House Price and the Labor Force Composition of Cities: Testing Models using the Location of Hispanic Workers*

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November 15, 2014

Abstract

Recent research has related variation in the labor force composition of cities to the cost of housing. First, workers with more human capital tend to locate in cities with high housing costs (*income elasticity effect*). Second, households with low demand for housing also select into expensive cities (*housing preference effect*).

This paper applies both effects to the location patterns of Hispanic versus non-Hispanic white workers across U.S. cities. Skill intensity in the labor force of both groups is expected to increase with the cost of housing according to the income elasticity effect. However, a number of low skill Hispanics are not permanent, long-term residents of cities and hence have relatively low demand for housing. This suggests an inverse relation between Hispanic skill intensity and house price based on the housing preference effect.

Empirical tests show that skill intensity varies positively with house price for non-Hispanic white workers as expected, and negatively for Hispanics (housing preference effect dominates income elasticity effect). The dominance of the housing preference effect means that the location patterns of Hispanic households by skill level are significantly different than those of non-Hispanic households. The results challenge models that assume homothetic or homogeneous preferences over housing, and show that the two effects together can explain the changing distribution of Hispanic households across U.S. cities.

Keywords: labor migration, skill intensity, wage inequality
JEL classification: J24, J31, J61, R21, R23

*I am grateful to my adviser, Anthony Yezer, and committee members, Bryan Boulier and Paul Carrillo, for their guidance and support. I also thank Barry Chiswick and Tara Sinclair for helpful suggestions.

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1 Introduction

This paper tests two hypotheses that relate variation in the labor force composition of cities to the cost of housing. The first is termed the *income elasticity of demand hypothesis* (IEH). If the income elasticity of demand for a primary residence is less than unity, workers with more human capital require relatively smaller compensating differentials in wages to locate in cities with high housing costs than do less skilled workers. Consequently, skill premiums are falling in cities where house prices are rising. Falling wage ratios induce substitution in production towards skilled workers, causing the average human capital level in a city to rise with the cost of housing. Second, is the *housing preference hypothesis* (HPH). It holds that preferences for housing versus non-housing consumption vary in the population based on observable and unobservable characteristics. Households with lower than average demand for housing tend to live in cities with higher than average house prices. Testing of the IEH and HPH has been limited to a small number of papers and no research has tested both theories simultaneously.

This paper compares the location patterns of Hispanic and non-Hispanic white (NHW) households.[1] The skill intensity of the NHW labor force is expected to vary positively with the cost of housing in a city as predicted by the IEH. However, the nature of housing demand in the Hispanic population implies that the housing preference effect may work in the opposite direction of the income elasticity effect for this group. A number of Hispanics are in the U.S. temporarily or have temporarily left members of their households in other locations.[2] This depresses their demand for a primary residence near their work location. Because workers in this state of depressed demand are disproportionately less skilled, the HPH effect tends to lower the skill intensity of the Hispanic labor force in cities with high

[1]The terms "Hispanic" and "non-Hispanic white" refer to categories used by federal agencies, as directed by the Office of Management and Budget, when data are collected on race and ethnicity together. In the empirical analysis, I refine the race/ethnicity categories to more accurately represent household types envisioned by the relevant theory

[2]Over 60 percent of the U.S. Hispanic population are 1st or 2nd generation immigrants and the available evidence suggests an association with high rates of return migration. See section 4.1.

housing costs. Thus, Hispanic households are subject to a within group housing preference effect as well as the conventional income elasticity response to the spatial variation in the cost of housing. These two effects have opposing impacts, yielding the hypothesis that rising house prices have smaller effects on skill intensity for Hispanic workers compared with non-Hispanic whites. Of course, other characteristics of cities, particularly amenities, are important in determining human capital levels, but the testing performed here differences the data to eliminate effects of permanent characteristics, and includes robustness tests to ensure that house price effects are not confounded by other specification issues.

1.1 Income Elasticity of Demand Hypothesis

The distribution of human capital in a city is conventionally described using skill intensity ratios, or SIRs. A commonly estimated SIR is equal to the ratio of adult workers with at least a bachelor's degree to those with less education.[3] Based on estimates in both levels and rates of change – to difference out the effects of city amenity – Broxterman and Yezer (2014) show that this measure is increasing with house price over the 1970 to 2000 period in accordance with the theoretical framework in their paper. The assumption that preferences for housing as a primary residence are non-homothetic, and that the income elasticity of demand for such a residence is significantly less than unity, plays a major role in the argument.

If housing demand is income inelastic, then the skilled wage premium falls as house price rises because skilled workers, who spend a smaller fraction of their budgets on housing than do unskilled workers, command relatively smaller compensating wage differentials to locate in cities with high housing costs. This reduction in relative wages induces a substitution effect in production across all industries causing the skill intensity of the labor force to rise with house price. Their preferred estimates of the elasticity of SIR with respect to house price (0.17 and 0.19) are consistent with values obtained from calibration of a theoretical model using an income elasticity of demand of 0.30. This positive relation between house

[3] The terms education, skill, and human capital are used interchangeably in this paper.

price and skill intensity due to non-homothetic preferences is what I have termed the income elasticity hypothesis in this paper. A more detailed explanation of the theoretical basis of the IEH is provided in section 2.

1.2 Housing Preference Hypothesis

Black et al. (2002) argue that any household type with low demand for housing disproportionately locates in high amenity cities and that the population of gay men in the U.S. represent one such group. According to the authors, gay households have lower lifetime demand for housing than similar heterosexual households because the cost of having children is higher for gay men. Consequently, gay men tend to sort into high amenity locations because they have more discretionary income to spend on amenities. Empirical results show that the cost of housing is more predictive of gay concentration than survey measures of gay friendliness, or amenity indexes.

Two departures from the conceptual framework in Black et al. (2002) are needed to apply their HPH to the location patterns of Hispanic workers. First, the authors explicitly assume that the distribution of human capital is the same in the gay and straight populations. In contrast, the members of the post-1964 wave of immigrants from Latin America have been less educated on average than the native-born U.S. population. Second, while Black et al. emphasize local amenity as the primary source of the variation in house price, more recent research has associated high house prices with city size, topography, land use regulation, and transportation systems. Thus, the argument in this paper, inspired by the work of Black et al., is that a segment of the Hispanic labor force with relatively low demand for housing and relatively low levels of education, tends to sort into cities with high housing costs to take advantage of the larger compensating differentials in wages available in those locations. This inverse relation between house price and skill intensity, due to heterogeneous preferences among Hispanic workers, is an example of what I have termed the housing preference hypothesis. A more detailed explanation of the theoretical basis of the HPH is provided in section 2.

1.3 Joint Hypothesis

This paper compares the variation across U.S. cities in the skill distributions of the Hispanic and non-Hispanic white labor forces, applying both the IEH and HPH. For most U.S. born Hispanic workers, the same forces that cause skill intensity to rise with house price for the NHW labor force (i.e., the IEH) apply. However, a significant number of low skill Hispanics are not permanent, long term residents of cities and hence have relatively low demand for housing. This suggests an inverse relation between skill intensity and house price based on the housing preference hypothesis. Thus, the housing preference effect for Hispanics is expected to mitigate the income elasticity effect, resulting in low correlations between Hispanic and NHW labor force education levels across cities.

The next section of this paper analyzes the theoretical rational for a relation between the cost of housing and the labor force composition of cities. The third and fourth sections review recent research on the distribution of human capital and Hispanic households, respectively. These are followed by a general empirical specification of a model of the time series variation in human capital by race/ethnicity. Empirical results in section six indicate that skill intensity varies positively with house price for non-Hispanic white workers as expected. The relation between worker skill and house price reverses sign for Hispanics, indicating the housing preference effect dominates the income elasticity effect. The dominance of the housing preference effect means that the location patterns of Hispanic households by skill level are significantly different than those of non-Hispanic households.

2 Theoretical Framework

Economic theory suggests the general relation among changes in house prices, wage structure, and skill intensity for cities. Unlike in the immigration and inequality literatures, which focus on the demand side of the labor market, the main device here rests squarely on the supply side.

Divide the labor force into two skill groups: skilled workers (S) and unskilled workers (U). The object of the modeling exercise is to determine how the relative proportion, i.e., the SIR, of the two worker types varies across cities.

Workers consume a composite commodity good, x, housing services h, and amenities, a. Consider first the case of unskilled workers in city j. Based on the subsistence nature of housing, a Samuelson-Stone-Geary utility function is used to represent consumer preferences over housing and the composite good,

$$U_{uj}(x_{uj}, h_{uj}; a_j) = a_j(x_{uj} - \gamma_x)^{\alpha}(h_{uj} - \gamma_h)^{1-\alpha}, \tag{1}$$

where the γ parameters represent minimum levels of subsistence consumption. The utility function is not homothetic: it yields an income expansion path that is linear, but that avoids the origin.

Maximization of equation (1) subject to a budget constraint produces the following demand functions for the composite commodity and housing services (expressed here in expenditure form for illustration purposes):

$$\begin{aligned} px_{uj} &= p\gamma_x + \alpha(y_{uj} - p\gamma_x - r_j\gamma_h) && (2) \\ r_jh_{uj} &= r_j\gamma_h + (1-\alpha)(y_{uj} - p\gamma_x - r_j\gamma_h), && (3) \end{aligned}$$

where p is the price of a composite commodity good, r_j is a house price index. Housing prices vary across cities while the composite commodity is a traded good with a price that is spatially constant. In equations (2) and (3), workers initially purchase subsistence quantities of each good and then divide supernumerary income among the goods in fixed, Cobb-Douglas, proportions.

2.1 Income Elasticity of Demand Hypothesis

In the housing demand equation (3), the share of income spent on housing is either monotonically decreasing or increasing with income depending on whether $\frac{r_j\gamma_h}{1-\alpha}$ is greater than or less than $\frac{p\gamma_x}{\alpha}$. Based on empirical estimates of the income elasticity of demand for a primary residence that are substantially less than one (table 1), the assumption that $\frac{r_j\gamma_h}{1-\alpha} > \frac{p\gamma_x}{\alpha}$ is deemed to represent a reasonable restriction on the model parameters.

Table 1 – Estimates of the income elasticity of demand for housing

Authors	Model	Estimate
Rosenthal, Duca, and Gabriel (1991)	table 2, model 1	0.182
Rapaport (1997)	table 3, model 2	0.284
Hansen et al. (1996)	table 4, owner model	0.627
Hansen et al. (1996)	table 4, renter model	0.369
Ioannides and Zabel (2008)*	table 5, model 2	0.211
Glaeser, Kahn, and Rappaport (2008)**	table 2, model 5	0.344

*Demand for structure, **Demand for land

Workers are perfectly mobile, sorting among cities based on an iso-utility condition and taking prices and wages as given. Substitute demand for housing and the composite good into log utility to obtain the following expression for indirect utility:

$$V_{uj} = \ln \frac{\alpha^\alpha (1-\alpha)^{1-\alpha} a_j (y_{uj} - \gamma_x p - \gamma_h r_j)}{p^\alpha r_j^{1-\alpha}}. \tag{4}$$

Take the antilog of both sides and and divide by the constant term $\alpha^\alpha(1-\alpha)^{1-\alpha}$ to obtain an expression in which indirect utility is the product of amenity level and supernumerary income deflated by a value akin to the geometric mean of prices.

$$V^*_{uj} \underset{trans}{\overset{mono}{\equiv}} \frac{\exp(V_{uj})}{\alpha^\alpha(1-\alpha)^{1-\alpha}} = \frac{a_j(y_{uj} - \gamma_x p - \gamma_h r_j)}{p^\alpha r_j^{1-\alpha}} = \overline{V}_u(y_{uj}, p, r_j; a_j). \tag{5}$$

In equilibrium, the indirect utility of unskilled workers is equated to the reference level available elsewhere, $\overline{V}_u$. Define a similar equilibrium condition for skilled workers. Solving the equilibrium conditions for income and taking the ratio gives an expression for the skilled wage ratio, or SWR.

$$SWR_j = \frac{y_{sj}}{y_{uj}} = \frac{\overline{V}_s p^\alpha r_j^{1-\alpha} + a_j(\gamma_x p + \gamma_h r_j)}{\overline{V}_u p^\alpha r_j^{1-\alpha} + a_j(\gamma_x p + \gamma_h r_j)} \tag{6}$$

The wage ratio is decreasing in the cost of housing under the assumption that housing is a necessity good, or that $\frac{r_j \gamma_h}{1-\alpha} > \frac{p\gamma_x}{\alpha}$. In other words, if the income elasticity of demand for a primary residence is less than unity, workers with more human capital require smaller compensating differentials in wages to locate in cities with high housing costs. To illustrate how firms respond to changes in relative wages, the demand side of the labor market is described next.

Perfectly competitive firms employ composite labor (N), capital (K), and space (L) to produce the composite good x using nested constant elasticity of substitution technology,

$$x_j = \left(\theta_N N_j^\pi + \theta_K K_j^\pi + \theta_L L_j^\pi\right)^{\frac{1}{\pi}}, \tag{7}$$

where $\theta_N + \theta_K + \theta_L = 1$, and

$$N_j = \left(\psi_{uj} U_j^\rho + \psi_{sj} S_j^\rho\right)^{\frac{1}{\rho}}. \tag{8}$$

In the aggregate production function, the θ terms are the output elasticities for labor, capital, and space, respectively. In the labor composite function, U_j and S_j denote quantities of unskilled and skilled workers employed in production, and the ψ terms represent relative productivity shocks.[4] Because labor is separable from capital and space, cost minimization produces a straightforward relative demand curve for skilled workers as a function of relative

[4]This one-sector, two-group CES production function is widely used in the literatures on immigration and wage inequality. Card and Lewis (2007) argue that a one sector model is appropriate given the limited role of sectoral adjustments in absorbing differences in relative labor supplies across cities. The two group assumption is a strong one that is loosened later.

wages and demand shifters,

$$\ln\left(\frac{S_j^D}{U_j^D}\right) = -\sigma \ln\left(\frac{y_{sj}}{y_{uj}}\right) - \sigma \ln\left(\frac{\psi_{uj}}{\psi_{sj}}\right), \tag{9}$$

where $\sigma = -\frac{1}{1-\rho}$ is the elasticity of substitution between skilled and unskilled workers. If relative demand for skilled workers is equal to relative supply, $\ln\left(\frac{S_j^D}{U_j^D}\right) = \ln\left(\frac{S_j}{U_j}\right)$, then equation (9) simplifies to

$$\ln(SIR_j) = -\sigma \ln(SWR_j) \tag{10}$$

The elasticities of SIR and SWR with respect to house price, η_{SIR} and η_{SWR}, are similarly related by the elasticity of substitution.

$$\eta_{SIR} = -\sigma \eta_{SWR} \tag{11}$$

To see this, take the ratio of the log definitions of η_{SIR} and η_{SWR}.

$$\frac{\eta_{SIR}}{\eta_{SWR}} = \frac{d\ln(SIR_j)}{d\ln(r_j)} \frac{d\ln(r_j)}{d\ln(SWR_j)} = \frac{d\ln(SIR_j)}{d\ln(SWR_j)} = -\sigma \tag{12}$$

In a widely cited article, Ciccone and Peri (2005) estimate σ to be approximately 1.5, a value that falls in the midpoint of a modest range of estimates from several empirical studies they review. Thus, a 10 percent decrease in the skilled wage ratio due to appreciating house prices should result in an approximately 15 percent increase in the skill intensity ratio of a city.

To summarize, in equation (6) the skilled wage ratio is decreasing in house price under the reasonable assumption that preferences for housing as a primary residence are non-homothetic and that the income elasticity of demand for such a residence is significantly less than unity. In turn, equation (11) shows that the skill intensity ratio is increasing in house price due to the effect of house price on wage structure in equation (6) and to simple neoclassical factor substitution. Together, these relations constitute the theoretical basis for the income elasticity of demand hypothesis.

2.2 Housing Preference Hypothesis

Households may differ systematically in their preference for housing. Following Black et al. (2002), heterogeneity in preferences is implemented by allowing the subsistence consumption levels of housing, i.e., the γ_h terms in the utility function, to vary. In this paper, the heterogeneity represents differences in preferences between Hispanics and non-Hispanic whites, but Hispanics could be replaced in the analysis with any household type with lower than average demand for housing, as was the case with gay households in Black et al.

Divide the labor force into two race/ethnicity categories: Hispanic and non-Hispanic white. Further divide the Hispanic population into two groups. The first group has preferences that are the same as non-Hispanic whites. The members of the second group, call them immigrants, have low housing demand and are all unskilled. In terms of the utility function, Hispanic immigrants (superscript M) require a lower minimum level of housing consumption than do native born Hispanics (superscript H), so that $\gamma_h^M < \gamma_h^H$. The lower subsistence level for housing could result from viewing housing as temporary, for example, in anticipation of a future move to reunite with dislocated family members. The productivity of workers of a given skill level is the same.[5]

Consider two cities, $j = \{1, 2\}$, that each contain Hispanic enclaves for reasons that may be historical. Exogenously shock the price of housing in the first city from r_1 to $r_1^{'}$. Based on equation (6), SWR falls consistent with the IEH. Solve equilibrium condition (5) for wage to obtain the new earnings required after the price shock to keep unskilled workers in city 1 at their reference utility level.

$$y_{u1}^{'} = \frac{\overline{V}_u p^{\alpha} {r_1^{'}}^{1-\alpha}}{a_1} + p\gamma_x + r_1^{'}\gamma_h \tag{13}$$

[5]There is no consensus in the literature on this fact. Jaeger (2007) finds that immigrants and natives with similar experience and skills are nearly prefect substitutes, while Card (2009) concludes they are imperfect substitutes.

Differentiate with respect to house price to obtain the compensating differential.

$$\frac{\partial y_{u1}}{\partial r_1} = \frac{(1-\alpha)\overline{V}_u}{a_1}\left(\frac{p}{r_1^{'}}\right)^{\alpha} + \gamma_h \tag{14}$$

The compensating differential clearly increases directly with minimum housing consumption, γ_h. For Hispanic immigrants living in city 2 – who have low values of γ_h^M – the indirect utility they would earn in city 1 at the new unskilled wage exceeds the indirect utility they currently receive in their home market, $V_{u1}^M(y_{u1}^{'}, p, r_1^{'}; a_1) > V_{u2}^M(y_{u2}, p, r_2; a_2)$.[6] Absent any frictions, the population of Hispanic immigrants from city 2 is willing to relocate at lower wages than unskilled workers command in the labor market of city 1. As a result of the house price shock, some unskilled workers leave city 1 due to substitution based on the new wage ratio and others are displaced by Hispanic immigrants with lower demand for housing.

Assuming that the inflow of unskilled immigrants into city 1 is small enough, the wage structure is still based on the preferences of the marginal unskilled worker rather than on the smaller γ_h^M for the inframarginal Hispanic immigrants. Thus, the skilled wage premium for the population of Hispanic workers falls in the first city after an increase in house price according to the IEH. However, expected substitution based on the new wage ratio is mitigated and possibly completely offset by the inflow of unskilled Hispanic immigrants predicted by the HPH, in which case Hispanic SIR varies inversely with house price. These effects of the skill biased variation in housing preferences among Hispanic workers represent the theoretical basis of the housing preference hypothesis.

The theoretical framework implies four hypotheses that are tested in the estimation section of the paper in the order they appear below:

(IEH_1) The effect of house price on SIR is positive for NHW workers.

(HPH_1) The effect of house price on SIR is lower for Hispanic workers than for NHWs.

(IEH_2) The effect of house price on SWR is negative for both Hispanic and NHW

[6]This result relies on the assumption of perfect substitutability.

workers.

(HPH_2) Demand for housing by unskilled Hispanic households is lower than that of unskilled NHWs.

An implication of these predictions is that differences in housing cost are driving tremendous sorting among U.S. cities along race/ethnicity and skill lines, suggesting a fifth and final hypothesis tested in the paper:

(HPH_3) For the least skill-intensive industries in a city, the Hispanic share of the workforce is directly related to the cost of housing in that city.

3 Geographic Distribution of Human Capital

Skill intensity is higher in larger cities. The positive relation between population and skill intensity has been studied intensively.[7] Broxterman and Yezer (2014) suggest a dominant role for house price, which is correlated with city size, in determining the variation in human capital levels across cities. Alternative explanations offered in the literature that inform the empirical specification in this paper are reviewed next.

On the supply side, the amenities offered in larger cities could be differentially attractive to more-educated workers. Urban amenities would lower the compensating differential required for skilled workers to settle in big cities, lowering SWR, and raising SIR (Glaeser, 2008). Similarly, Lee (2010) argues that the consumption variety available in large cities is a luxury good and as evidence shows that the urban wage premium is decreasing in skill for jobs in the healthcare industry.

On the demand side, the industrial composition of a city certainly could matter to the skill mix of a city's labor force. The spatial distribution of industries is not random and different industries require different skill mixes. However, Hendricks (2011) finds that only

[7] Hendricks (2011), and Elvery (2010) treat population as exogenous to skill intensity in levels. For analyses with skill intensity level as exogenous to population growth, see Shapiro (2006), and Glaeser and Saiz (2003).

20 percent of the variation in SIR across cities is due to educated cities specializing in more skill intensive industries. Thus the majority of the effect of city size on SIR is not due to differences in the industrial composition of small versus large cities.

Of course, the size of a city could result in amenities that cause both productivity differentials and locational preferences that vary with education. Diamond (2012), for example, proposes a general equilibrium model that features endogenous amenities. Bartik (1991)-type demand shocks in the model cause increases in wages and amenities that drive in-migration and increase local house prices. GMM estimates indicate that low skilled workers are "more price sensitive" (p. 5) to the high rents in high amenity cities than skilled workers, supporting the conception of housing as a necessity good put forward here.

4 Geographic Distribution of the Hispanic Population

The historic concentration of the Hispanic population in the southwestern border states of Arizona, California, New Mexico, and Texas has been fading since the 1990s. Driving the change has been a shift in the settlement patterns of immigrants, particularly from Mexico, who arrived in the U.S. during the nineties and naughts. The members of this new wave of immigrants are more likely to locate outside of the border states than those who arrived in earlier decades (Singer, Hardwick, and Brettell, 2009). As a result the fraction of the Mexican origin population residing in the four border states fell from 82 percent in 1990 to 69 percent in 2009.

Table 2 – Share of Hispanic population

	Border States		California	
	Hispanic	Mexican	Hispanic	Mexican
1980	57.7	80.3	31.0	41.4
1990	59.9	81.5	34.6	45.3
2000	55.8	72.5	31.0	41.0
2009	52.4	68.5	28.0	36.2

Note: Tabulations of decennial census and ACS data

Concurrent with the increasing dispersion of the Hispanic population, skill distributions are diverging across U.S. cities for the Hispanic and non-Hispanic white populations. Locations with large gains in the education levels of their NHW labor forces tend to experience modest gains, even losses, for Hispanics. Over the period from 1980 to 2009, a 10 percent increase in the share of NHW adults with at least a bachelor's degree is associated with a 3.6 percent increase in the share of Hispanic adults without a high school diploma.[8]

$$\ln(\text{Hispanic Drop Out Share}) = -\underset{(5.28)}{2.07} + \underset{(3.41)}{0.36} \ln(\text{NHW College Share})$$

In contrast to the development in cities, skill distributions at the national level are gradually converging. As shown in table 3, the share of the adult population with a high school diploma grew by considerably more for Hispanics (43 percent versus 23 percent) between 1980 and 2009, and college shares grew by nearly identical amounts (68 versus 72 percent) for the two race/ethnicity groups.

[8] Adj $R^2 = 0.21$. Model includes year fixed effects. Cross sections = 50 largest metropolitan areas based on 2009 population. Time series = 4: 1980, 1990, 2000, and 2009.

Table 3 – Educational distribution of working-age population (percents)

	Levels				Changes			
	1980	1990	2000	2009	1980s	1990s	2000s	1980-2009
Non-Hispanic White								
High School Share	76.7	87.8	92.1	94.0	14.5	4.9	2.1	22.6
College Share	19.6	24.9	29.8	33.8	27.0	19.6	13.5	72.4
Hispanic								
High School Share	46.9	58.4	61.2	67.1	24.5	4.8	9.6	43.1
College Share	8.1	9.6	10.9	13.6	18.7	13.5	24.9	68.2

Note: Tabulations of decennial census and ACS data

The existence of an inverse relation between Hispanic and NHW skill intensity in cities absent in the national data begs the question, are there factors differentially influencing the locational decisions of skilled and unskilled workers to which Hispanics and NHWs respond differentially? In other words, what attracts unskilled Hispanics and skilled NHWs to the same places? The answer proposed in this paper, growing house prices, follows *a priori* from the theoretical framework developed earlier in the paper. The small number of alternative explanations offered in the economics literature are discussed briefly next.

Given the significant share of the Hispanic population that is foreign born, a natural place to begin a study of the location patterns of Hispanic workers is in the literature on the economics of immigration. Stemming from an influential work by Grossman (1982), a large number of academic papers have examined the impact of immigration on labor markets where the labor market is defined as a metropolitan area. While in these papers the flow of immigrants to a particular city is not considered random, the impact of economic conditions on immigrant location choice is generally not considered explicitly. The extent to which locational choice is treated as endogenous, tracing back to Altonji and Card (1991), has been to use lagged immigrant share as an instrument. Thus, the only explanation offered by much of the economic literature for the locational decisions of immigrants is that they tend to go where immigrants have gone before. This is not a particularly satisfying explanation in light of the emergence over the previous two decades of new “immigrant gateways”.

A notable exception is a chapter by Card and Lewis (2007) on the causes and consequences of the geographic diffusion of Mexican immigrants during the 1990s. The authors explain the location choices of Mexican immigrants using lagged Mexican population shares as supply factors and predicted employment growth rates as demand factors. They find that supply factors account for 75 percent of the variation in inflow and demand factors 10 percent. Cost of living is not considered.[9]

4.1 Which Hispanics?

The Census Bureau defines *Hispanic or Latino* as "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race." Hispanics represent a broadly defined population to say the least as the distinct histories of these constituent groups have greatly affected their location choices and their geographic concentrations differ sharply. The housing preference hypothesis does not argue that Hispanics as whole possess idiosyncratic preferences, just the fraction consisting of worker households who view their tenure as temporary. The housing preference effect would certainly not apply, for example, to a land grant family in New Mexico.[10]

State of mind, of course, is not an observable trait in census data. A focus on immigrants would seem a logical strategy to isolate the theoretical population in the available data. Thirty-nine percent of the U.S. Hispanic population are foreign born, and an additional 33 percent have at least one foreign born parent (2010 Current Population Survey). However, second generation immigrants are not identifiable in the decennial census and ACS data, and after applying sample exclusion criteria, the net sample of foreign born Hispanics becomes too small to estimate with adequate precision a skill intensity ratio for cities in which one of the education levels is a college education.[11]

[9] Recognizing that location specific characteristics may attract differential inflows of skilled and unskilled workers, estimation is in first differences. However, because house price appreciation rates are not permanent features of cities, their effects are not eliminated by differencing.

[10] Land grant families are the descendants of early settlers who still live on land given to their ancestors by the Spanish and Mexican governments, some more than three hundred years in the past.

[11] Additionally, the focus is not on all immigrants because many non-Hispanic immigrants face higher

Another possible strategy to isolate the theoretical population of households with low demand for housing is to study just the Mexican origin population. This group comprises 62 percent of the total Hispanic population and evidence suggests an association with high rates of return migration. Between 2005 and 2010, for example, 1.4 million Mexicans moved from the U.S. to Mexico, most voluntarily, roughly the same number as immigrated to the U.S. from Mexico (Passel, D'Vera Cohn, and Gonzalez-Barrera, 2012). Among migrants interviewed in a recent study, over two thirds of the migrants from Mexico to the U.S. reported having only intended to stay in the United States temporarily (MATT, 2013). Thus, the analysis will supplement equations estimated for the entire Hispanic population, with ones based on just those Hispanics of Mexican origin.[12]

5 Variation in Human Capital and City Characteristics

Existing research shows potential roles for amenity, city size, industry mix, and house price in determining the skill intensity ratio of a city. The focus of this paper is on the impact of house price. To test the income elasticity hypothesis, the empirical approach exploits the substantial variation in the cost of housing that occurs across cities holding population constant. That is, topography, land use regulation, and transportation systems determine the supply of land for housing (Glaeser, Gyourko, and Saks, 2005), and the relative importance of these factors varies among cities. Differencing across worker type and time is used to remove the confounding effect of amenity, while industrial composition is addressed by the inclusion of control variables.

Specification begins with a pseudo reduced-form equation relating the number of skilled workers to housing cost, population, and industry mix in city j at time t.

costs of immigration (and return migration) than Hispanics and seem less likely to view their tenure as temporary.

[12] Although, the obvious measurement error induced by poorly identifying the theoretical population should increase the possibility of a type-II error in testing the housing preference hypotheses.

$$S_{jt} = \beta_{0s} + \beta_{1s}R_{jt} + \beta_{2s}N_{jt} + \mathbf{Z}'_{jt}\delta_s + \mu_{sj} + \upsilon_{st} + \epsilon_{sjt} \tag{15}$$

S_{jt}: log number of skilled workers
R_{jt}: log city housing cost index
N_{jt}: log city population
$\mathbf{Z}_{jt}$: vector of log city employment shares in manufacturing trade, and professional services
μ_{sj}: unobserved, time-invariant city characteristics that impact earnings of skilled workers net of amenities and taxes
υ_{st}: time error specific to skilled workers
ϵ_{sjt}: observation specific error

Write an equivalent equation for the log-number of unskilled workers, U_{jt}, and difference the equations to yield an expression for the logarithm of SIR,

$$\ln(SIR_{jt}) = \beta_0 + \beta_1 R_{jt} + \beta_2 N_{jt} + \mathbf{Z}'_{jt}\delta + \mu_j + \upsilon_t + \epsilon_{jt}. \tag{16}$$

In this equation, the coefficient and error terms lack skill-type subscripts because they are difference scores, e.g., $\beta_1 = \beta_{1s} - \beta_{1u}$, and $\mu_j = \mu_{sj} - \mu_{uj}$.

The inclusion of city fixed effects eliminates the effects of most urban amenity, local public service quality, and tax variables, which change very slowly if at all. The elasticity of the SIR with respect to house price ($\hat{\beta}_1$) can also be estimated directly by differencing equation (16) over time, so that the equation relates changes in SIR to changes in housing cost, population, and industry mix. Specifically, the estimating equation for the differenced model is given by

$$\Delta \ln(SIR^W_{jt}) = \beta_1 \Delta R_{jt} + \beta_2 \Delta N_{jt} + \Delta \mathbf{Z}'_{jt}\delta + \Delta \upsilon^W_t + \Delta \epsilon^W_{jt}, \tag{17}$$

where the inclusion of superscript W indicates that this is the estimating equation for the non-Hispanic white labor force. The change period here is ten years based on the availability of census data and following the general custom in the literature of examining changes over decades.

To test the housing preference hypothesis, the specification takes advantage of the variation in preferences among Hispanic workers. As discussed in the introduction, a significant number of low skill Hispanics are not permanent, long term residents of cities and hence have relatively low demand for housing. An equation for Hispanics (superscript H) analogous to (17) adds a variable (C_{jt-1}) for the relative concentration of Hispanics in a city during the previous period,

$$\Delta \ln(SIR^{H}_{jt}) = \beta_1 \Delta R_{jt} + \beta_2 \Delta N_{jt} + \beta_3 C_{jt-1} + \Delta \mathbf{Z}'_{jt}\delta + \Delta \upsilon^{H}_{t} + \Delta \epsilon^{H}_{jt}, \tag{18}$$

where

$$C_{jt-1} = \frac{population^{H}_{jt-1}}{population_{jt-1}} \Bigg/ \frac{\sum_{j=1}^{n} population^{H}_{jt-1}}{\sum_{j=1}^{n} population_{jt-1}}.$$

In addition to eliminating city fixed effects, differencing also removes the time invariant component of measurement errors in house price indexes due to unobserved differences in housing quality across cities.

Equations (17) and (18) comprise the preferred specifications in this paper.

6 Data and Estimation Results

The data used in this paper are drawn from the five percent public use microdata samples of the 1980, 1990, and 2000 decennial censuses, and the pooled 2007 to 2011 American Community Survey (ACS). For expositional ease, the ACS data are referred to as the 2009 data, indicating the year on which the five year period is centered.

This paper uses two approaches to measuring the distribution of human capital across cities. The first is nearly identical to the skill intensity ratio based on attainment of a bachelor's degree. The difference is that the skilled worker group consists not only of workers with at least a bachelor's degree (BA), but also, following the practice in the inequality literature, a share of those with some college but not a BA (i.e., 1-3 years). The low skill group consists of everyone else: drop outs, high school graduates, and the remaining share of those with some college. The two groups of workers are referred to as *college equivalent* and *high school equivalent*, respectively. Skill intensity is measured as the ratio of the two groups, and the variable is denoted as SIR when estimation results are presented in tables.

To span a range of more narrowly defined substitution possibilities, the second approach classifies workers into five skill groups: 1. drop out (unskilled), 2. high school (low skill), 3. some college (medium skill), 4. college (skilled), and 5. post-college (high skill). Using these categories, the six additional skill ratios listed below in table 2 are estimated by city for each of three race/ethnicity/nativity categories used in the analyses: native born whites of non-Hispanic ancestry (NHW), Hispanics of any race, nativity, and ancestry (Hispanic), and Hispanics of Mexican origin (Mexican Origin).

Table 4 – Measures of skill intensity

Name	Construction
SIR	College Equivalent ÷ High School Equivalent
SIR_41	College ÷ Drop Out
SIR_42	College ÷ High School
SIR_43	College ÷ Some College
SIR_31	Some College ÷ Drop Out
SIR_32	Some College ÷ High School
SIR_21	High School ÷ Drop Out

Finding a measure of housing cost appropriate for all households in a city is challenging. For low-income households, rental prices are an attractive choice. However, most households are owner-occupiers. For these households, the real after tax cost of housing is based on value and user cost that varies by income level. Use of house value is also complicated by the fact that it is based on expectations of future rents, and hence on the economic future of the city, whereas the theory developed here is based on the spot price of housing services. An additional complication has to do with the geographic definitions of metropolitan areas. Those used in this paper differ from the standard OMB definitions in order to maintain consistency over time.[13]

[13]The creation of the sample, skill categories, and metropolitan areas is described in detail in the data appendix.

In response to questions regarding the appropriate housing cost measure, results using four indexes are presented. Two are used in the initial analysis and two in a robustness check. All four are based on the same underlying U.S. Census Bureau data used to estimate the skill intensity ratios. An advantage of using the same underlying data is that the explanatory and dependent variables can thus be estimated for cities using the same consistent geographic definitions.

Tables A1 and A2 in the appendix report summary statistics for SIR, population, Hispanic concentration, industrial composition, and four housing cost measures for the 50 largest cities based on 2009 population. The mean and variance of skill intensity for NHW workers has been increasing proportionately over time at a decreasing rate in this 50 city sample. As a result, the coefficient of variation in the SIR has been remarkably stable, ranging from 0.28 to 0.30. In contrast, the two skill intensity measures for Hispanics increase in the eighties and aughts, and decline in the nineties. Hispanic population has been increasing at a considerably faster rate than total population in the sample cities. As a result, mean Hispanic concentration has increased from 6 percent in 1980 to 16 percent in 2009.

The industrial composition variables indicate a steady rise in the share of professional employment and fall in manufacturing employment, while the retail trade share is nearly constant. Median rent and median value have been increasing over time. However, the coefficient of variation is larger both in levels and in growth rates for median value.

6.1 Testing the effect of housing cost on skill intensity

Empirical analysis begins with estimates of the SIR and SIR_41 measures for the Hispanic and NHW labor forces in a sample of the 50 largest metropolitan areas covering the period from 1980 to 2009. Tables A3 and A4 report estimates of $\hat{\beta}_1$ from equations (17) and (18) that are positive and significant for NHW workers, but negative and mostly not significant for Hispanics (using median owner's estimate of value and median gross rent as housing cost indexes). In contrast to expectations based on literature suggesting that skill intensity responds positively to city size, estimates of $\hat{\beta}_2$ for non-Hispanic white workers are mostly negative. The effect of city size is also negative and significant for Hispanics in agreement with expectations from literature that immigrants are more likely to relocate for employment opportunities than are native born workers. Importantly, and perhaps surprisingly, estimates of $\hat{\beta}_3$ indicate a positive association of relative Hispanic concentration with human capital level in the Hispanic labor force. The negative estimates for coefficients on manufacturing and contrasting positive estimates for professional services for both demographic groups are not surprising given differences in the skill intensity of these sectors.

Table A5 reports estimates of just $\hat{\beta}_1$ for all seven of the skill intensity ratios listed in table 4. Equations are estimated separately for NHW, Hispanic, and Mexican origin workers. The sample of cities is restricted to the 30 largest cities in order to maintain adequate cell sizes for the smaller Mexican origin population and the models are otherwise the same as the analogs in tables A3 and A4.

For NHW workers, the estimated values for $\hat{\beta}_1$ in equations for SIR and SIR_41 are comparable in the 30 city sample to the elasticities estimated using the 50 city sample. The additional elasticities are nearly uniformly positive, and the strongest effect is estimated for SIR_41, the skill intensity measure with the largest differential in skill between the two levels making up the ratio. This finding is consistent with the emphasis in this paper on the role in determining skill intensity of the decline with income of fractional expenditure on housing.

For Hispanics, the estimated values for $\hat{\beta}_1$ in equations for SIR and SIR_41 are more negative in the 30 city than the 50 city sample. The elasticities for the various SIR measures are consistently negative with the exception of SIR_43, the ratio of workers with a bachelor's degree to those with some college (a ratio with no low-skill workers). When the sample is restricted to the Mexican origin population, the housing cost effect becomes more negative, indicating better identification of the theoretical "low housing demand" population.

The results in tables A3 to A5 support IEH_1 and HPH_1: increases in the cost of housing in a city are clearly associated with increases in the skill intensity of the NHW labor force and decreases in the skill intensity of the Hispanic labor force. Further, the results suggest a primary role for housing cost variation in driving the divergence in skill distributions across cities of the Hispanic and non-Hispanic white populations. Of the possible effects on skill intensity examined here – relative Hispanic concentration, and changing housing cost, population, and industry mix – only housing cost has opposite signed elasticities for Hispanic versus non-Hispanic white workers.

6.2 Testing the effect of housing cost on wage structure

The next step of the analysis tests whether the relations between wage premiums and house price have the same sign across demographic groups. If the elasticity of the skilled wage ratios with respect to housing cost are commensurate for NHWs and Hispanics, then the divergent SIR elasticities are not due to differences in money wages, and the explanation for the divergence can rely in a straight-forward way on differences in consumption bundles, as proposed in the theoretical framework section of this paper.

Tables A6.a and A7 report results when equation (17) is estimated using skilled wage ratio in place of skill intensity ratio as the dependent variable. The estimates of $\hat{\beta}_1$ – the elasticity of the wage ratio with respect to housing cost – are negative as predicted by the theoretical framework and of comparable magnitude for NHW and Hispanic workers. Along with the SIR elasticities from tables A3, the SWR elasticities in table A6.b imply values for the elasticity of substitution between college equivalent and high school equivalent workers that range from -0.85 to -1.31. These values are less negative than the value of -1.5 taken from the literature mentioned in section 2.1.[14] If agglomeration economies increase the marginal product of more-educated workers more than less-educated workers, a positive sign for $\hat{\beta}_2$ is expected. However, a negative relation is suggested by the data. The results provide clear support for IEH_2 and suggest that the possibility of finding a labor demand explanation for the opposite-signed SIR elasticities for Hispanics versus NHW workers is unlikely.

[14]Some divergence is not surprising considering no effort has been made to control for worker gender and age/experience.

6.3 Testing the effect of race/ethnicity on housing demand

To show what might be responsible for the divergent findings, the next step in the analysis tests for for differences in consumption bundles. If a significant segment of the unskilled Hispanic population have lower demand for housing than comparable unskilled NHW households, then the inverse relation between housing cost and skill intensity observed for the Hispanic population could result from simple variation in preferences.

Table A6 shows how the average number of persons-per-room (PPR) in a dwelling unit varies by skill level and demographic group in the 30 city sample. PPR represents the most commonly used measure of overcrowding in the housing literature. The measure is generally increasing from 1980 to 2000 and then declines in 2009 following the housing bust.

Customarily, overcrowding is defined as more than one person-per-room. Overcrowding is clearly present among the population of unskilled Hispanics who rent their housing units. Across the four census periods, 45 percent to 68 percent of renter occupied, unskilled Hispanic households are overcrowded. In contrast, the values for unskilled NHWs range from 17 to 24 percent over the same period. Additionally, the difference between PPR values for NHWs and Hispanics gets smaller with skill level.

Next, standard constant-quality demand methodology is used to see whether unskilled Hispanics have lower demand for housing than unskilled NHW households controlling for income. First, a hedonic rent index described later in section 6.5 is used to separate housing expenditure into price ($\ln \widehat{P}_{jt}$) and quantity ($\ln \widehat{h}_{ijt}$) components. Then, a demand function of the form

$$\begin{aligned}\ln \widehat{h}_{ijt} \quad = \quad & \phi_0 + \phi_1 \ln \widehat{P}_{jt} + \phi_2 \ln y_{ijt} + \phi_3 I_{ijt} \\ & + \phi_4 I_{ijt} \ln \widehat{P}_{jt} + \phi_5 I_{ijt} \ln y_{ijt} + \upsilon_t + \epsilon_{ijt}, \end{aligned} \tag{19}$$

is estimated by skill level, where I is an indicator variable that equals one when the householder is Hispanic. In the theoretical framework, a subset of unskilled Hispanics are assumed to have a lower level of minimum housing consumption than do their counterparts in the general population. Based on the assumption that $\gamma_{hu}^{M} < \gamma_{hu}$, hypotheses that Hispanics have lower total demand ($\phi_3 < 0$) and income elasticity of demand ($\phi_5 < 0$) than NHWs, but higher price elasticity of demand ($\phi_4 > 0$), can be derived from the theoretical framework.

Estimates of (19) by skill level reported in the two panels of table A9 show that $\hat{\phi}_3$ is negative and significant for the population of workers who did not complete high school. The Hispanic effect becomes less negative for higher skill levels such that college educated Hispanics actually demand more housing than comparable non-Hispanic white households. The number of family members living with the householder, a typical argument in a housing demand function, is intentionally excluded here, because the point of the exercise is to allow demand for housing to vary with the demographic characteristics of the households controlling only for income. The estimates of $\hat{\phi}_4$ an $\hat{\phi}_5$ are as expected. The findings clearly support HPH_2: the demand for housing by unskilled Hispanic households holding income constant is less than that of NHWs.

6.4 Testing the effect of housing cost on Hispanic employment share

If unskilled Hispanics sort into cities with high housing costs, then house price should explain the variation in the employment share of Hispanics in the lowest-skill industries. Thirty industries are ranked according to the employment share that lacks a high school diploma in 2009. For the seven industries with the highest share of low skill employment, Hispanic employment share in industry i for city j is regressed on median value, population, and relative Hispanic concentration. The sample is again the fifty largest metro areas by 2009 population and the estimating equation is as follows:

$$\Delta \ln \left(\frac{E_{ijt}^{H}}{E_{ijt}} \right) = \zeta_{0i} + \zeta_{1i} \Delta R_{jt} + \zeta_{2i} \Delta N_{jt} + \zeta_{2i} C_{jt-1} + \upsilon_{it} + \epsilon_{ijt}, \tag{20}$$

where $\frac{E_{ijt}^{H}}{E_{ijt}}$ is the share of employment in industry i by Hispanics.

The share of the workforce that lacks a high school diploma ranges from 16 to 36 percent across the seven lowest skill industries reported in table A10. For all seven industries estimates of $\hat{\zeta_{1i}}$ are positive and significant, ranging from 0.23 to 1.08. In supporting HPH_3, these results imply that differences in housing cost are leading to tremendous sorting among U.S. cities along race/ethnicity and skill lines.

6.5 Robustness checks

The estimates thus far have used median owner's estimate of value and median gross rent as indexes of housing cost. While the quality of the median unit varies across locations, these differences persist given durability of the housing stock and hence much of the effect of variation in quality is differenced away in the estimates of equations (17) and (18). Nevertheless, as a robustness test, median value and median rent are replaced by simple hedonic price indexes based on the rather limited information available in Census data on the characteristics of housing units.

The standard hedonic semi-log equation regresses log-value or log-rent against a vector of structural characteristics $\mathbf{X_{ijt}}$ for each unit i by city j and census year t.

$$\ln(R_{ijt}) = a_{jt} + \mathbf{X}'_{ijt}\mathbf{b_{jt}} + \epsilon_{ijt} \tag{21}$$

The unit characteristics include categorical variables for year built, number of units in building, rooms, bedrooms, and type of heating fuel. Based on the hedonic coefficients, a standard unit is priced for each city in each census year, creating indexes for both the owner-occupant and rental stock. Tables A11 and A12 reports results of estimating equations (17) and (18) using the hedonic value and rent indexes. Comparing estimates of $\hat{\beta}_1$ with those in tables A3 and A4, the results are fairly consistent for both NHW workers and Hispanics across housing cost measures.

Another possible objection to the specifications described in section 5 is the potential endogeneity of housing cost. While it is difficult to imagine how a change in the SWR or SIR of a city, holding population growth constant, could cause the price of housing to change, nevertheless, a robustness check for the endogeneity of housing cost in equations (17) and (18) is included in the paper.

The instrumental variables introduced in the literature recently – historical transportation plans Duranton and Turner (2012) and mineral deposits Glaeser et al. (2012), for example – while innovative, are only appropriate for cross-sectional usage, not estimation in differences. To instrument for house price change, this paper utilizes an Export Price Index (EPI) due to Pennington-Cross (1997) and updated by Larson (2011). The EPI is designed to avoid problems of Bartik's (1991) employment share index.[15] It uses location quotients to identify export industries in each city. Then relative export shares are used to weight national price change indexes to form a measure of demand shocks experienced by individual cities. The EPI is a suitable instrument as changes in the index are correlated with house price growth, but are clearly not caused by changes in SIR.

Comparing the two stage least squares results from tables A13 and A14 with the OLS coefficients in tables A3 and A4, the estimated elasticities are larger for median value and smaller for median rent, but none are significant for the NHW population. For Hispanics, all of the housing cost change coefficients are more negative and the t-statistics are smaller under 2SLS estimation. Although, the results of this robustness check are not significant, the test fails to reject the positive relation between housing cost and skill intensity for the NHW labor force and the negative relation for the Hispanic labor force.

6.6 Size of the Effects

Averaging across the four housing cost measures used in the analyses, a 10 percent increase in housing cost is associated with a 1 percent increase in the broad SIR measure for the NHW

[15]Bartik (1991) takes national employment growth by sector and shares it out across cities in proportion to their shares of employment in that sector. This implicitly assumes that industrial growth in some cities does not come at the expense of growth in other locations.

labor force and a 2.3 percent decrease for that of Hispanics. For the more narrowly focused SIR_41 measure, the effects are larger: a 10 percent increase in housing cost is associated with a 2.2 percent increase for the NHW labor force and a 3.5 percent decrease for Hispanics.

The relative importance of housing cost variation in determining changes in skill intensity for the Hispanic labor force can be compared to the other explanatory variables by examining the panels in table A15. For each of the four housing cost variables, population, and the three industry mix variables, the estimated effect of the mean change over a decade on SIR and SIR_41 are displayed. The estimated effect of both the mean absolute change and a one standard deviation in the change over a decade on SIR is displayed. Overall, in terms of explaining variation in the rate of change in the two skill intensity measures across cities, the results show that the effects of housing cost change over the typical decade between 1980 and 2009 likely play a dominant role. Additionally, only the housing cost effects have opposite signs across the two race/ethnicity groups. Thus, regarding the question posed early in this paper, what attracts unskilled Hispanics and skilled NHWs to the same places, the answer proposed in the theoretical framework, growing house prices, finds strong support in the data.

7 Conclusions and Implications

This paper presents two theories relating the cost of housing and the labor force composition of cities: the income elasticity hypothesis and the housing preference hypothesis. The empirical approach to testing the theories exploits the variation in preferences among Hispanic worker households by skill level and the variation in housing costs across cities (holding population constant).

For most U.S. born Hispanic workers, the same forces that cause skill intensity to rise with house price for the NHW labor force (i.e., the IEH) apply. However, a significant number of low skill Hispanics are not permanent, long term residents of cities and hence have relatively low demand for housing. This suggests an inverse relation between skill intensity and house price based on the housing preference hypothesis. Thus, the housing preference effect for Hispanics is expected to mitigate the income elasticity effect, resulting in low correlations between Hispanic and NHW labor force education levels across cities.

Empirical tests support these predictions of theory. First, the effects of housing costs on skill intensity are positive for non-Hispanic white workers and lower, negative in fact, for Hispanics. In contrast, the elasticity of the analogous skilled wage ratios with respect to housing costs have the same sign and comparable magnitude across the two race/ethnicity groups. Next, results show that low skill Hispanics have lower demand for constant-quality housing than do non-Hispanic whites. Together, these findings imply that the divergent effects of housing cost on skill intensity result not from differences in money wages, but rather from differences in consumption bundles. Finally, for the least skill-intensive industries, the Hispanic share of employment is found to be directly related to the cost of housing. This result provides further evidence that differences in housing cost are leading to tremendous sorting among U.S. cities along race/ethnicity and skill lines.

The findings presented here may be interpreted as demonstrating that models with either homothetic or homogenous housing preferences that assume away the IEH or HPH are problematic. The results support earlier work finding that SWR varies inversely and SIR varies directly with housing cost. The assumption that preferences for housing as a primary residence are non-homothetic, and that the income elasticity of demand for such a residence is significantly less than unity, is central to the argument. The results also support existing work (estimated in levels) finding that households with low demand for housing tend to live in cities with high housing costs. However, the results here (estimated in differences) favor the view of low demand households as arbitragers, sorting into expensive cities to take advantage of the larger compensating wage differentials available in those locations, rather than as consumers of "adult-related" urban amenities (Black et al., 2002, p. 32).

The view of interurban labor markets developed in this paper has a number of implications that are discussed in Broxterman and Yezer (2014). Briefly, the findings reinforce the warning in Black, Kolesnikova, and Taylor (2009) that measures of the real returns from education are overstated because SIR rises with house price and this means that more-educated workers live in higher cost areas. Additionally, it may be misleading to measure productivity differences of cities based on output per worker or wages. Higher skill workers differentially select into cities with higher house prices and this increases normal measures of labor productivity. Furthermore, the mechanism that relates housing cost variation to differences in skill intensity should apply equally well to unobserved worker characteristics, like education quality, that are related to productivity.

The results imply that the IEH and HPH theories together provide a systematic explanation for the changing spatial distribution of Hispanic workers in the U.S., and in so doing may provide an explanation for a longstanding conundrum in the immigration economics literature. Economists generally find that cities receiving large flows of unskilled Mexican immigrants absorb the new workers with only small reductions in the relative wages of unskilled native-born workers.[16] Grounding such a result in the theory of the firm implies an unreasonably high wage elasticity of labor demand. Card and Lewis (2007) describe the issue clearly:

> Evidently, the adjustments needed to accommodate differences in the relative supply of dropout labor in different markets occur without the intervening mechanism of relative wage changes. The data do not allow us to tell whether this is because high school dropouts and high school graduates are highly substitutable in production or as a result of other adjustment processes such as endogenous technical change. (p. 195)

This apparent “flexibility” of local labor demand to changes in supply is potentially explained by the attraction of immigrants to locations with appreciating house prices (HPH) where falling wage ratios (IEH) offset the impacts on wage structure of relative labor supply

[16] See Longhi et al. (2010) for a meta-analysis and survey of the literature.

shocks. Sorting out whether house price dynamics or some other mechanism represents the adjustment process described by Card and Lewis (2007) is left as a challenge for future research

A Tables

Table A1 – Summary statistics in levels, ($N = 50$)

	Min	Max	Mean	STD	CV
1980					
SIR (NHW)	0.21	0.88	0.44	0.13	0.29
SIR (Hispanic)	0.06	0.54	0.23	0.11	0.45
SIR_41 (NHW)	0.41	2.23	0.99	0.44	0.44
SIR_41 (Hispanic)	0.05	0.72	0.24	0.17	0.71
Median Value*	32.50	112.50	54.00	15.55	0.29
Hedonic Value*	23.57	98.51	48.56	14.40	0.30
Median Rent	194.00	325.00	260.33	30.85	0.12
Hedonic Rent	218.28	423.78	312.42	52.21	0.17
Population*	464.76	18 350.68	2481.08	3048.10	1.23
Hispanic Population*	4.62	2823.74	207.76	502.43	2.42
Rel. Hispanic Concentration	0.05	5.67	0.80	1.12	1.39
Manufacturing Share	0.04	0.39	0.23	0.09	0.38
Professional Services Share	0.13	0.27	0.19	0.02	0.12
Retail Trade Share	0.12	0.19	0.15	0.01	0.10
1990					
SIR (NHW)	0.33	1.29	0.67	0.19	0.28
SIR (Hispanic)	0.12	0.92	0.35	0.19	0.54
SIR_41 (NHW)	0.95	6.93	2.72	1.39	0.51
SIR_41 (Hispanic)	0.07	2.78	0.57	0.61	1.08
Median Value*	52.50	275.00	97.60	46.93	0.48
Hedonic Value*	45.05	261.77	89.66	44.22	0.49
Median Rent	363.00	735.00	493.08	87.80	0.18
Hedonic Rent	400.04	975.79	602.02	137.06	0.23
Population*	738.70	18 763.21	2787.05	3281.04	1.18
Hispanic Population*	5.02	4762.46	319.71	780.57	2.44
Rel. Hispanic Concentration	0.04	4.42	0.76	0.97	1.28
Manufacturing Share	0.05	0.31	0.18	0.06	0.34
Professional Services Share	0.14	0.29	0.22	0.02	0.11
Retail Trade Share	0.12	0.18	0.15	0.01	0.09

*Divided by 1000

Table A1 cont'd – Summary statistics in levels, ($N = 50$)

	Min	Max	Mean	STD	CV
2000					
SIR (NHW)	0.45	1.69	0.90	0.26	0.29
SIR (Hispanic)	0.12	0.68	0.29	0.12	0.43
SIR_41 (NHW)	1.86	15.32	5.50	2.91	0.53
SIR_41 (Hispanic)	0.09	1.47	0.33	0.25	0.78
Median Value*	75.00	350.00	138.20	47.11	0.34
Hedonic Value*	71.13	307.82	124.87	42.49	0.34
Median Rent	504.00	1003.00	658.40	96.77	0.15
Hedonic Rent	583.44	1369.77	795.83	154.37	0.19
Population*	1053.93	20 456.85	3220.58	3606.15	1.12
Hispanic Population*	20.11	6680.74	512.92	1095.81	2.14
Rel. Hispanic Concentration	0.06	3.45	0.80	0.82	1.02
Manufacturing Share	0.04	0.29	0.15	0.05	0.35
Professional Services Share	0.15	0.3	0.25	0.03	0.11
Retail Trade Share	0.12	0.18	0.15	0.01	0.08
2009					
SIR (NHW)	0.55	2.29	1.11	0.34	0.30
SIR (Hispanic)	0.17	0.92	0.33	0.13	0.41
SIR_41 (NHW)	3.42	23.30	9.51	5.05	0.53
SIR_41 (Hispanic)	0.14	2.75	0.46	0.42	0.91
Median Value*	137.50	908.64	246.42	130.29	0.53
Hedonic Value*	120.95	567.70	227.22	99.32	0.44
Median Rent	721.00	1433.00	960.20	177.98	0.19
Hedonic Rent	821.24	1827.31	1220.32	258.63	0.21
Population*	1153.89	21 037.59	3532.50	3773.97	1.07
Hispanic Population*	30.72	8051.14	700.63	1328.74	1.90
Rel. Hispanic Concentration	0.07	2.93	0.83	0.71	0.86
Manufacturing Share	0.04	0.22	0.11	0.04	0.36
Professional Services Share	0.18	0.35	0.28	0.03	0.10
Retail Trade Share	0.12	0.19	0.16	0.01	0.08

*Divided by 1000

Table A2 – Summary statistics in annual growth rates, ($N = 50$)

	Min	Max	Mean	STD	CV
1980 to 1990					
SIR (NHW)	2.93	7.18	5.50	0.99	0.18
SIR (Hispanic)	−2.08	18.71	5.07	4.24	0.84
SIR_41 (NHW)	9.55	24.03	16.81	3.62	0.22
SIR_41 (Hispanic)	−4.66	104.32	12.23	16.92	1.38
Median Value	1.60	25.71	7.83	5.09	0.65
Hedonic Value	2.39	21.30	8.08	4.54	0.56
Median Rent	4.70	13.52	8.92	2.15	0.24
Hedonic Rent	5.38	15.34	9.23	2.37	0.26
Population	−0.69	5.89	1.66	1.53	0.92
Hispanic Population	−1.98	26.68	5.49	4.71	0.86
Rel. Hispanic Concentration	−4.25	7.70	−0.30	2.21	−7.45
Manufacturing Share	−4.22	0.86	−1.96	1.02	−0.52
Professional Services Share	0.37	2.56	1.53	0.46	0.30
Retail Trade Share	−0.66	1.77	0.43	0.51	1.19
1990 to 2000					
SIR (NHW)	1.41	4.99	3.27	0.67	0.20
SIR (Hispanic)	−7.56	3.60	−0.90	2.76	−3.08
SIR_41 (NHW)	4.68	15.81	10.30	2.27	0.22
SIR_41 (Hispanic)	−9.31	8.40	−1.28	4.41	−3.44
Median Value	−1.67	12.41	5.03	3.16	0.63
Hedonic Value	−1.25	12.51	4.75	2.76	0.58
Median Rent	1.07	6.63	3.46	1.16	0.34
Hedonic Rent	0.75	5.98	3.36	1.23	0.37
Population	−0.14	8.62	1.97	1.52	0.77
Hispanic Population	2.65	76.91	16.05	17.52	1.09
Rel. Hispanic Concentration	−2.19	45.51	5.42	9.56	1.77
Manufacturing Share	−2.75	1.22	−1.52	0.74	−0.49
Professional Services Share	−0.50	2.37	1.23	0.57	0.46
Retail Trade Share	−1.01	0.69	−0.22	0.36	−1.65

Table A2 cont'd – Summary statistics in annual growth rates, ($N = 50$)

	Min	Max	Mean	STD	CV
2000 to 2009					
SIR (NHW)	1.38	3.52	2.39	0.53	0.22
SIR (Hispanic)	−2.05	6.45	1.81	1.93	1.07
SIR_41 (NHW)	4.29	11.13	7.35	1.68	0.23
SIR_41 (Hispanic)	−1.61	13.6	4.65	4.01	0.86
Median Value	1.82	15.96	7.38	3.67	0.50
Hedonic Value	2.86	15.53	7.95	3.39	0.43
Median Rent	2.54	7.35	4.55	1.25	0.27
Hedonic Rent	2.45	9.33	5.33	1.45	0.27
Population	−0.33	4.02	1.22	0.96	0.78
Hispanic Population	2.05	18.41	7.16	4.10	0.57
Rel. Hispanic Concentration	−1.50	11.41	2.14	2.87	1.34
Manufacturing Share	−3.69	−1.12	−2.36	0.59	−0.25
Professional Services Share	0.52	1.86	1.16	0.33	0.28
Retail Trade Share	−0.27	1.61	0.54	0.44	0.82

Table A3 – First-differenced regression coefficients
Sample – non-Hispanic, white, native born workers (NHW)

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR) (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Median Value)	0.055***		0.092**	
	(3.46)		(2.01)	
Δln(Median Rent)		0.172***		0.381***
		(4.40)		(3.79)
Δln(Population)	-0.065*	-0.077**	0.023	-0.004
	(1.78)	(2.08)	(0.25)	(0.05)
Δln(Manufacturing)	-0.182***	-0.175***	-0.247**	-0.202
	(3.90)	(3.83)	(2.05)	(1.64)
Δln(Professional Serv)	0.085	0.153	0.166	0.407
	(0.62)	(1.16)	(0.52)	(1.41)
Δln(Retail Trade)	0.112	0.110	0.016	0.066
	(1.18)	(1.22)	(0.07)	(0.28)
Year 1990	0.232***	0.187***	0.458***	0.353***
	(24.28)	(12.04)	(17.43)	(9.41)
Year 2000	0.107	0.112***	0.201***	0.217***
	(9.02)	(9.43)	(6.92)	(7.33)
Intercept	0.129***	0.090***	0.406***	0.299***
	(5.52)	(3.30)	(7.36)	(4.76)
Adj R^2	0.842	0.848	0.752	0.763

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A4 – First-differenced regression coefficients
Sample – Hispanic workers of any nativity

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR) (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Median Value)	-0.136*		-0.197	
	(1.79)		(1.59)	
Δln(Median Rent)		-0.271		-0.388
		(1.45)		(1.22)
Δln(Population)	-0.464***	-0.455***	-0.778***	-0.766***
	(3.21)	(3.13)	(3.20)	(3.18)
Conc_Rel_L1	0.074***	0.076***	0.141***	0.144***
	(5.80)	(5.80)	(6.34)	(6.37)
Δln(Manufacturing)	-0.195	-0.140	-0.445	-0.363
	(0.95)	(0.70)	(1.16)	(0.95)
Δln(Professional Services)	0.269	0.299	0.456	0.507
	(0.50)	(0.54)	(0.47)	(0.51)
Δln(Retail Trade)	0.015	0.133	0.004	0.180
	(0.04)	(0.34)	(0.01)	(0.25)
Year 1990	0.104**	0.171	0.028	0.122
	(2.48)	(2.28)	(0.37)	(0.95)
Year 2000	-0.232***	-0.221	-0.465***	-0.449
	(4.85)	(4.69)	(5.75)	(5.60)
Intercept	0.174*	0.202*	0.318*	0.356**
	(1.79)	(1.74)	(1.90)	(1.86)
Adj R^2	0.439	0.435	0.407	0.404

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A5 – Estimated elasticities of skill intensity with respect to housing cost

	Non-Hispanic White		Hispanic		Mexican Origin	
	Mdn Value	Mdn Rent	Mdn Value	Mdn Rent	Mdn Value	Mdn Rent
SIR	0.061***	0.177***	-0.184**	-0.238	-0.216**	-0.244
	(2.86)	(3.35)	(2.10)	(1.19)	(2.62)	(1.18)
SIR_41	0.133**	0.546***	-0.308**	-0.526	-0.343**	-0.453
	(2.27)	(4.57)	(2.18)	(1.56)	(2.50)	(1.38)
SIR_42	0.097***	0.321***	-0.176*	-0.234	-0.149	-0.256
	(3.01)	(3.36)	(1.87)	(1.14)	(1.44)	(1.06)
SIR_43	0.118***	0.372***	0.039	0.018	0.048	0.086
	(3.79)	(4.63)	(0.62)	(0.13)	(0.55)	(0.45)
SIR_31	0.018	0.174*	-0.346**	-0.543	-0.391***	-0.539*
	(0.33)	(1.72)	(2.56)	(1.64)	(3.10)	(1.88)
SIR_32	-0.020	-0.051	-0.215***	-0.251	-0.197**	-0.342*
	(0.67)	(0.64)	(2.95)	(1.50)	(2.40)	(1.88)
SIR_21	0.038	0.225**	-0.131	-0.292	-0.194*	-0.197
	(0.81)	(2.43)	(1.38)	(1.33)	(1.97)	(0.96)

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Absolute value of t-statistics in parentheses

Cross section observations: 30

Time series = 3: 1980-1990, 1990-2000, 2000-2009

Skill Intensity Ratio Construction	
SIR	College Equivalent / High School Equivalent
SIR_41	College ÷ Drop Out
SIR_42	College ÷ High School
SIR_43	College ÷ Some College
SIR_31	Some College ÷Drop Out
SIR_32	Some College ÷ High School
SIR_21	High School ÷ Drop Out

Table A6.a – First-differenced regression coefficients
Sample – non-Hispanic, white, native born workers (NHW)

Dependent Variable ->	Δln(SWR) (1)	Δln(SWR) (2)	Δln(SWR_41) (3)	Δ(SWR_41) (4)
Δln(Median Value)	-0.065***		-0.108***	
	(4.74)		(5.5)	
Δln(Median Rent)		-0.186***		-0.288***
		(6.29)		(5.49)
Δln(Population)	-0.067***	-0.054**	-0.201***	-0.181***
	(2.62)	(2.14)	(4.4)	(4.28)
Δln(Manufacturing)	-0.022	-0.024	0.108	0.113*
	(0.53)	(0.55)	(1.65)	(1.74)
Δln(Professional Services)	-0.038	-0.094	-0.067	-0.132
	(0.50)	(1.33)	(0.56)	(1.05)
Δln(Retail Trade)	0.021	0.034	-0.053	-0.020
	(0.28)	(0.43)	(0.43)	(0.15)
Year 1990	0.000	0.048***	0.108***	0.181***
	(0.03)	(3.95)	(9.09)	(10.04)
Year 2000	-0.043***	-0.047***	-0.005	-0.010
	(5.15)	(5.42)	(0.33)	(0.57)
Intercept	0.0756***	0.114***	0.171***	0.225***
	(4.61)	(6.44)	(6.79)	(7.18)
Adj R^2	0.353	0.381	0.474	0.480

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A6.b – Implied elasticities of substitution

Sample ->	50 City		30 City	
	Mdn Value	Mdn Rent	Mdn Value	Mdn Rent
SIR Elasticity	0.055	0.172	0.064	0.160
SWR Elasticity	−0.065	−0.186	−0.049	−0.156
Elasticity of Substitution	−0.846	−0.925	−1.306	−1.026

Table A7 – First-differenced regression coefficients
Sample – Hispanic workers of any nativity

Dependent Variable ->	Δln(SWR) (1)	Δln(SWR) (2)	Δln(SWR_41) (3)	Δ(SWR_41) (4)
Δln(Median Value)	-0.029		-0.116**	
	(0.97)		(2.79)	
Δln(Median Rent)		-0.079		-0.347***
		(1.00)		(3.38)
Δln(Population)	-0.148**	-0.145**	-0.274***	-0.261***
	(2.17)	(2.13)	(2.78)	(2.78)
Δln(Manufacturing)	0.091	0.095	0.090	0.093
	(1.02)	(1.07)	(0.77)	(0.83)
Δln(Professional Services)	-0.105	-0.131	0.020	-0.126
	(0.48)	(0.59)	(0.07)	(0.43)
Δln(Retail Trade)	0.174	0.182	-0.056	-0.042
	(0.97)	(1.03)	(0.22)	(0.17)
Year 1990	0.075***	0.096***	0.209***	0.301***
	(4.22)	(3.37)	(8.90)	(8.21)
Year 2000	0.001	0.000	-0.019	-0.024
	(0.03)	(0.02)	(0.72)	(0.84)
Intercept	0.088**	0.105**	0.128***	0.201***
	(2.58)	(2.41)	(2.77)	(3.56)
Adj R^2	0.126	0.127	0.377	0.389

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A8 – Persons per room (PPR) and share overcrowded (PPR > 1)
Sample – 30 largest metropolitan areas

	Non-Hispanic White		Hispanic		Mexican Origin	
	Mean PPR	Share PPR > 1	Mean PPR	Share PPR > 1	Mean PPR	Share PPR > 1
1980						
Drop Out	0.65	0.21	0.95	0.45	0.99	0.48
High School	0.57	0.13	0.77	0.30	0.80	0.29
Some College	0.52	0.10	0.69	0.25	0.68	0.26
College	0.46	0.07	0.64	0.22	0.59	0.18
Post College	0.46	0.07	0.69	0.24	0.59	0.11
1990						
Drop Out	0.67	0.22	1.19	0.56	1.28	0.62
High School	0.60	0.15	0.89	0.38	0.85	0.32
Some College	0.54	0.11	0.79	0.33	0.78	0.31
College	0.48	0.08	0.64	0.22	0.61	0.20
Post College	0.45	0.06	0.71	0.27	0.77	0.30
2000						
Drop Out	0.68	0.24	1.40	0.68	1.48	0.71
High School	0.60	0.18	1.09	0.51	1.17	0.56
Some College	0.55	0.13	0.91	0.40	0.93	0.41
College	0.48	0.10	0.76	0.30	0.78	0.31
Post College	0.45	0.08	0.79	0.30	0.80	0.29
2009						
Drop Out	0.61	0.17	0.91	0.46	0.98	0.52
High School	0.54	0.12	0.79	0.33	0.84	0.39
Some College	0.50	0.09	0.68	0.24	0.74	0.29
College	0.45	0.07	0.60	0.18	0.68	0.24
Post College	0.42	0.06	0.57	0.16	0.61	0.17

Table A9a – Demand for rental housing by skill level

Sample – NHW and Hispanic workers in 30 largest metro areas

Sample ->	Drop Out (1)	High School (2)	Some College (3)	College (4)	Post College (5)	All (6)
ln(Hedonic Rent)	-0.223***	-0.250***	-0.280***	-0.246***	-0.229***	-0.240***
	(67.66)	(136.63)	(140.52)	(104.8)	(60.82)	(224.01)
ln(Hhld Income)	0.149***	0.179***	0.217***	0.237***	0.244***	0.219***
	(82.61)	(149.85)	(162.22)	(153.32)	(104.41)	(317.83)
Hispanic	-0.438***	-0.011	0.196***	0.272***	0.322***	0.075***
	(16.06)	(0.41)	(5.4)	(4.46)	(3.46)	(4.98)
ln(Hedonic Rent)*Hisp	0.069***	0.022***	0.001	-0.029***	-0.049***	0.033***
	(15.44)	(5.16)	(0.13)	(2.96)	(3.44)	(13.66)
ln(Hhld Inc)*Hisp	-0.014***	-0.022***	-0.028***	-0.015**	-0.006	-0.044***
	(5.76)	(8.57)	(7.8)	(2.39)	(0.69)	(30.6)
Intercept	-0.370***	-0.445***	-0.576***	-0.956***	-1.121***	-0.863***
	(18.88)	(40.28)	(47.62)	(69.08)	(50.9)	(137.19)
Adj R^2	0.140	0.143	0.172	0.185	0.185	0.197
n	210,728	364,312	305,900	205,717	88,749	1,175,406

Table A9b – Demand for rental housing by skill level

Sample – NHW and Mexican origin workers in 30 largest metro areas

Sample ->	Drop Out (1)	High School (2)	Some College (3)	College (4)	Post College (5)	All (6)
ln(Hedonic Rent)	-0.218***	-0.242***	-0.276***	-0.244***	-0.226***	-0.236***
	(57.95)	(118.59)	(126.38)	(94.82)	(55.9)	(199.39)
ln(Hhld Income)	0.151***	0.179***	0.218***	0.241***	0.247***	0.222***
	(73.8)	(135.59)	(148.58)	(143.17)	(98.49)	(293.06)
Hispanic	-0.463***	-0.033	-0.005	0.181	0.248	0.043
	(13.8)	(0.85)	(0.08)	(1.71)	(1.46)	(2.09)
ln(Hedonic Rent)*Hisp	0.084***	0.026***	0.021**	-0.029*	-0.090***	0.056***
	(15.54)	(4.47)	(2.48)	(1.78)	(3.5)	(17.55)
ln(HhId Inc)*Hisp	-0.022***	-0.023***	-0.023***	-0.007	0.023	-0.058***
	(7.29)	(6.64)	(4.25)	(0.7)	(1.58)	(30.7)
Intercept	-0.425***	-0.499***	-0.614***	-1.012***	-1.168***	-0.922***
	(18.84)	(40.5)	(46.14)	(66.86)	(49.3)	(132.24)
Adj R^2	0.139	0.136	0.168	0.186	0.185	0.195
n	141,177	269,535	237,533	169,286	73,922	891,453

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Absolute value of t-statistics in parentheses

Table A10 – Elasticity of Hispanic employment share with respect to housing cost

Industry	N	Unskilled Share	Median Value	t-stat	Adj R^2
		Dependent variable: Δln(Hispanic Share)			
Retail Trade	150	0.16	0.321***	4.07	0.327
Personal Servics	150	0.18	0.228**	2.11	0.170
Construction	150	0.20	0.606***	5.28	0.340
Food and Kindred Products	150	0.20	0.485***	3.51	0.325
Lumber and Wood Products	145	0.21	1.081***	3.77	0.164
Textile Mill Products	145	0.29	0.606***	3.52	0.264
Agriculture, Forestry, Fisheries	149	0.36	0.482***	2.87	0.333

**$p < 0.05$, ***$p < 0.01$

Table A11 – First-differenced regression coefficients
Sample – non-Hispanic, white, native born workers (NHW)

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Hedonic Value)	0.055***		0.120**	
	(3.19)		(2.29)	
Δln(Hedonic Rent)		0.106***		0.273**
		(3.16)		(2.45)
Δln(Population)	-0.071**	-0.090**	0.008	-0.042
	(1.91)	(2.34)	(0.09)	(0.46)
Δln(Manufacturing)	-0.193***	-0.195***	-0.244**	-0.233**
	(4.32)	(4.48)	(2.06)	(2.01)
Δln(Professional Services)	0.069	0.049	0.217	0.225
	(0.48)	(0.38)	(0.67)	(0.75)
Δln(Retail Trade)	0.092	0.077	0.024	0.017
	(1.00)	(0.83)	(0.10)	(0.07)
Year 1990	0.234***	0.212***	0.458***	0.397***
	(24.43)	(15.18)	(17.88)	(10.22)
Year 2000	0.110***	0.113***	0.213***	0.227***
	(9.22)	(8.96)	(6.95)	(6.74)
Intercept	0.127***	0.118***	0.384***	0.345***
	(4.85)	(4.44)	(6.19)	(4.94)
Adj R^2	0.840	0.839	0.754	0.757

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A12 – First-differenced regression coefficients
Sample – Hispanic workers of any nativity

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Hedonic Value)	-0.161*		-0.252*	
	(1.97)		(1.77)	
Δln(Hedonic Rent)		-0.341**		-0.559**
		(2.49)		(2.06)
Δln(Population)	-0.433***	-0.397***	-0.731***	-0.669***
	(2.99)	(2.72)	(2.99)	(2.74)
Conc_Rel_L1	0.072***	0.075***	0.138***	0.142***
	(5.88)	(6.10)	(6.38)	(6.62)
Δln(Manufacturing)	-0.205	-0.171	-0.476	-0.434
	(1.05)	(0.90)	(1.27)	(1.20)
Δln(Professional Services)	0.248	0.268	0.378	0.374
	(0.46)	(0.53)	(0.38)	(0.38)
Δln(Retail Trade)	0.040	0.098	0.008	0.078
	(0.10)	(0.27)	(0.01)	(0.12)
Year 1990	0.108**	0.190***	0.034	0.171
	(2.53)	(3.27)	(0.44)	(1.47)
Year 2000	-0.241***	-0.249***	-0.485***	-0.502***
	(4.79)	(5.08)	(5.71)	(5.89)
Intercept	0.188*	0.232**	0.351*	0.433**
	(1.83)	(2.20)	(1.95)	(2.24)
Adj R^2	0.439	0.440	0.408	0.411

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A13 – 2SLS regression coefficients
Sample – non-Hispanic, white, native born workers (NHW)

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Median Value)	0.067		0.108	
	(0.77)		(2.65)	
Δln(Median Rent)		0.044		0.070
		(0.77)		(0.48)
Δln(Population)	-0.050	-0.059	0.058	0.044
	(1.19)	(1.45)	(0.48)	(0.42)
Δln(Manufacturing)	-0.175*	-0.231***	-0.253	-0.343***
	(1.67)	(4.53)	(0.53)	(2.62)
Δln(Professional Services)	0.132	-0.035	0.235	-0.032
	(0.42)	(0.26)	(0.94)	(0.10)
Δln(Retail Trade)	0.084	0.024	-0.046	-0.143
	(0.70)	(0.25)	(0.29)	(0.58)
Year 1990	0.227***	0.227***	0.450***	0.450***
	(12.08)	(12.04)	(0.15)	(9.28)
Year 2000	0.095***	0.095***	0.181***	0.181***
	(8.38)	(8.35)	(9.27)	(6.20)
Intercept	0.123**	0.148***	0.396***	0.435***
	(2.12)	(5.04)	(6.20)	(5.80)
Adj R^2	0.842	0.841	0.750	0.751

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A14 – 2SLS regression coefficients
Sample – Hispanic workers of any nativity

Dependent Variable ->	Δln(SIR) (1)	Δln(SIR (2)	Δln(SIR_41) (3)	Δ(SIR_41) (4)
Δln(Median Value)	-0.441		-0.739	
	(1.13)		(1.36)	
Δln(Median Rent)		-0.308		-0.515
		(1.23)		(1.68)
Δln(Population)	-0.613***	-0.533	-1.015**	-0.882***
	(2.91)	(3.03)	(1.02)	(1.09)
Conc_Rel_L1	0.072	0.078***	0.136***	0.147***
	(4.66)	(5.80)	(2.59)	(2.66)
Δln(Manufacturing)	-0.610	-0.135	-1.171	-0.376
	(1.04)	(0.59)	(4.75)	(5.78)
Δln(Professional Services)	-1.123	0.103	-1.936	0.117
	(0.69)	(0.17)	(1.07)	(0.87)
Δln(Retail Trade)	0.082	0.421	0.033	0.600
	(0.15)	(0.99)	(0.64)	(0.10)
Year 1990	0.182*	0.182**	0.162	0.162
	(1.94)	(2.12)	(0.03)	(0.75)
Year 2000	-0.174***	-0.174***	-0.382***	-0.382***
	(3.41)	(3.72)	(0.93)	(1.00)
Intercept	0.378	0.223*	0.678	0.420*
	(1.41)	(1.68)	(4.03)	(4.33)
Adj R^2	0.390	0.434	0.368	0.406

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$
Absolute value of t-statistics in parentheses
Cross section observations: 50
Time series = 3: 1980-1990, 1990-2000, 2000-2009

Table A15.a – Effect size of decadal growth rates (percents) in explanatory variables
Skill Intensity Measure – SIR (Hispanic)

	Elasticity	Growth Rate		Effect		Relative Effect	
		Mean	Dev.	Mean	Dev.	Mean	Dev.
House Cost Measures							
Median Value	−0.136	67.5	30.6	−9.2	−4.2	−46.2	−18.3
Hedonic Value	−0.271	69.3	27.8	−18.8	−7.5	−94.5	−33.0
Median Rent	−0.161	56.4	12	−9.1	−1.9	−45.7	−8.5
Hedonic Rent	−0.341	59.7	13.3	−20.4	−4.5	−102.5	−19.9
Conditioning Variables							
Population	−0.437	16.2	10.3	−7.1	−4.5	−35.7	−19.8
Manufacturing	−0.178	−19.5	6	3.5	−1.1	17.6	−4.7
Professional Services	0.271	13.1	3.5	3.6	0.9	18.1	4.2
Retail Trade	0.072	2.5	3.5	0.2	0.3	1.0	1.1
Skill Intensity Ratio							
SIR (Hispanic)		19.9	22.8				

Table A15.b – Effect size of decadal growth rates (percents) in explanatory variables
Skill Intensity Measure – SIR_41 (Hispanic)

	Elasticity	Growth Rate		Effect		Relative Effect	
		Mean	Dev.	Mean	Dev.	Mean	Dev.
Housing Cost Measures							
Median Value	−0.197	67.5	30.6	−13.3	−6.0	−66.8	−26.4
Hedonic Value	−0.388	69.3	27.8	−26.9	−10.8	−135.1	−47.3
Median Rent	−0.252	56.4	12	−14.2	−3.0	−71.4	−13.3
Hedonic Rent	−0.559	59.7	13.3	−33.4	−7.4	−167.7	−32.6
Conditioning Variables							
Population	−0.736	16.2	10.3	−11.9	−7.6	−59.9	−33.2
Manufact Share	−0.430	−19.5	6	8.4	−2.6	42.1	−11.3
Pro Services Share	0.429	13.1	3.5	5.6	1.5	28.2	6.6
Retail Share	0.068	2.5	3.5	0.2	0.2	0.8	1.0
Skill Intensity Ratio							
SIR_41 (Hispanic)		52.0	56.0				

B Data

B.1 Source

The data used in this paper are drawn from the five percent Public Use Microdata Samples (PUMS) of the 1980, 1990, and 2000 decennial censuses, and the pooled 2007 to 2011 American Community Survey (ACS). The data were downloaded from the Integrated Public Use Microdata Series (IPUMS) at the Minnesota Population Center (Ruggles et al., 2010). For expositional ease, the ACS data are referred to as the 2009 data, indicating the year on which the five year period is centered.

B.2 Sample Selection

The standard universe for labor force analysis consists of the civilian noninstitutional population ages 16 and older. For the purposes of this paper, the sample is further restricted to employed adults, ages 18 to 64, living in private, permanent residential housing in the lower 48 states and the District of Columbia. Specifically, the following exclusion criteria are applied to the five percent PUMS: 1) aged 18-64, 2) worked at least one week in year prior to census, 3) positive usual hours worked, 4) not in Hawaii or Alaska, 5) not in military, 6) not in school, 7) not living in group quarters, 8) no negative self-employment income, and no residence in mobile home, trailer, tent, boat, van, or farm.

B.3 Earnings

Income is the sum of wage and salary income and non-farm self-employment income. Self-employment income is included in income calculations following Jaeger (2007) because share of workers with this type of income is changing at different rates across the race/ethnicity categories. Hourly wage is defined as the sum of wage, salary, and self employment income divided by total hours worked, where total hours worked is equal to the number of weeks worked times the usual number of hours worked per week. The 2007-2011 ACS data report weeks worked in intervals. Following Borjas (2014), weeks worked are imputed based on mean values in the 2000-2007 ACS as follows: 7.4 weeks for 13 weeks or less, 21.3 for 14-26 weeks, 33.1 for 27-39 weeks, 42.4 for 40-47 weeks, 48.2 for 48-49 weeks, and 51.9 for 50-52 weeks.

B.4 Topcoding

Whenever possible, the analyses in this paper utilize median values to avoid issues associated with top coding. The one exception is the hedonic rent and value equations described in section 6.5. Here, top coded observations are replaced by 1.5 times the top-coded value. To make the top codes for gross rent and owner's estimate of value consistent over time, the lowest real top value across the four censuses is applied to data for each survey year. In other words, some data that were not censored in the existing data have been top coded, in order to avoid introducing biases into the analyses from changes in the top coding regime.

B.5 Skill Categories

In the 1980 data, educational attainment is based on years of schooling. For subsequent years, due to changes in Census Bureau survey questions, attainment is based differently on a combination of years of schooling and receipt of degree. For consistency over time, workers are classified into five skill groups based on a classification scheme suggested by Jaeger (1997): 1) drop out (less than 12 years of schooling), 2) high school (= 12 years), 3) some college (13-15 years), 4) college (BA or exactly 16 years), and 5) post-college (advanced degree or greater than 16 years). The tradeoff for temporal consistency, is that the 12th grade category includes respondents who have completed 12 years of schooling but lack a diploma, and the college category includes respondents who have completed 16 years of schooling but lack a bachelor's degree.

Based on these skill categories, seven skill intensity ratios and seven analogous skilled wage ratios are estimated by locality for three populations examined in the paper: native born whites of non-Hispanic ancestry, Hispanics of any race, nativity, and ancestry, and Hispanics of Mexican origin.

In the baseline SIR and SWR measures, the skilled worker group in the numerator includes not only workers with at least a bachelor's degree, but also a share of those with some college (i.e., 1-3 years) but not a BA, while the low skill group in the denominator consists of everyone else. The inclusion of a fraction of respondents with some college in a "college equivalent" category is a common practice originating, it seems, with Katz and Murphy (1992). The fraction is determined by regressing the median wage of the group with some college on that of the high school and college categories. If the median wage of a worker ($\ddot{Y}_{jt(\text{Some})}$) with some college is thought of as a linear combination of the median wages of workers with high school ($\ddot{Y}_{jt(\text{HS})}$) and college ($\ddot{Y}_{jt(\text{Collg})}$) diplomas, then parameter estimates indicate the weights should be 0.37 for college and 0.63 for high school workers, respectively.[17]

$$\ddot{Y}_{jt(\text{Some})} = -\underset{(3.69)}{0.24} + \underset{(12.77)}{0.63\ddot{Y}_{jt(HS)}} + \underset{(13.37)}{0.37\ddot{Y}_{jt(\text{Collg})}}$$

B.6 Geography

During the period examined by this paper, the Census Bureau utilized multiple taxonomies and geographic definitions to code metropolitan areas. Because this study uses panel methods with metro area as the unit of analysis, geographic definitions must be held constant over time. Otherwise, the same household could be observed in different cities across census periods without ever having moved.[18]

[17] Adj $R^2 = 0.99$. Cross sections = 50 largest metropolitan areas based on 2009 population. Time series = 4: 1980, 1990, 2000, and 2009.

[18] Respondents residing in San Francisco and Oakland, for example, have the same metro area code in 1980. However, the residents of Oakland get a different code in 1990. Without accounting for this change, the population of San Francisco appears to plummet from 1980 to 1990 and the demographics of the city alter dramatically

Using a procedure outlined by Jaeger, Loeb, Turner, and Bound (1998) and updated by Beeson, Shore-Sheppard, and Watson (2010), consistently defined metro areas can be constructed by aggregating geographic subunits – county groups for 1980, and Public Use Microareas (PUMAs), thereafter – for the 132 cities with 1990 populations in excess of 250,000. The metro areas defined using the Jaeger-Shore-Sheppard procedure tend to have larger populations than the official OMB entities. However, because the number of skilled Hispanic workers meeting the sample exclusion criteria is so limited, particularly in the early years of the study period, the sample includes just the 50 largest cities in 2009. When the sample is restricted to Hispanics of Mexican origin, the number of cities is further reduced from 50 to 30.

B.7 Weighting

The 1980 and 2000 data are five percent random samples of the population. The 1990 and 2009 data are five percent non-random samples. The sampling weights PERWT and HHWT provided by the Census Bureau are used to obtain representative statistics at the person and household levels, respectively.

All regressions in the paper utilize analytical weights given the substantial differences across locations in sample sizes used to estimate the analysis variables. Because estimation is in first differences, the weights are calculated as the sum of the inverse of the sample size for the two samples used to create each skilled wage or skill intensity ratio, $(1/N_{jt}+1/N_{j,t-10})^{-0.5}$, where N_{jt} indicates the sample size for a race/ethnicity group in city j at time t.

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