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# Essays in Local Labor Economics: Dissertation Summary

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This dissertation consists of three independent chapters all related to local labor market and urban economics. Chapter 1 studies the causes and welfare consequences of the increase in geographic sorting of workers by skill from 1980 to 2000. Chapter 2 examines the abilities of state and local governments to extract rent from private sector workers by charging high tax rates and spending the revenue on nonsocial desirable projects, such as excessive government worker wages. In Chapter 3, which is joint work with Guido Imbens, Michal Kolesar, and Thomas Barrios, we examine the standard practice in regression analysis of allowing for clustering in the error covariance matrix when the explanatory variable of interest varies at a more aggregate level (e.g., the state level) than the units of observation (e.g., individuals). This is a common econometric problem when using geographic variation to study local labor market outcomes.

## Chapter 1

## The Determinants and Welfare Implications of U.S. Workers' Diverging Location Choices by Skill: 1980–2000

The dramatic increase in the wage gap between high school and college graduates over the past three decades has been accompanied by a substantial increase in geographic sorting of workers by skill.[1] Metropolitan areas that had a disproportionately high share of college graduates in 1980 further increased their share of college graduates from 1980 to 2000. Increasingly high-skill cities also experienced higher wage and housing price growth than less-skilled cities (Moretti 2004b; Shapiro 2006).

These facts call into question whether the increase in the college wage gap reflects a similar increase in the college well-being gap. Since college graduates increasingly live in areas with high housing costs, local price levels might offset some of the consumption benefits of their high wages, making the increase in wage inequality overstate the increase in consumption or well-being inequality (Moretti 2011b). Alternatively, high-housing-cost cities may offer workers desirable amenities, compensating them for high house prices, and possibly increasing the well-being of workers in these cities. The welfare implications of the increased geographic skill sorting depend on why high- and low-skill workers increasingly chose to live in different cities.

This chapter examines the determinants of high- and low-skill workers' choices to increasingly segregate themselves into different cities and the welfare implications of these choices. By estimating a structural spatial equilibrium model of local labor demand, housing supply, labor supply, and amenity levels in cities, I show that changes in firms' relative demands for high- and low-skill labor across cities, due to local productivity changes, were the underlying drivers of the differential migration patterns of high- and low-skill workers.[2] Despite local wage changes being the initial cause of workers' migration, I find that cities that attracted a higher share of college graduates endogenously became more desirable places to live and more productive for both high- and low-skill labor. The combination of desirable wages and amenities made college workers willing to pay high housing costs to live in these cities. While lower-skill workers also found these areas' wages and amenities desirable, they were less willing to pay high housing costs, leading them to choose more affordable cities. Overall, I find that the welfare effects of changes in local wages, rents, and endogenous amenities led to an increase in well-being inequality between college and high school graduates that was significantly larger than would be suggested by the increase in the college wage gap alone.

To build intuition for this effect, consider the metropolitan areas of Detroit and Boston. The economic downturn in Detroit has been largely attributed to the decline in auto manufacturing (Martelle 2012), but the decline goes beyond the loss of high-paying jobs. In 2009, Detroit Public Schools had the lowest scores ever recorded in the 21-year history of the national math proficiency test (Winerip 2011). Historically, the Detroit school district had not always been in such a poor state. In the early twentieth century, when manufacturing was booming, Detroit's public school system was lauded as a model for the nation in urban education (Mirel 1999).

By comparison, Boston has increasingly attracted high-skill workers with its cluster of biotech, medical device, and technology firms. In the mid 1970s, Boston's public schools were declining in quality, driven by racial tensions from integrating the schools (Cronin 2011). In 2006, however, the Boston public school district won the Broad Prize, which honors the urban school district that demonstrates the greatest overall performance and improvement in student achievement while reducing achievement gaps among low-income and minority students. Similar patterns can be seen in the histories of the Detroit and Boston Symphony Orchestras.[3] The prosperity of Boston and decline of Detroit go beyond jobs and wages, directly impacting the amenities and quality of life in these areas.

I illustrate these mechanisms more generally using U.S. census data by estimating a structural spatial equilibrium model of cities. The setup shares features of the Rosen (1979) and Roback (1982) frameworks, but I extend the model to allow workers to have heterogenous preferences for cities. The fully estimated model allows me to assess the importance of changes in cities' wages, rents, and amenities in differentially driving high- and low-skill workers to different cities.

I use a static discrete choice setup to model workers' city choices.[4] The model allows workers with different demographics to differentially trade off the relative values of cities' characteristics, leading them to make different location decisions.[5] Workers maximize their utility by living in the city that offers them the most desirable bundle of wages, housing rent, and amenities.

Firms in each city use capital, high-skill labor, and low-skill labor as inputs into production. High- and low-skill labor have a constant elasticity of substitution in firms' production functions. I assume capital is sold in a national market, while labor is hired locally in a perfectly competitive labor market. Housing markets differ across cities due to heterogeneity in their elasticity of housing supply.

The key distinguishing worker characteristic is skill, as measured by graduation from a four-year college. Cities' local productivity levels differ across high- and low-skill workers, and the productivity levels of both high- and low-skill workers within a city are endogenously impacted by the skill mix in the city. Thus, changes in the skill mix of a city will impact local wages both by moving along firms' labor demand curves and by directly impacting worker productivity.

A city's skill mix is also allowed to influence local amenity levels, both directly, as more-educated neighbors may be desirable, and indirectly, by improving a variety of city amenities (Becker and Murphy (2000, Chapter ). Indeed, observable amenities such as bars and restaurants per capita, crime rates, and pollution levels improve in areas with larger college populations and decline in areas with larger noncollege populations. I use the ratio of college to noncollege employees in each city as a unidimensional index for all amenities that endogenously respond to the demographics of cities' residents.

Workers' preferences for cities are estimated using a two-step estimator, similar to the methods used by Berry, Levinsohn, and Pakes (2004) and the setup proposed by McFadden (1973). In the first step, a maximum likelihood estimator is used to identify how desirable each city is to each type of worker, on average, in each decade, controlling for workers' preferences to live close to their state of birth. The utility levels for each city estimated in the first step are used in the second step to estimate how workers trade off wages, rents, and amenities when selecting a location to live. The second step of estimation uses a simultaneous equation nonlinear generalized method of moment estimator. Moment restrictions on workers' preferences are combined with moments identifying cities' labor demand and housing supply curves. These moments are used to simultaneously estimate local labor demand, housing supply, and labor supply to cities.

The model is identified using local labor demand shocks driven by the industry mix in each city and their interactions with local housing supply elasticities. Variation in productivity changes across industries differentially impact cities' local labor demand for high- and low-skill workers based on the industrial composition of the city's workforce (Bartik 1991). I measure exogenous local productivity changes by interacting cross-sectional differences in industrial employment composition with national changes in industry wage levels separately for high- and low-skill workers.

I allow cities' housing supply elasticities to vary based on geographic constraints on developable land around a city's center and land-use regulations (Gyourko, Saiz, and Summers 2008; Saiz 2010). A city's housing supply elasticity will influence the equilibrium wage, rent, and population response to the labor demand shocks driven by industrial labor demand changes.

Workers' migration responses to changes in cities' wages, rents, and endogenous amenities, driven by the Bartik labor demand shocks and the interactions of these labor demand shocks with housing supply elasticity determinants, identify workers' preferences for cities' characteristics. Housing supply elasticities are identified by the response of housing rents to the Bartik shocks across cities.

The interaction of the Bartik productivity shocks with cities' housing markets identifies the labor demand elasticities. The wage differences, driven by the productivity shocks, induce workers to migrate to cities that offer more desirable wages. The migration drives demand in the local housing markets, which impacts housing prices, as determined by the elasticity of housing supply. Heterogeneity in housing supply elasticity leads to differences in population changes, in response to a given Bartik shock. For a given size labor demand shock, fewer workers will migrate to a city with a less elastic housing supply because rents increase more than in a more elastic city. Thus, the interaction of Bartik shocks with measures of housing supply elasticity creates variation in high- and low-skill local populations that is independent of unobserved local productivity changes, which can identify labor demand elasticities.

The parameter estimates of workers' preferences show that while both college and noncollege workers find higher wages, lower rents, and higher amenity levels desirable, high-skill workers' demand is relatively more sensitive to amenity levels, and low-skill workers' demand is more sensitive to wages and rents.[6] The labor demand estimates show that increases in the college employment ratio lead to productivity spillovers on both college and noncollege workers. Combining the estimates of firms' elasticity of labor substitution with the productivity spillovers, I find that an increase in a city's college worker population raises both local college and noncollege wages. Similarly, an increase in a city's noncollege worker population decreases college and noncollege wages.

Using the estimated model, I decompose the changes in cities' college employment ratios into the underlying changes in labor demand, housing supply, and labor supply to cities. I

show that when a city's productivity gap between high- and low-skill workers exogenously increases, the local wage gap between these workers increases. If the migration responses to these wage changes lead to an increase in the local share of college workers, the wages of all workers will further increase beyond the initial effect of the productivity change due to the combination of endogenous productivity changes and shifts along firms' labor demand curves.

In addition to raising wages, an increase in a city's college employment ratio leads to local amenity improvements. The combination of desirable wage and amenity growth for all workers causes large amounts of in-migration, as college workers are particularly attracted by desirable amenities, while low-skill workers are particularly attracted by desirable

wages. The increased housing demand in high college share cities leads to large rent increases. Since low-skill workers are more price sensitive, the increases in rent disproportionately discourage low-skill workers from living in these high-wage, high-amenity cities. Lower-skill workers are not willing to pay the "price" of a lower real wage to live in high-amenity cities. Thus, in equilibrium, college workers sort into high-wage, high-rent, high-amenity cities.

I use the model estimates to quantify the change in well-being inequality. I find that the welfare impacts due to wage, rent, and endogenous amenity changes from 1980 to 2000 led to an increase in well-being inequality equivalent to at least a 24-percentage-point increase in the college wage gap, which is 20 percent more than the actual increase in the college wage gap. In other words, the additional utility college workers gained from being able to consume more desirable amenities made them better off relative to high school graduates, despite the high local housing prices.

This chapter is related to several literatures. Most closely related to this chapter is work studying how local wages, rents, and employment respond to local labor demand shocks (Topel [1986]; Bartik [1991]; Blanchard and Katz [1992]; Saks [2008]); Notowidigdo [2011]. See Moretti [2011a] for a review). Traditionally, this literature has only allowed local labor demand shocks to influence worker migration through changes in wages and rents.[7] My results suggest that endogenous local amenity changes are an important mechanism driving workers' migration responses to local labor demand shocks.

A small and growing literature has considered how amenities change in response to the composition of an area's local residents (Becker and Murphy 2000, Chapter 5; Bayer, Ferreira, and McMillan 2007; Card, Mas, and Rothstein 2008; Guerrieri, Hartley, and Hurst 2011; Handbury 2012). Handbury (2012) studies the desirability and prices of grocery products for sale across cities. Her work finds that higher-quality products (an amenity) are more available in cities with higher incomes per capita, but these areas also have higher prices for groceries. She finds that higher-income households are more willing to pay for grocery quality, leading them to prefer the high-price, high-quality grocery markets relative to lower-income households. I find a similar relationship for amenities and local real wages.

My findings also relate to the literature studying changes in the wage structure and inequality within and between local labor markets (Berry and Glaeser 2005; Beaudry, Doms, and Lewis 2010; Moretti 2011b; Autor and Dorn 2012; Autor, Dorn, and Hanson 2012). Most related to this chapter is Moretti (2011b), who is the first to show the importance of accounting for the diverging location choices of high- and low-skill workers when measuring both real wage and well-being inequality changes. Another strand of this literature, most specifically related to my labor demand estimates, studies the impact of the relative supplies of high- and low-skill labor on high- and low-skill wages (Katz and Murphy 1992; Card and Lemieux 2001; Card 2009). Card (2009) estimates the impact of local labor supply on local wages in cities. This chapter presents a new identification strategy to estimate city-level labor demand and allows for endogenous productivity changes.

This chapter is also related to the literature on the social returns to education (Acemoglu and Angrist 2001; Moretti 2004a,c;) and work studying the determinants of economic growth in cities (Glaeser et al. 1992; Glaeser, Scheinkman, and Shleifer 1995; Shapiro 2006). By using the interaction of local labor productivity shocks with housing supply elasticities as instruments for education differences across cities, I provide a new identification strategy for measuring the impact of an increase in a city's education level on the wages for all workers. Further, my findings show that an increase in a city's education level also spills over onto all workers' well-being through endogenous amenity changes.

The labor supply model and estimation draws on the discrete choice methods developed in empirical industrial organization to estimate consumers' demand for products (McFadden 1973; Berry, Levinsohn, and Pakes 1995, 2004). These methods have been applied to estimate households' preferences for neighborhoods by Bayer, Ferreira, and McMillan (2007). This chapter adapts these methods to estimate the determinants of workers' labor supply to cities.8

## Chapter 2

## Housing Supply Elasticity and Rent Extraction by State and Local Governments

Can government workers extract rent from private sector workers by charging high tax rates and paying themselves high wages? The determinants and justification of government workers' compensation levels have taken on considerable heat in the past few years, as many states and localities face budgetary stress. Since state and local governments set taxes and government employee wages, government employ-

ees could earn rents by charging high taxes and receiving high wages. There has long been debate over whether the government acts as a benevolent social planner for its citizens or uses its market power to benefit its workers and political interest groups (see Gregory and Borland [1999] for a review of this literature). In particular, the high unionization rate in the public sector may allow union bargaining to influence the political process and the decisions of elected officials (Freeman 1986). In this chapter, I analyze whether government workers receive higher wages than similar private sector workers in areas where state and local governments have stronger abilities to exercise market power.

This chapter develops a model where state and local governments set taxes and the level of government services to maximize government "profits," which can then be paid to employees as excessive wages. I use a Rosen (1979) and Roback (1982) spatial equilibrium model where workers maximize their utility by living in the city that offers them the most utility based on the city's wage, rental rate of housing, tax rate, government services, and other amenities. Thus, governments must compete for residents to tax, and workers can "vote with their feet" by migrating away from excessively rent-extractive governments.

I show that if state and local governments are using their market power to overpay their employees, their abilities to extract rents from their citizens are determined by the equilibrium migration elasticity of private sector residents with respect to local tax rates. Governments must trade off the benefits of a higher tax with the cost that a higher tax will cause workers to migrate away, leaving the government with a smaller population to tax. This is analogous to the standard result found in analysis of imperfect competition between product producers where a firm's optimal price markup over cost is equal to the inverse elasticity of consumer demand with respect to price for the firm's product.

Unlike firm competition for consumer demand, I show that a government's market power to charge excessive taxes remains even when there are a large number of governments competing for residents and every government is small.[9] The spatial equilibrium model shows that when a government raises taxes, workers will migrate away to other jurisdictions. However, this out-migration decreases the level of labor supply and housing demand in the area. Assuming labor demand curves slope down and housing supply curves slope up, this decrease in population raises wages and decreases housing rents. Thus, some of the disutility of a tax increase will be offset by an increase in the desirability of local wages and rents, which limits the amount of out-migration caused by the tax increase. Since the local housing and labor markets will respond to government-imposed taxes through migration, the government will always have market power.

An area's elasticity of housing supply will determine how local housing rents respond to population changes in an area. Governments presiding over areas with inelastic housing supplies will have more market power than governments in housing elastic areas. A tax hike by a government in an area with inelastic housing supply leads to a small amount of out-migration because housing prices sharply fall due to the decrease in housing demand driven by the tax hike. The housing cost decline offsets the negative utility impact of a tax increase with only a small amount of out-migration in the housing inelastic area. Thus, governments in housing inelastic areas can charge higher taxes without shrinking their tax base since housing price changes limit the migration response.

If state and local governments exercise more market power in areas with inelastic housing supplies, the wage gap between public and private sector workers should be larger in these areas. I test the model's prediction by measuring variation in public-private sector wage gaps across areas with different housing supply elasticities. I measure workers' wages using data from the 1995–2011 Current Population Survey Merged Outgoing Rotation Groups (CPS-MORG). I proxy for a metropolitan area's housing supply elasticity using data from Saiz (2010) on the share of land within 50 kilometers of a city's center unavailable for real estate development because of geographic constraints, such as the presence of swamps, steep grades, or bodies of water. With less available land around to build on, the city must expand farther away from the central business area to accommodate a given amount of population, driving up average housing costs.[10] I also use the Wharton Land Use Regulation Index from Gyourko, Saiz, and Summers (2008) as a component of housing supply elasticity. Since the decision to regulate real-estate development is endogenous and possibly correlated with unobserved characteristics that could impact government workers wages, I focus on the Saiz (2010) measure of geographic constraints on real estate development as an exogenous source of variation in housing supply elasticity. These data are the metropolitan area level. To measure states' housing supply elasticities I use an average of these measures across each state's MSAs, weighted by the MSAs' populations.

I find that the public-private sector wage gap is higher in states and metropolitan areas with less elastic housing supplies. This result holds when analyzing variation in state government-private sector wage gaps across states and in local government-private sector wage gaps across MSAs. This finding is robust to including a host of controls for workers' demographics and characteristics, including dummies for three-digit occupation codes. Additionally, the local government-private sector wage gap is found to be higher in housing inelastic MSAs, even when only comparing MSAs within the same state.

As falsification tests, I show that housing supply elasticity has no impact on the federal government worker-private sector wage gap. Since federal workers' compensation is not derived from government revenues of their place of resi-

dence, the market power of the state and local government should have no impact on their wages. Additionally, I show that variation in the state government worker-private sector wage gap does not vary across MSAs, within a state. The public-private wage gaps only vary with housing supply elasticities when the housing supply elasticity variation impacts the government's market power. I also show that the effect is larger for government workers who are union members, suggesting unions allow government workers to bargain for a larger share of government rents.

The CPS-MORG only reports data on workers' earnings, and does not include data on the value of workers' benefits. Gittleman and Pierce (2012) show that government employees receive more generous benefits than similar private sector workers, on average. I use data from average government pension payouts per beneficiary across states from the census's 2007–2010 Annual Surveys of Public Employee Retirement Systems as a measure of state government workers' benefits. While I do not have a data source for similar private sector workers' retirement benefits, I show that average annual state government pension payouts per beneficiary are higher in states with less elastic housing supplies. This suggests that the wage gap estimates from the CPS understate the full impact of housing supply elasticity on government workers' compensation.

Previous work has also found evidence suggesting government jobs are more desirable than similar private sector jobs. Gittleman and Pierce (2012) show that public sector employees are more generously compensated than similarly qualified private sector employees. In particular, they find that government workers' wages tend to be slightly lower than similar private sector workers. However, the value of government workers' benefits strongly outweighs those of the private sector, leading to public sector employees to be better compensated overall. Krueger (1988) finds that there are more job applications for each government job than for each private sector job, suggesting that government jobs are more desirable to workers, on average. Additionally, average job quit rates reported from the 2002–2006 Job Openings and Labor Turnover Surveys show that average annual quit rate is 28 percent for private sector workers but only 8 percent for public sector employees. These facts taken together suggest that government jobs are better compensated than private sector jobs, and that there appears to be excess labor supply for these jobs, which is consistent with government workers receiving rents. While this evidence shows that government jobs appear desirable to workers, it is not clear that this desirability is due to rent-seeking behavior of governments exercising market power. This chapter shows that an increase in governments' abilities to extract rent directly leads to better paid government employees.

The public sector workforce is also highly unionized, enabling government employees to bargain for government rents. Gyourko and Tracy (1991) use a spatial equilibrium model to show that if the cost of government taxes to citizens are not completely offset by benefits of government services, they will be capitalized into housing prices. Similarly, if high levels of public sector unionization lead to more government rent extraction, the public sector unionization rate will proxy for government waste and also be capitalized into housing prices. While Gyourko and Tracy (1991) find evidence for both of these effects, it is unclear what drives the variation in taxes and unionization rates across localities. This chapter uses housing supply elasticity as a source of exogenous variation in government market power to assess whether governments take advantage of their power to overpay employees.

## Chapter 3

## Clustering, Spatial Correlations, and Randomization Inference

Many economic studies that analyze the causal effects of interventions on economic behavior study interventions or treatments that are constant within clusters whereas the outcomes vary at a more disaggregate level. In a typical example, and the one we focus on in this chapter, outcomes are measured at the individual level, whereas interventions vary only at the state (cluster) level. This is a common econometric problem when using geographic variation to study local labor market outcomes, such as workers' wages. Often, the effect of interventions is estimated using least squares regression. Since the mid-eighties empirical researchers in social sciences have generally been aware of the implications of within-cluster correlations in outcomes for the precision of such estimates (Liang and Zeger 1986; Moulton 1986). The typical approach is to allow for correlation between outcomes in the same state in the specification of the error covariance matrix. However, there may well be more complex correlation patterns in the data. Correlation in outcomes between individuals may extend beyond state boundaries, it may vary in magnitude between states, and it may be stronger in more narrowly defined geographical areas.

In this chapter we investigate the implications, for the repeated sampling variation of least squares estimators based on individual-level data, of the presence of correlation structures beyond those that are constant within states, identical across states, and vanish between states. First, we address the empirical question of whether such correlation patterns are present in census data on earnings with states as clusters. We estimate general spatial correlations for the logarithm of earnings and find that, indeed, such correlations are present, with substantial correlations within groups of nearby states and correlations within smaller geographic units (specifically public use microdata areas) considerably larger than within states. Second, we address whether accounting for such correlations is important for the properties of confidence

intervals for the effects of state-level regulations or interventions. We report theoretical results and demonstrate their relevance using illustrations based on earnings data and state regulations, as well as Monte Carlo evidence. The theoretical results show that if covariate values are as good as randomly assigned to clusters, implying that there is no spatial correlation in the covariates beyond the clusters, variance estimators that incorporate only cluster-level outcome correlations remain valid despite the misspecification of the error-covariance matrix. Whether this theoretical result is useful in practice depends on the magnitude of the spatial correlations in the covariates. We provide some illustrations that show that, given the spatial correlation patterns we find in the individual-level variables, spatial correlations in state-level regulations can have a substantial impact on the precision of estimates of the effects of interventions.

This chapter draws on three strands of literature that have largely evolved separately. First, it is related to the literature on clustering, where a primary focus is on adjustments to standard errors to take into account clustering of explanatory variables. (See, e.g., Liang and Zeger [1986]; Moulton [1986]; Bertrand, Duflo, and Mullainathan [2004]; Hansen [2007]; and the textbook discussions in Diggle et al. [2002]; Wooldridge [2002]); and Angrist and Pischke [2009]. Second, it draws on the literature on spatial statistics. Here a major focus is on the specification and estimation of the covariance structure of spatially linked data. For textbook discussions, see Schabenberger and Gotway (2004) and Gelfand et al. (2010). In interesting recent work Bester, Conley, and Hansen (2011) and Ibragimov and Muller (2010) link some of the inferential issues in the spatial and clustering literatures. Finally, we use results from the literature on randomization inference going back to Fisher (1925) and Neyman (1990). For a recent textbook discussion see Rosenbaum (2002). Although the calculation of Fisher exact p-values based on randomization inference is frequently used in the spatial statistics literature (Schabenberger and Gotway 2004), and sometimes in the clustering literature (Bertrand, Duflo, and Mullainathan 2004; Abadie, Diamond, and Hainmueller 2010), Neyman's approach to constructing confidence intervals using the randomization distribution is rarely used in these settings. We will argue that the randomization perspective provides useful insights into the interpretation and properties of confidence intervals in the context of spatially linked data.

## Notes

1. This large increase in wage inequality has led to an active area of research into the drivers of changes in the wage distribution nationwide. See Goldin and Katz (2007) for a recent survey.
2. Work by Berry and Glaeser (2005) and Moretti (2011b) comes to similar conclusions. Berry and Glaeser (2005) consider the role of entrepreneurship in cities. Moretti (2011b) analyzes the differential labor demands for high- and low-skill workers across industries.
3. The Detroit Symphony Orchestra was one of the top in the nation during the 1950s. More recently, it has defaulted on loans and is facing a labor dispute over wage cuts driven by decreased ticket sales and corporate donations (Bennett 2010). The Boston Symphony Orchestra, however, continues to be one of the best in the world.
4. The model could be extended to allow for dynamics, as done by Kennan and Walker (2011) and Bishop (2010). However, panel data are needed to estimate a model of this nature. I focus on the role of preference heterogeneity in determining long-run migration patterns, while Kennan and Walker (2011) and Bishop (2010) focus exclusively on high school graduates and life-cycle migration patterns.
5. Estimation of spatial equilibrium models when households have heterogeneous preferences using hedonics have been analyzed by Epple and Sieg (1999).
6. These results are consistent with a large body of work in empirical industrial organization that finds substantial heterogeneity in consumers' price sensitivities. A consumer's price sensitivity is also found to be closely linked to his income. See Nevo (2010) for a review of this literature.
7. Notowidigdo (2011) allows government social insurance programs in a city to endogenously respond to local wages, which is one of many endogenous amenity changes.
8. Similar methods have been used by Bayer, Keohane, and Timmins (2009); Bishop (2010); and Kennan and Walker (2011) to estimate workers' preferences for cities. However, these papers do not allow local wages and rents to be freely correlated with local amenities. Bayer, Keohane, and Timmins (2009) focus on the demand for air quality, while Bishop (2010) and Kennan and Walker (2011) study the dynamics of migration over the life cycle exclusively for high school graduates.
9. This result is closely related to Epple and Zelenitz (1981), which shows that worker migration between government jurisdictions is not enough to entirely compete away a government's market power.
10. A full microfoundation of this mechanism can be derived from the Alonso-Muth-Mills model (Brueckner 1987), where housing expands around a city's central business district and workers must commute from their house to the city center to work. Within-city housing prices are set such that workers are indifferent between having a shorter versus longer commute to work. Average housing prices rise as the population grows since the houses on the edge of the city must offer the same utility as the houses closer in. As the city population expands, the edge of the city becomes farther away from the center, making the commuting costs of workers living on the edge higher than those in a smaller city. Since the edge of the city must offer the same utility value as the center of the city, housing prices rise in the interior parts of the city.

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