in skill-biased sorting. Prior research on home market effects and preference externalities suggests that firms vary their product offerings across geographic markets to cater to local tastes (Waldfogel, 2003; Fajgelbaum, Grossman, and Helpman, 2011). Presumably, if individuals of different skill levels have different tastes, these preference externalities will amplify any existing tendency of households to cluster spatially with those of the same skill. In fact, the within-group agglomerative force of preference externalities could theoretically result in sorting equilibria even in the absence of other skill-biased

U.S. cities.

[4] A subsequent literature including DellaVigna and Gentzkow (2019) and Hitsch, Hortaçsu, and Lin (2019) builds on this result to demonstrate that stores from the same chain tend to charge the same price for the same product, despite operating in geographically segmented markets.

[5] These papers estimated city-specific amenities as the residual compensating differential required to rationalize differences in wages and housing prices with the Rosen-Roback spatial equilibrium condition.

agglomeration forces, such as the productivity spillovers discussed in Davis and Dingel (2012).

Whether skill-biased pecuniary externalities exist is an empirical question. I ask this question in "**Non-Homotheticity [5]**", focusing on how tastes vary with income, which is highly correlated with skill. I estimate price indexes that allow for systematic variation in tastes between high- and low-income households and find that, indeed, cross-city costs vary widely across income groups. In particular, grocery costs are lower in a poor city relative to a wealthy city for a low-income household, but they are higher in the poor city for a high-income household. This gap is quantitatively important: high-income households find grocery costs in wealthy cities to be around 40 percent lower than grocery costs in poor cities, relative to poor households. These differences will not be accounted for in analysis that uses a standard homothetic index to adjust for spatial variation in living costs when measuring real income inequality (Moretti, 2013) or income tax incidence (Albouy, 2009).

I look within cities to unpack these cost differentials. I calculate price indexes that reflect how households at different income levels value the choice set available to them in individual stores. I find meaningful within-city variation in these indexes: higher-income households face relatively lower price indexes in stores located in higher-income neighborhoods in the same metro area.

As in **"Goods Prices [1]"**, the key factor driving differences in the price indexes for high- vs. low-income households across cities is product variety: high-income households have stronger tastes for the high-quality products that are disproportionately available in high-income cities. I further analyze store-level data to show that the differences in variety across cities and neighborhoods within them is entirely driven by variation in the local mix of retail chains. Consistent with recent evidence of within-chain uniform pricing (Adams and Williams, 2019; DellaVigna and Gentzkow, 2019; Hitsch, Hortaçsu, and Lin, 2019), I further find that there is no systematic variation in the quality mix of products offered by stores in the same chain but located in markets with different local incomes, or at least not enough to generate meaningful variation in the variety-adjusted price indexes for high- and low-income households.

"Goods Prices [1]" and "**Non-Homotheticity [5]**" each develop a new methodology to calculate theoretically-founded spatial price indexes. These new indexes bring the spatial index methodology "up-to-speed" with the methods used to calculate inflation rates and other inter-temporal price indexes in two ways. First, each index uses the detailed nature of the data to compare the relative prices of identical goods sold in the same store. Second, each index accounts for the significant variation I have found in product availability across locations. Measuring the extent to which households value products available in one location versus another requires some theoretical structure. In these papers, I assume that household demand is governed by a variant of the Constant Elasticity of Substitution (CES) preferences, commonly employed in NEG and quantitative spatial equilibrium models and tractable for working with detailed price data.

The principal challenge that I face in calculating a CES price index is that the barcode data is not a census of all varieties purchased in a city; I only observe the varieties purchased by sample households.

In "**Goods Prices [1]**," David Weinstein and I use a semi-parametric method derived from a literature in ecology (see Mao, Colwell, and Chang (2004) and Mao, Colwell, and Chang (2005)) to estimate the key input to the variety component of a CES index, the share of national expenditure represented by the varieties available to households in each city. In the context of our variant of the Feenstra (1994) exact price index, this expenditure share scaled by a function of the elasticity of substitution between products is a sufficient statistic for the extent to which households value the varieties available in one city, relative to those available in other cities.[6]

The sample sizes in household purchase data are sometimes too small to apply the Feenstra (1994) approach to price index measurement. In "**Non-Homotheticity [5]**," I split an already limited sample by income group and have too few households per income group in each city to estimate the Feenstra (1994) variety adjustment term with any degree of accuracy. So, I instead use store-level data to identify what varieties of products are available in each location and use structural demand estimates to infer how households at each income level value these varieties. The demand system that I develop provides a tractable way to characterize non-homothetic preferences across many sectors. These preferences nest two forms of non-homotheticities - demand for both observable (price) and unobservable (brand quality) characteristics vary with income and are structured in a way that enables me to test for relative importance of these forms of non-homotheticity in explaining systematic differences in consumer purchases. This demand system has since been applied to questions in international trade in Faber and Fally (2017) and generalized in a methodological industrial organization paper by Hortaçsu and Joo (2015).

A growing literature builds on my work using micro-data to measure the spatial variation in variety and a combination of exact and structural price indexes to quantify the degree to which individuals value this variety (Couture, 2013; Diamond and Moretti, 2021). Together this body of work has revealed economically significant spatial variation in consumption amenities and the extent to which different demographic groups value these amenities.

In on-going work, I extend these methods to measure the differential impact of changes in the retail landscape on different demographic groups. In one pipeline project, **"Retail Apocalypse"**, Yue Cao, Judy Chevalier, Hayden Parsley, Kevin Williams, and I seek to measure the distributional consequences of the decisions of retail chains to open and close brick-and-mortar stores, as well as e-commerce platforms. We are particularly interested in how the proliferation of dollar stores and e-commerce options has compensated households for the closures of department and big-box retail establishments, and the differential effects of these trends on households at different income levels. This study requires a novel mix of credit card transaction data (to estimate the elasticity of demand between online and offline retail establishments) and cell-phone travel data (to estimate preferences of households using cash, instead of credit cards) and an innovative research design to estimate these preferences jointly. Preliminary results

[6]The Feenstra (1994) price index is exact under the assumption of constant elasticity of substitution (CES) demand.

show that retail exits disproportionately affected low-income neighborhoods since the late 1990s, but that dollar store entry offset these costs for low-income households.[7]

Though my research and that of others has found remarkable uniformity in the prices and variety offered across different retail outlets of the same chain, the shopping experience is not identical across establishments in the same chain because the mix of consumers visiting establishments varies. This variation in co-patron mix may be an important characteristic for consumers, particularly in service establishments where social interactions occur.

In **"Quantifying Social Interactions"**, Victor Couture, Jonathan Dingel, Allison Green, and I characterize the mix of co-patrons that visit establishments and estimate how consumers from different demographic groups value different co-patron mixes. We use unique building-level data on resident income and race, along with cell-phone data describing the visits of building residents to different establishments, to infer the socio-economic and racial mix of consumers visiting establishments. We quantify how consumers value co-patron mix as the additional distance they are willing to travel to visit an establishment that better suits their preferences for co-patron mix.

Our main challenge is to identify preferences for co-patron mix separately from preferences for establishment-specific services and amenities. For example, are consumers willing to travel further to visit establishments where the co-patrons look more similar to them either because they have a taste for spending time among their own type (homophily) or because preferences for establishment characteristics like services and amenities are correlated with demographics? We distinguish between these possibilities by looking at how consumers select which establishment to visit from a set of establishments belonging to the same chain. To address the concern that establishments in the same chain may vary in quality, we demonstrate the robustness of our results in a sample of wholly-owned establishments, which are more likely to offer consistent quality than franchised stores.

We characterize how preferences for co-patron mix vary across consumer types. This variation in preferences implies that different consumer types will value the co-patron landscape offered in establishments located in different cities and neighborhoods differently. We plan to use these preference estimates, along with our new data describing the co-patron mix in establishments across U.S. cities, to quantify the extent to which the co-patron mix available in different U.S. cities serves the preferences of different consumer types. For example, we will measure the benefits that someone enjoys from residing in a city (or area) where their type is less of a minority because it affords better opportunities for same-type social interactions. This analysis is a starting point for thinking about the degree to which residential segregation is driven by preferences for social interactions.

[7] In related work-in-progress, **"SNAP Chains"** (discussed in more detail below) co-authors and I also find that more recent (post-Great Recession) chain-wide adoptions of payment systems to accept Supplemental Nutrition Assistance Program (SNAP) benefits by non-traditional retailers like dollar stores amplified the benefits of dollar store growth for the most vulnerable households.

2.2 Consumption Amenities, Household Location Decisions, and Welfare

The consumption opportunities available in different cities and neighborhoods are not fundamental features of these areas. The cost and variety of goods and services vary across space because retailers operate in only certain neighborhoods and set the variety and prices of their goods and services in response to local demand. Local demand is not intrinsic to an area either: household decisions on where to live and where to shop are based at least in part on proximity to retailers.

These feedback effects are often absent in the workhorse quantitative models used in urban and spatial economics. This literature often assumes that amenities are fixed features of locations and, therefore, play no role in driving the agglomeration or dispersion of households across space. Allowing for endogenous amenity production in these models is complicated, so it is first worth asking whether these amenities play a quantitatively relevant role in household location decisions.

In "**Urban Revival [3]**", Victor Couture and I examine the role of consumption amenities in explaining a dramatic shift in where young college graduates chose to live in U.S. cities between the late 20th and early 21st centuries. This shift in location choices was central to the gentrification of U.S. downtowns that was (and continues to be) the subject of policy debate. We establish that urban gentrification was not associated with an increase in the population of downtowns, but a change in the composition of this population: between the late 1990s and early 2000s in the 50 largest Core-Based Statistical Areas (CBSAs), while the aggregate population grew faster in the suburbs than downtown, the population of 25-to-44 year old college graduates instead grew three times faster downtown than in the suburbs.

We extend the workhorse residential choice model to analyze the factors behind this shift. As in the standard model, households trade off commuting costs, housing costs, and local amenities in choosing where to live. In our model, we allow for both these location characteristics and the utility weights that households attribute to them to vary over time. The estimated model successfully predicts the urbanization of the young and college-educated and the suburbanization of the old and non-college-educated and provides a lens through which to assess what factors are most important for this prediction.

Importantly, we find that the classic factors used to explain household residential location decisions (jobs, housing, crime, and schooling) do not explain the locational shift of the college- and non-college-educated. Instead, changing tastes for consumption amenities – particularly, service establishments (such as bars, restaurants, and gyms) – play an important role in explaining why young college graduates are moving downtown.

We turn to more disaggregate data to show that the diverging preferences of the college- and non-college-educated for locations with many non-tradable services is partially explained by shifts in the composition of young college graduates towards demographic groups that have always favored non-tradable services. Young college graduates are earning higher incomes and delaying marriage and childbearing, relative to their counterparts without college degrees. High-income and solo college-educated households spend more at and take more trips to service establishments (even controlling for their resi-

dential location), so the increasing incomes and delayed family formation rates of college graduates alone are enough to explain a significant portion of the changing consumption patterns that are increasingly drawing college graduates downtown.[8]

In **"Spatial Sorting [6]**", Victor Couture, Cecile Gaubert, Erik Hurst, and I study the macroeconomic welfare implications of the spatial sorting that resulted from the increasing skill premium paid to college graduates. We develop a new economic model to show how rising income inequality can interact with non-homothetic preferences for urban amenities to attract high-income households back downtown. When the wealthy move downtown, the cost of living increases more for the poor than it does for the rich, who benefit from the growing variety of newly-gentrified downtown neighborhoods, amplifying the growth in real income inequality beyond nominal income inequality growth.

Our model is motivated by a novel fact: the propensity of households to live downtown in U.S. cities is U-shaped in household income. That is, both low- and high-income households are more likely to reside downtown than middle-income households. While we see this U-shape in the data in 1970 and 1990, it became more pronounced between 1990 and 2014, with an uptick in the relative propensity of the wealthy to reside downtown consistent with those areas becoming more attractive to the wealthy.

We establish a causal link between increasing incomes of the wealthy and their propensity to reside downtown and show that this link is important for explaining sorting patterns and measuring real income inequality growth. We find that the 1990-2014 change in the income distribution explains around half of both the urbanization of the top income decile and the suburbanization of the bottom income decile. The price increases and neighborhood development that drive this re-sorting have sizable welfare effects: the neighborhood change induced by the 19 percentage point growth in income inequality between 1990 and 2014 increased the welfare of rich, relative to poor, households by an additional 3 percentage points. This implies that one would understate welfare inequality growth by over 15 percent by ignoring the spatial re-sorting that results from the 19 percent growth in nominal income inequality. These results show that *within*-city spatial sorting can amplify nominal income inequality growth in real terms, complementing a sizable literature on the welfare consequences of skill-biased sorting *across* cities (Combes, Duranton, and Gobillon, 2008; Moretti, 2013; Gyourko, Mayer, and Sinai, 2013; Diamond, 2016).

The key mechanism driving these changes is that wealthy households are more likely to reside in expensive neighborhoods. We estimate the elasticity that governs this mechanism and, in doing so, provide causal evidence that city-level income growth generates downtown neighborhood change. We estimate an equation derived from the model that relates cross-city variation in the increased propensity of wealthy households to reside downtown to cross-city variation in income growth. In the data, these variables might be correlated across cities due to unobservables – such as changes in job opportunities and urban renewal projects – that attract wealthy households to downtowns of certain cities, increasing

[8] A literature building on these ideas further establishes that endogenous retail amenities play in household location decisions (Miyauchi, Nakajima, and Redding, 2021) and spatial sorting by income (Hoelzlein, 2019). The role of delayed childbearing in driving gentrification is studied more recently in Moreno-Maldanado and Santamaria (2020).

both the urban propensity of the wealthy and the average income in these cities. So we rely on an instrument for city-level income growth that is exogenous to these unobserved factors. This instrument is the city-level income growth predicted by the national employment growth in each industry interacted with the pre-determined industrial mix of the city.[9] We show that these "Bartik" shocks to income increase the relative attractiveness of downtowns to the wealthy by increasing housing costs downtown more than in the suburbs, where housing is less supply-constrained.

We contribute to a large literature on spatial sorting and gentrification with counterfactual policy analysis. We use the estimated model to assess two policies aimed at stemming the neighborhood change and associated welfare effects. Neither can achieve both targets. First, a policy that taxes high-quality downtown neighborhood rents to subsidize low-quality downtown neighborhood rents can prevent spatial re-sorting. But a consequence is that price and quality upgrades are pushed to the suburbs, so inequality is still increased. Second, a policy that relieves housing supply constraints downtown mitigates the negative welfare impact of neighborhood change on the poor, but does not curb the influx of the rich.

Together, the results in "**Urban Revival [3]**" and **"Spatial Sorting [6]"** are important for assessing the future of spatial sorting within cities. The spatial re-sorting of the past 20 years will not be a cyclical phenomenon but instead will persist as long as the trends of income growth among top earners and delayed childbearing continue.

In pipeline work, I am studying inequality in access to affordable housing. In work-in-progress with my colleague Ben Keys and Ph.D. student Sam Hughes, we find that since the late 1990s rent growth has been higher for units in low-end buildings than high-end buildings, even within the same ZIP code and controlling for property redevelopment. This fact complements evidence on price trends in different quality segments of the market for single-family homes (e.g., Landvoigt, Piazzesi, and Schneider (2015)). However, the drivers of this pattern in the rental market may be quite different from the drivers in owner-occupied single-family housing. Using novel datasets linking property-level rents with operating and capital expenses, financing costs, and acquisition costs, we plan to investigate whether the outsized growth in low-end rents is best explained by differences in demand or instead by changes in landlords' costs over this period. We are developing a new model of the rental housing market to guide this reduced-form analysis. We will, in turn, use the variation from the reduced-form analysis to quantify the model to assess the potential of policies aimed at stemming the affordability crisis.

2.3 Causes and Consequences of Disparate Access to Food Retail

One policy area where the spatial variation in product availability has received significant attention is health. Under the assumption that differential access to healthy foods plays an important role in explaining nutritional and related health disparities across socio-economic groups in the U.S., federal, state, and

[9] Our results are robust to excluding technology firms and other urban-biased industries.

local funds have been invested in programs to resolve these spatial disparities. However, the spatial correlation between household socio-economic status and product availability may be driven by underlying differences in demand. Indeed, the structural preference estimates in "**Non-Homotheticity [5]**" show that household tastes for food products vary with household income. If differences in supply are driven by differences in demand (rather than different supply-side constraints), then policies that aim to equate supply will have a limited impact on the nutritional and related health disparities that governments seek to resolve.

In **"Food Deserts [2]"**, we study the extent to which differences in supply are to blame for socio-economic disparities in nutritional consumption. These disparities are large: households in the top income quartile buy groceries that are 0.56 standard deviations more healthful than the groceries purchased by the bottom income quartile. We also find differences in availability – retailers in low-income neighborhoods offer less healthy groceries than those in high-income neighborhoods. This disparity is largely explained by the fact that low-income neighborhoods have more drug and convenience stores and fewer large supermarkets, which typically offer a wider variety of healthy options.

Our analysis exploits a combination of geo-coded and product-level data on store sales and household purchases, uniquely paired with nutritional information for each of those products. With these data, we provide the most comprehensive depiction of the healthfulness of the grocery products households purchase and the retail environments in which they are making those decisions.

Identifying whether disparities in access affect healthy eating is difficult because households sort into retail environments that offer products that suit their tastes. We meet this challenge by looking at how household food purchases adjust after their retail environment changes in ways that are plausibly exogenous to changes in individual household tastes (or at least empirically uncorrelated with pre-existing trends household purchases).

We first study how household food purchases respond when supermarkets enter their neighborhoods, increasing the availability of nutritious foods. The results are striking: the effects of new supermarkets on healthy eating are small. Households do shift their purchases towards the new supermarkets, but this does not change the products they buy because they are typically substituting away from other supermarkets that offer a similar range of products. We bound the short-run effect of differential access to supermarkets at no more than 1.5% of the gap in nutritional consumption between high- and low-income households.

Next we look at how a household's grocery purchases change after they move homes testing whether a broader set of place-related factors, including peer effects and supply differences other than supermarket density, contribute to nutritional inequality. After a move, household eating patterns converge towards eating patterns of incumbent households in the new location. However, this effect, while statistically significant, is still economically small, even several years after a move.

We complement these analyses with a simple comparison of the nutritional disparities in the purchases of households in the same retail environment (i.e., living in the same neighborhood or shopping in the same store) to the disparities that we observed in the full cross-section. Here we find that over

two-thirds of the gap in the nutritional quality of purchases by high- vs. low-income households persists even after controlling for the retail environment. Households sort into their retail environments based on unobservables, so we expect that these selected households that we observe in the same retail environment have more similar tastes for healthy or unhealthy food products than the average high- and low-socio-economic status household and interpret this estimate as a lower bound on the amount of the disparity that would persist under a policy to resolve spatial differences in access.

Finally, we estimate a structural demand model to predict how nutritional consumption would change in response to alternative policies that do not focus solely on spatial differences in access. As a benchmark, we show that only a small component of the socio-economic disparities in purchases would be resolved if disparities in access were removed entirely. We predict that the gap in the nutritional quality of purchases between the bottom and top income quartiles of households decreases by just 10 percent when the two groups of households are offered the same choice set (i.e., the same products at the same prices). This result indicates that only 10 percent of the relationship between nutrition and income can be explained by differences in supply. Again, these findings suggest that supply-side policy initiatives aimed at eliminating food deserts will have limited effects on the nutrition-income gap. By contrast, a second counterfactual shows that a set of means-tested subsidies for healthy foods has the potential to eliminate socio-economic nutritional disparities at a relatively modest cost of $11 billion per year (about 15% of the current Supplemental Nutritional Assistance Program (SNAP) budget).

Our finding that spatial disparities in retail access do not explain socio-economic disparities in nutrition does not imply that these differences do not matter. In fact, our estimates of the elasticity of demand in response to store entry and price adjustments indicate that households care about their proximity to stores and the prices they charge.

In a more recent research, I seek to better understand how the differences in access and pricing arise. Specifically, I use spatial policy discontinuities and adjustments to measure the elasticity of prices and store variety with respect to food and nutrition programs, such as the SNAP and the National School Lunch and School Breakfast programs (NSLP and SBP, respectively). These programs reach over 40 million households in the U.S. and together account for more spending than the Earned Income Tax Credit (Hoynes and Schanzenbach, 2016). Their direct effects on recipients are well-established and range from food security to health outcomes. Given their scope and magnitude, however, a natural question is whether these programs have any positive or negative spillovers on the broader population. My work in this area provides novel evidence of one such spillover: the impact of these programs on the retail food environment.

In "**School Lunch [7]**", Sarah Moshary and I show that expanded provision of free meals in schools via the NSLP and SBP has a sizable impact on retail food demand. We find that chains respond to this demand shock by lowering prices and, to a lesser extent, the number of stores they operate and the assortment of products offered in these stores.

To establish these effects, we study a large expansion to the provision of free school meals under the

Community Eligibility Provision (CEP), which was introduced as part of the 2010 Healthy, Hunger-Free Kids Act. Under the CEP, participating schools started offering free meals to all students, regardless of whether they qualify for the free or reduced-price meals under the standard NSLP and SBP eligibility criteria. Schools must apply to participate in the CEP, so to identify store responses to the program itself (independent of other factors that might induce schools to participate and stores to adjust their operations and pricing), we exploit a cut-off in the school eligibility criteria and the program's staggered roll out across states.

We show that the expansion of free school meals resulted in an economically-significant demand shock to local retail stores: households with school-age children reduced spending by as much as 15% and the number of grocery trips by over 5%. Retailers responded to these local shocks at the chain level: stores belonging to chains with higher average exposure to the program reduced their prices, irrespective of whether they were exposed to the local demand shock. This chain-level response propagated the shock across neighborhoods and, by 2016, the CEP had slowed grocery inflation such that the median zip code saw 4.5% lower grocery costs in 2016 than they would have absent the program expansion.

The retailer price responses we estimate in "**School Lunch [7]**" are particularly relevant in light of our finding in **"Food Deserts [2]"** that socio-economic nutritional disparities can be addressed more efficiently through price adjustments than via changes in retail access. The results in "**School Lunch [7]**" show that that the government can impact store pricing with levers beyond the direct subsidies considered in **"Food Deserts [2]"**. When the government offers a public option to a significant segment of the market, it competes with the private sector. This competitive effect extends the benefits of the government program beyond its targeted population. In this case, the direct benefits enjoyed by the families of children newly eligible for free school meals are amplified by the indirect benefit of lower grocery prices paid by all households in neighborhoods with highly-exposed chains. These results are consistent with Cunha, De Giorgi, and Jayachandran (2019), who find that the prices of grocery products fall following the introduction of a food delivery program in rural Mexico. Our paper is the first to show the pecuniary benefits of a national in-kind food assistance program for non-recipients in the U.S.. These indirect pecuniary benefits enjoyed by all households amount to approximately 10% of the direct benefit enjoyed by families receiving free lunch.

In on-going work, I am studying how retailers respond to adjustments in SNAP, the largest food assistance program in the U.S.. SNAP provides recipients with a cash benefit (or rather a cash equivalent to be spent on food at retailers) instead of an in-kind benefit. Since SNAP benefits are spent at food retailers, one might expect that prices would increase in response to SNAP expansions, creating a negative pecuniary externality for non-recipients and offsetting the program's benefits for recipients. Indeed, Leung and Seo (2018) find that retailers increased prices in response to increases in the per-recipient generosity of SNAP benefits after the Great Recession. In contrast, Lin Fan, Erik Scherpf, Ilya Rahkovsky, and I find that large retail chains instead reduced prices in response to expansion in program participation over

the same period (**"SNAP Eligibility"**).

We posit that this is because newly-eligible SNAP recipients are more likely to switch which store they shop at when they start receiving benefits than existing beneficiaries are when their benefits increase. The reason for this store switching behavior is that SNAP benefits are distributed monthly, so recipients have liquidity for a large and potentially far-flung grocery shopping trip, to replace of the frequent small, local trips made under liquidity constraints. In the face of a more elastic demand curve, large stores will compete for the benefit dollars of new recipients, thereby lowering prices by incumbent shoppers.

Enhancing the degree of competition among retailers for SNAP dollars during the Great Recession was a widespread uptick in the number of non-traditional food retailers, like dollar stores and mass merchandisers, which started accepting SNAP benefits as payment over this period. These expansions tended to occur in waves driven by chain-wide take-up and dramatically increased the access of SNAP recipients to retail stores at which they could spend their benefits. In new work with Xiao Dong and Katherine Meckel, (**"SNAP Chains"**), I quantify these benefits with a spatial price index that accounts for the effective savings that SNAP recipients benefit from when a store starts accepting their SNAP benefits as payment. We are also testing whether enhanced competition for these SNAP customers induced price reductions that would benefit both recipient and non-recipient households.

2.4 Measuring Inflation and Exposure

Much of my work uses price indexes to compare consumption opportunities across space. In the course of this work, I have accumulated expertise in price index measurement more generally. I have put this expertise to use in concurrent work addressing questions related to the use of price indexes to measure inflation, as well as high-frequency movement and social contact.

Inflation Measurement

An enormous literature on inflation measurement studies the systematic errors – or bias – in the indexes calculated by statistical agencies. In "**Inflation [8]**", Tsutomu Watanabe, David E. Weinstein, and I document new facts about this bias. We use detailed store-level barcode data to calculate "true" inflation for grocery products in Japan and compare this index with the official CPI over the same set of product categories. We show that (i) the measurement error in the CPI is not constant, but noisy, and (ii) when measured inflation is low (below 2.4 percent), this noisy measurement error actually outweighs the signal provided by the CPI, leaving little relation between measured and actual inflation (at higher levels, measured inflation changes are correlated with actual inflation changes).

Japan is the ideal setting in which to compare the biases in the CPI between high and low inflation regimes, as the country has experienced both regimes over the 17 years covered in our data. That said, we find that the source of the CPI error that is driving the non-linear relationship between the CPI and our measure of true inflation is related to the index methodology used in Japan as well as other OECD

countries, including Belgium, Germany, and the U.K.. So we expect that the non-linear relationship holds more broadly. We also show that the U.S. procedure of geometric averaging of prices reduces, but does not eliminate, the non-linearity and biases.

Exposure Indexes

At the onset of the pandemic in Spring 2020, the extent to which people took advantage of the consumption opportunities available to them became an important policy concern as such visits put individuals, and their communities, at risk for contracting SARS-COV-2. Recognizing our unique access to a cleaned smartphone dataset describing this visit behavior, my co-authors on on-going research projects (**"Quantifying Social Interactions"** and **"Retail Apocalypse"**) and I turned our attention to constructing indexes that described the exposure of individuals via their movement patterns and social contact. We designed three indexes that each describe different types of exposure on a daily frequency for different geographies. The indexes respectively summarize (i) county-to-county movements of devices; (ii) foot traffic in different types of venues at the county-level; (iii) exposure of devices in a given county or a given state and demographic group as a function of their travel patterns across venues with different foot traffic. From June 2020 to September 2021, we updated the indexes on a rolling basis on a public repository, where they continue to be available as an input to non-commercial research projects.

Our aim was to reduce the entry costs for those interested in using smartphone movement data for pandemic-related research. Since the indexes we shared do not enable researchers to assess the quality of the underlying data, we published a companion paper, **"Measuring Movement [4]"**, which uses the micro-data to demonstrate the suitability of smartphone data for quantifying movement and social contact, both during the pandemic and more generally.

Research papers

(Numbers correspond to the list in the C.V., abbreviations are used to reference papers in the statement)
1. "Goods Prices and Availability in Cities," Jessie Handbury and David E. Weinstein, Review of Economic Studies, 2014. Abbreviated as **"Goods Prices [1]"**.

2. "Food Deserts and the Causes of Nutritional Inequality," Hunt Allcott, Rebecca Diamond, Jean-Pierre Dube, Jessie Handbury, Ilya Rahkovsky, and Molly Schnell, Quarterly Journal of Economics, 2019 (subsumes "Is the focus on food deserts fruitless? Retail access and food purchases across the socio-economic spectrum," previously circulated as "What drives nutritional disparities? Retail access and food purchases across the socio-economic spectrum", Jessie Handbury, Ilya Rahkovsky, and Molly Schnell, November 2017). Abbreviated as **"Food Deserts [2]"**.

3. "Urban Revival in America," Victor Couture and Jessie Handbury, Journal of Urban Economics, 2020. Abbreviated as **"Urban Revival [3]"**.

4. "Measuring Movement and Social Contact with Smartphone Data: A Real-Time Application to COVID-19" with Victor Couture, Jonathan Dingel, Allison Green, and Kevin Williams, accepted at Journal of Urban Economics: Insights, 2020. Abbreviated as **"Measuring Movement [4]"**.

5. "Are Poor Cities Cheap for Everyone? Non-Homotheticity and the Cost of Living Across U.S. Cities," accepted at Econometrica, April 2021. Abbreviated as **"Non-Homotheticity [5]"**.

6. "Income Growth and the Distributional Effects of Urban Spatial Sorting," Victor Couture, Cecile Gaubert, Jessie Handbury, and Erik Hurst, resubmitted to the Review of Economic Studies, August 2020. Abbreviated as **"Spatial Sorting [6]"**.

7. "School Food Policy Affects Everyone: Retail Responses to the National School Lunch Program," Jessie Handbury and Sarah Moshary, July 2020. Abbreviated as **"School Lunch [7]"**.

8. "How Much Do Official Price Indexes Tell Us About Inflation?" Jessie Handbury, Tsutomu Watanabe, and David E. Weinstein, January 2017. Abbreviated as **"Inflation [8]"**.

Work in progress ***(pre-working paper stage)***

"The Disparate Effects of the Retail Apocalypse" with Yue Cao, Judy Chevalier, Kevin Williams, and Hayden Parsley. Abbreviated as **"Retail Apocalypse"**.

"Quantifying Social Interactions Using Smartphone Data" with Victor Couture, Jonathan Dingel, and Allison Green. Abbreviated as **"Social Interactions"**.

"The Role of Non-Traditional Food Stores in the SNAP Program" with Xiao Dong and Katherine Meckel. Abbreviated as **"SNAP Chains"**.

"Food Retailers and SNAP: Who Captures the Federal Food Dollar?" with Lin Fan, Ilya Rahkovsky, and Erik Scherpf. Abbreviated as **"SNAP Eligibility"**.

References

ADAMS, B., AND K. R. WILLIAMS (2019): "Zone pricing in retail oligopoly," *American Economic Journal: Microeconomics*, 11(1), 124–56.

ALBOUY, D. (2008): "Are big cities bad places to live? Estimating quality of life across metropolitan areas," Discussion paper, National Bureau of Economic Research.

——— (2009): "The Unequal Geographic Burden of Federal Taxation," *Journal of Political Economy*, 117(4), 635–667.

BLOMQUIST, G. C., M. C. BERGER, AND J. P. HOEHN (1988): "New estimates of quality of life in urban areas," *The American Economic Review*, pp. 89–107.

BRODA, C., AND D. E. WEINSTEIN (2010): "Product Creation and Destruction: Evidence and Price Implications," *American Economic Review*, 100, 691.

COMBES, P.-P., G. DURANTON, AND L. GOBILLON (2008): "Spatial wage disparities: Sorting matters!," *Journal of Urban Economics*, 63(2), 723–742.

COUTURE, V. (2013): "Valuing the Consumption Benefits of Urban Density," .

CUNHA, J. M., G. DE GIORGI, AND S. JAYACHANDRAN (2019): "The price effects of cash versus in-kind transfers," *The Review of Economic Studies*, 86(1), 240–281.

DAVIS, D. R., AND J. I. DINGEL (2012): "A Spatial Knowledge Economy," NBER Working Paper No. 18188.

DELLAVIGNA, S., AND M. GENTZKOW (2019): "Uniform pricing in us retail chains," *The Quarterly Journal of Economics*, 134(4), 2011–2084.

DIAMOND, R. (2016): "The determinants and welfare implications of us workers' diverging location choices by skill: 1980-2000," *American Economic Review*, 106(3), 479–524.

DIAMOND, R., AND E. MORETTI (2021): "Where is Standard of Living the Highest? Local Prices and the Geography of Consumption," Discussion paper.

FABER, B., AND T. FALLY (2017): "Firm heterogeneity in consumption baskets: Evidence from home and store scanner data," Discussion paper, National Bureau of Economic Research.

FAJGELBAUM, P., G. M. GROSSMAN, AND E. HELPMAN (2011): "Income Distribution, Product Quality, and International Trade," *Journal of Political Economy*, 119(4), 721–765.

FEENSTRA, R. C. (1994): "New Product Varieties and the Measurement of International Prices," *The American Economic Review*, 84(1), 157–177.

GYOURKO, J., C. MAYER, AND T. SINAI (2013): "Superstar cities," *American Economic Journal: Economic Policy*, 5(4), 167–99.

GYOURKO, J., AND J. TRACY (1991): "The structure of local public finance and the quality of life," *Journal of political economy*, 99(4), 774–806, Publisher: The University of Chicago Press.

HITSCH, G. J., A. HORTAÇSU, AND X. LIN (2019): "Prices and Promotions in US Retail Markets: Evidence from Big Data," *University of Chicago, Becker Friedman Institute for Economics Working Paper*, (2019-117).

HOELZLEIN, M. (2019): "Two-Sided Sorting and Spatial Inequality in Cities," Discussion paper.

HORTAÇSU, A., AND J. JOO (2015): "Semiparametric estimation of a CES demand system with observed and unobserved product characteristics," *arXiv preprint arXiv:1511.05600*.

HOYNES, H., AND D. W. SCHANZENBACH (2016): *3. US Food and Nutrition Programs*pp. 219–302. University of Chicago Press.

KRUGMAN, P. (1991): "Increasing Returns and Economic Geography," *Journal of Political Economy*, 99(3), 483–499.

LANDVOIGT, T., M. PIAZZESI, AND M. SCHNEIDER (2015): "The housing market(s) of San Diego," *American Economic Review*, 105(4), 1371–1407.

LEUNG, J. H., AND H. K. SEO (2018): "How Do Government Transfer Payments Affect Retail Prices and Welfare? Evidence from SNAP," Discussion paper, Working Paper.

MAO, C. X., R. K. COLWELL, AND J. CHANG (2004): "Interpolating, Extrapolating, and Comparing Incidence-Based Species Accumulation Curves," *Ecology*, 85(2717-2727), 433–441.

——— (2005): "Estimating the Species Accumulation Curve Using Mixtures," *Biometrics*, 61(2), 433–441.

MIYAUCHI, Y., K. NAKAJIMA, AND S. J. REDDING (2021): "Consumption access and agglomeration: evidence from smartphone data," Discussion paper, National Bureau of Economic Research.

MORENO-MALDANADO, A., AND C. SANTAMARIA (2020): "Delayed Childbearing and Gentrification," Discussion paper.

MORETTI, E. (2013): "Real Wage Inequality," *American Economic Journal: Applied Economics*, 5(1), 65–103.

WALDFOGEL, J. (2003): "Preference Externalities: An Empirical Study of Who Benefits Whom in Differentiated-Product Markets," *The RAND Journal of Economics*, 34(3), 557–568.