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Why has regional income convergence in the U.S. declined?

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ABSTRACT

The past thirty years have seen a dramatic decline in the rate of income convergence across states and in population flows to high-income places. These changes coincide with a disproportionate increase in housing prices in high-income places, a divergence in the skill-specific returns to moving to high-income places, and a redirection of low-skill migration away from high-income places. We develop a model in which rising housing prices in high-income areas deter low-skill migration and slow income convergence. Using a new panel measure of housing supply regulations, we demonstrate the importance of this channel in the data.

1. Introduction

The convergence of per-capita incomes across US states from 1880 to 1980 is one of the most striking patterns in macroeconomics. For over a century, incomes across states converged at a rate of 1.8% per year. Over the past thirty years, this relationship has weakened dramatically, as shown in Fig. 1.[1] The convergence rate from 1990 to 2010 was less than half the historical norm, and in the period leading up to the Great Recession there was virtually no convergence at all.

Fig. 1 also plots what we call “directed migration”: the relationship between population growth and income per capita across states. Prior to 1980, people were moving on net from low-income places to high-income places. Like convergence, this historical pattern has declined over the last thirty years.

To better understand the decline of income convergence and directed migration, this paper makes three contributions to the regional economics literature. First, we document that increased housing prices have differential effects on the returns to migration and the migration flows of low- and high-skill workers. Second, we develop a model which shows that changes in the elasticity of housing supply in high-income places can explain the decline in directed migration and income convergence. Third, we construct a novel panel measure of land use regulations, which are a determinant of the housing supply elasticity, and use it to empirically confirm predictions from the model.

The mechanism we propose for explaining the decline in income convergence can be understood through an example. Through most of the twentieth century, both janitors and lawyers earned considerably more in the tri-state New York area (NY, NJ, CT) than their colleagues in the Deep South (AL, AR, GA, MS, SC). This was true in both nominal terms, and after adjusting for differences in housing prices.[2] Migration responded to these differences, and this labor reallocation reduced income gaps over time.

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[1] See Barro and Sala-i Martin (1992, 1991), and Blanchard and Katz (1992) for classic references on convergence. For prior work documenting the decline in convergence, see Crain (2003), DiCecio and Gascon (2008), and Berry and Glaeser (2005).

[2] In 1960, wages were 38% and 84% higher in NY than in the Deep South for lawyers and janitors respectively. After adjusting for housing costs (12 times monthly rent or 5% of home value), these premia were 39% and 70%.

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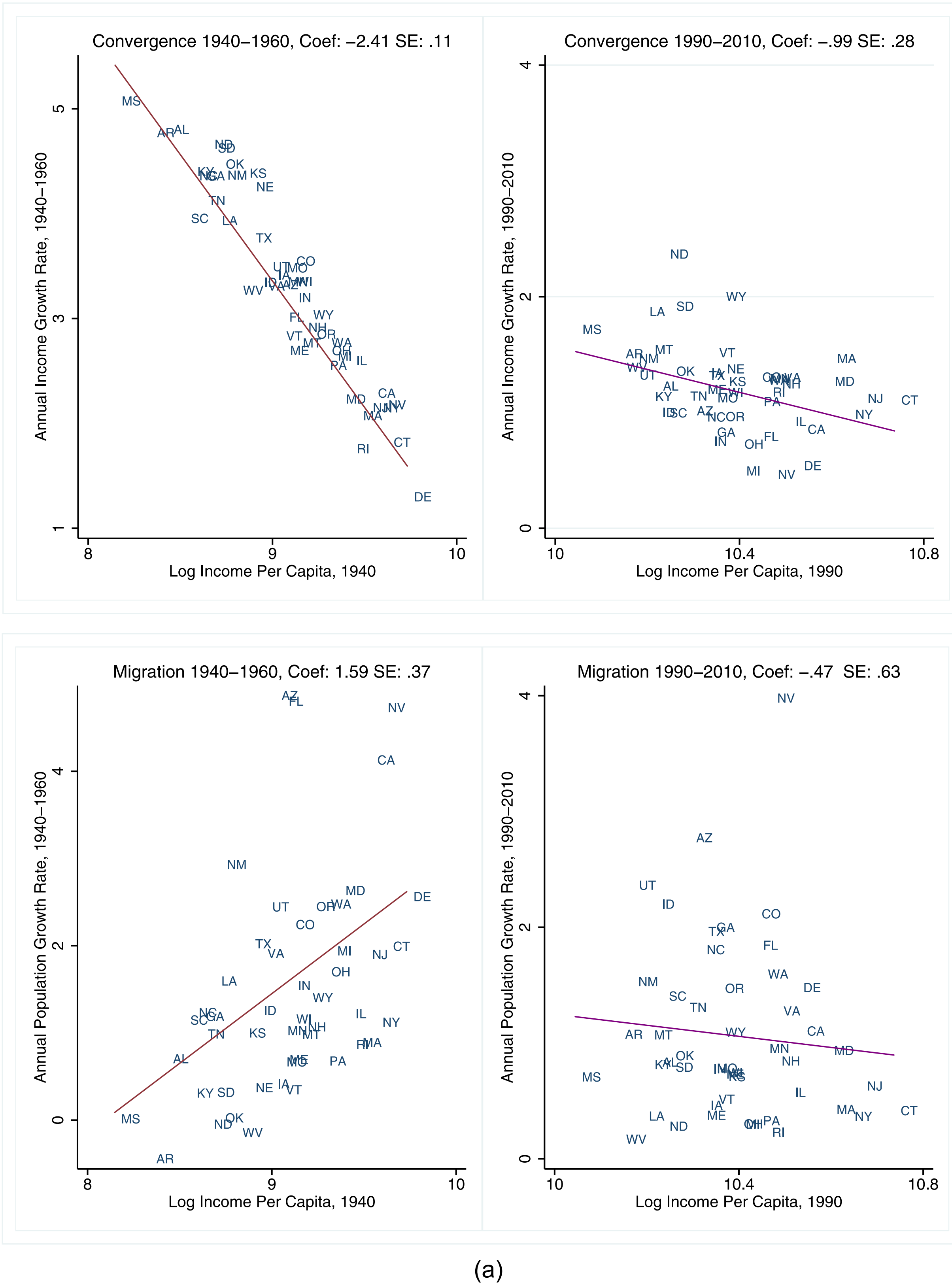
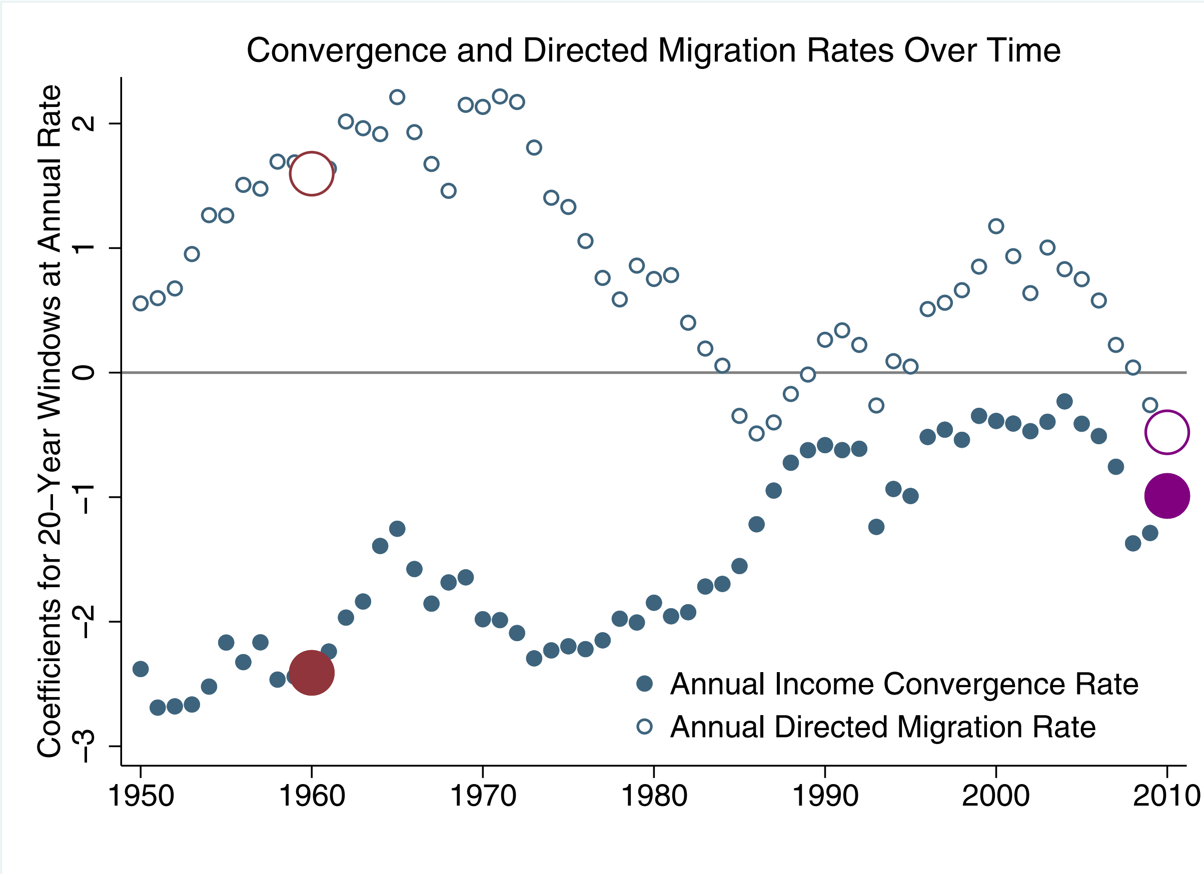


Fig. 1. Decline of income convergence and directed migration. (a) The lines show slopes from linear regressions for 1960 and 2010. (b) This panel shows estimated regression coefficients for every twenty-year window from 1950 to 2010. The larger circles reflect slopes for 1960 and 2010.



(b)

Fig. 1. Continued

Today, though nominal premiums to being in the New York area are large for these two occupations, the high costs of housing in the New York area have changed this calculus. Lawyers continue to earn much more in the New York area in both nominal terms and net of housing costs, but janitors now earn *less* in the New York area after subtracting housing costs than they do in the Deep South.[3] This sharp difference arises in part because for lawyers in the New York area, housing costs are equal to 21% of their income, while housing costs are equal to 52% of income for New York area janitors. While it may still be worth it for lawyers to move to New York, high housing prices offset the nominal wage gains for janitors.

Our paper's first contribution is to show that the patterns described above for janitors and lawyers generalize to all low- and high-skill workers. Prior research shows that income differences across states have been increasingly capitalized into housing prices in the last fifty years (Van Nieuwerburgh and Weill, 2010; Glaeser et al., 2005b; Gyourko et al., 2013). We calculate the gains to moving separately by skill group in terms of income net of housing costs using Census data. Through most of the twentieth century, the returns net of housing costs to migrating from a low-income place to a high-income place were similar for low- and high-skill workers. However, low-skill workers spend a larger fraction of their income on housing. For these low-skill workers, rising house prices have eroded the gains from migration. We document that migration flows have responded to these changing returns to migration. In the mid-twentieth century, low- and high-skill workers moved from low-income to high-income places. In recent years, as high-skill workers move to high-income places, low-skill workers leave. We call this phenomenon "skill sorting".

We build a model to formalize the mechanism by which directed migration could have driven income convergence in the past, and to explore the consequences of increased land use regulations for directed migration and convergence. Our model analyzes two locations that have a fixed difference in productivity. When the population in the more productive location rises, the marginal product of labor falls due to downward-sloping labor demand. When the local housing supply is unconstrained, workers of all skill types will choose to move to the more productive location. This migration pushes down wages and skill differences, generating income convergence. Low-skill workers are more sensitive to changes in housing prices. When housing supply becomes constrained in the productive area, the model makes three predictions: (1) total migration to the productive location is reduced, (2) migration of low-skill workers in particular slows, and (3), as a result of the first two changes in migration, income convergence slows.

To test the model, we construct a new panel measure of land use regulation. Our measure is a scaled count of the number of appeals and supreme court decisions for each state that mention "land use," as tracked through an online database. We validate this measure of regulation using existing cross-sectional survey data. To the best of our knowledge, this is the first national panel mea-

[3] In nominal terms, the wages of lawyers and janitors are 46% and 28% higher in the New York area respectively in 2010. After adjusting for housing prices, these premia are 39% and −7%.

sure of land use regulations in the US.[4] We show that tight land use regulations weaken the historic link between high incomes and new housing permits. Instead, income differences across places become more capitalized into housing prices.

Using differential regulation patterns across states, we show that the impact of housing supply limits in the data matches the three predictions from the model. Constrained housing supply reduces total migration to high-income areas. Net migration of workers of all skill types from low-income to high-income places is replaced by skill sorting. Finally, income convergence persists among places unconstrained by these regulations, but it is diminished in areas with supply constraints.

To assess whether housing supply constraints are causing a reduction in income convergence, and not the other way around, we conduct two tests. First, we use a state's historical tendency to regulate land use as measured by the number of land use cases per capita around 1965. We use this measure of regulations because it predates the decline in income convergence, which occurred around 1980. We find that income convergence rates fell after 1985, but only in those places with a high tendency to regulate land use. Second, we repeat this exercise using another predetermined measure based on geographic land availability from Saiz (2010). Again, we find income convergence declined the most in areas with supply constraints.

In this paper, we highlight a single channel – labor mobility – which can help explain both regional income convergence through 1980 and its subsequent disappearance from 1980 to 2010. Much of the literature on regional convergence has focused on the role of capital, racial discrimination, or sectoral reallocations.[5] We build on an older tradition of work by economic historians (Easterlin, 1958; Williamson, 1965) as formalized by Braun (1993), in which directed migration drives convergence. Finally, much of the existing literature on regional patterns since 1980 in the U.S. emphasizes changes in labor demand from skill-biased technological change and trade (Autor and Dorn, 2013; Diamond, 2016; Artuç et al., 2010). In contrast, our channel emphasizes the role of housing supply constraints.

The study of regional convergence is also important for understanding trends in inequality. From 1940 to 1980, the standard deviation of hourly earnings (a common measure of inequality) significantly declined. We calculate that cross-state convergence in wages accounted for 34% of this drop.[6] Had convergence continued apace through 2010, implementing the same methodology indicates that the increase in hourly wage inequality from 1980 to 2010 would have been 8% smaller. Thus, our results imply that forces such as housing regulation that slow regional convergence also increase inequality.

The remainder of the paper proceeds as follows. In Section 2, we show that increased housing prices have differential impacts on low- and high-skill workers. In Section 3, we develop a model where directed migration drives convergence and an increase in housing supply constraints changes migration patterns and reduces convergence. Section 4 introduces a new measure of land use regulation, and directly assesses its impact on convergence, and Section 5 concludes.

2. Motivating facts on housing prices and migration

Fig. 1 shows a dramatic reduction in income convergence as well as in directed migration from low-income to high-income places.[7] In this section, we show that changes in housing prices may be reducing directed migration and changing its composition in ways that could impact convergence using three stylized facts. Specifically, we show (1) a disproportionate rise in housing prices in high-income areas; (2) that the returns to migrating to high-income areas for low-skill workers has fallen in recent years after taking into account housing costs; and (3) that low-skill workers have redirected their migration away from high-income places. At the end of the section, we discuss how these changes in migration flows may affect income convergence.

We construct these three facts using public data from the Census for each decade from 1940 to 2000 and the American Community Survey for 2006–2010 to capture 2010 (Ruggles et al., 2010).[8] In each year, we observe household wage income, monthly rent or self-reported home value, education, sex, race, age, location of residence today and location of residence five years ago. In this section, we analyze two measures of state-level income: nominal wage income for the entire population and income net of housing costs, which is computed separately by skill group. In order to estimate annual housing costs for the entire population, we use 12 times the monthly rent or 5% of home value for homeowners.[9] Our analysis focuses on states in the continental U.S., omitting Hawaii and Alaska.

Fact 1 The first fact is that differences in housing prices have doubled relative to differences in incomes. This fact has been documented in prior work by Van Nieuwerburgh and Weill (2010), Glaeser et al. (2005b), and Gyourko et al. (2013). The top two panels of Fig. 2 plot the relationship between log income and log housing prices in 1960 and 2010. Each observation is a state's mean income and median house value from the Census. In 1960, housing prices are 1 log point higher in a state with 1 log point higher income. By 2010, the slope doubles, with housing prices 2 log points higher in a state where income is 1 log point higher. The bottom panel of Fig. 2 shows that the patterns from 1960 and 2010 reflect a secular trend towards higher capitalization of income differences into housing prices. This increased capitalization may lower the return to migration from a low-income place to a high-income place.

Fact 2 The second fact is that housing prices have specifically lowered the return to migration for low-skill workers. Our goal is to test whether the difference in income less housing cost between high-income and low-income states is smaller for low-skilled workers than for high-skilled workers. To establish this fact, we regress:

$$\underbrace{Y_{ij} - C_{ij}}_{\text{Income-Housing Cost}} = \alpha + \beta_{low-skill} \underbrace{Y_j}_{\text{Nominal Income}} \times (1 - S_{ij}) + \beta_{high-skill} Y_j \times S_{ij} + \eta S_{ij}$$

[4] Prior work has examined housing price changes, quantity changes, and cross-sectional measures of regulation to provide suggestive evidence of increasing supply constraints (Sinai, 2010; Glaeser et al., 2005a; 2005b; Quigley and Raphael, 2005; Glaeser and Ward, 2009).

[5] See Barro and Sala-i Martin (1992), Caselli and Coleman, 2001), Michaels et al. (2012), and (Hsieh et al., 2013).

[6] From 1940 to 1980, the standard deviation of log hourly wages for adult males working full-time fell from 0.781 to 0.618, which is a drop of 0.163. Over the same period, the standard deviation of state-level means for log hourly wages fell from 0.300 to 0.106, which is a 65% drop in cross-state inequality. In the absence of regional convergence, we assume that the distribution of wages would have been $Y^{\text{indiv}}_{\text{no conv},80} = Y^{\text{indiv}}_{\text{data},80} + Y^{\text{state}}_{40,\text{ no conv}} - Y^{\text{state}}_{80,\text{no conv}} = Y^{\text{indiv}}_{\text{data},80} + Y^{\text{state}}_{40,\text{ no conv}} - 0.35 Y^{\text{state}}_{40,\text{no conv}}$. We calculate that $Var(Y^{\text{indiv}}_{\text{no conv},1980})/Var(Y^{\text{indiv}}_{1940})$ is 34% smaller than $Var(Y^{\text{indiv}}_{1980})/Var(Y^{\text{indiv}}_{1940})$.

[7] The decline in income convergence is robust to the choice of income measure and level of geographic aggregation (Online Appendix Table 1). The decline in directed migration is robust to the choice of migration measure and level of geographic aggregation (Online Appendix Table 2).

[8] We omit 1950 because no housing cost data are available in that year.

[9] About two-thirds of households are homeowners and so if we used rent alone to estimate housing costs, we would miss most of the U.S. population. Van Nieuwerburgh and Weill (2010) and Gyourko et al. (2013) similarly use housing values as their primary measure of housing costs.

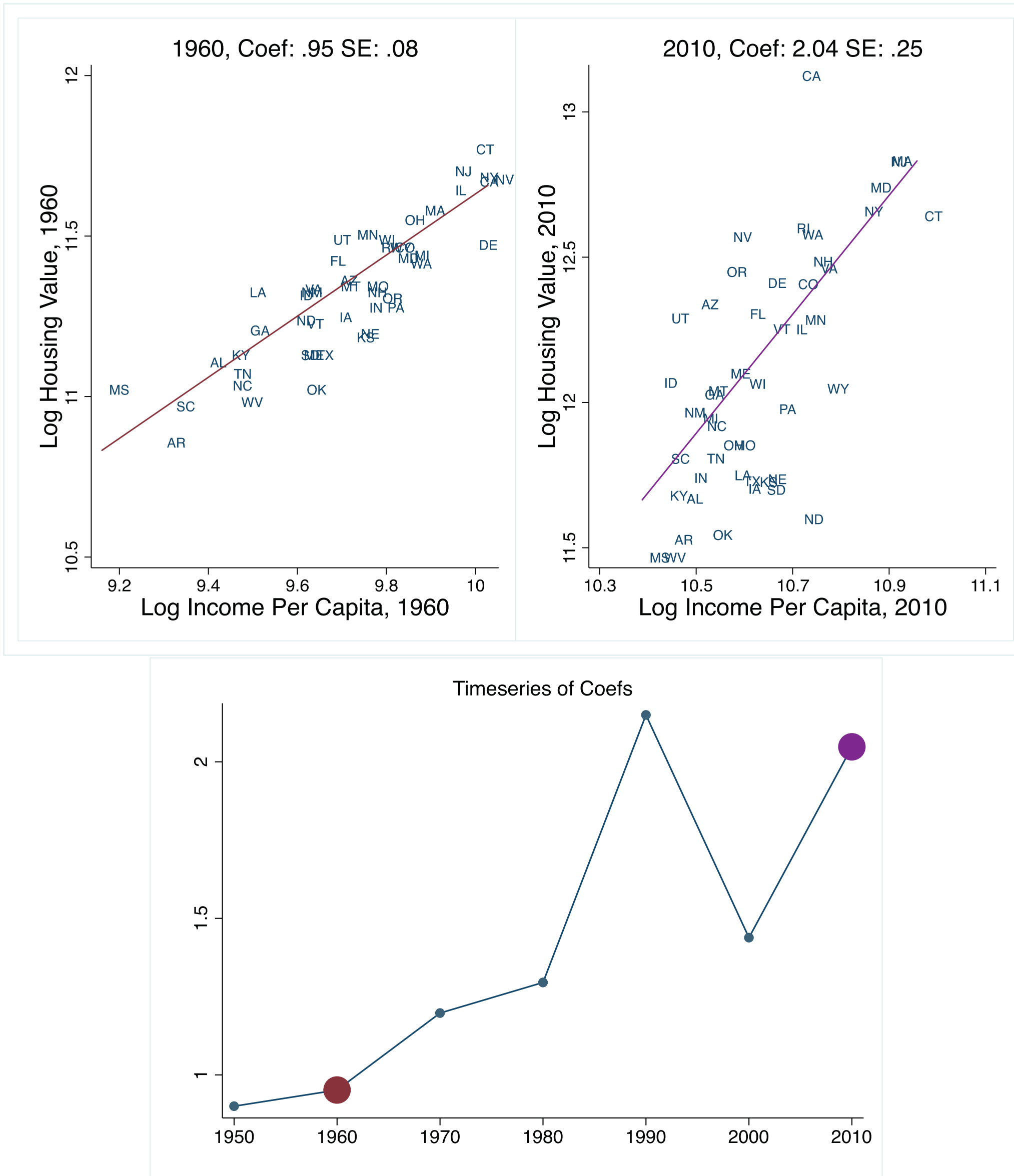


Fig. 2. Rising prices in high-income states. *Notes:* The first two panels regress median housing value on BEA income per capita at the state level. The third panel plots coefficients from 20-year rolling windows. The larger dots correspond to the coefficients from the first two panels.

$$+\gamma X_{ij} + \varepsilon_{ij} \tag{1}$$

with i indexing households, j indexing state of residence, where Y_{isj} is household wage income, C_{ij} is a measure of housing costs, and S_{ij} is the share of the labor force participants in the household that are high-skill, and Y_j is the mean nominal wage income in the state.[10] We use a regression because it enables us to collapse the returns to migrating between many pairs of U.S. states into a single summary statistic. The interpretation of the $\beta_{low-skill}$ coefficient is that when average nominal income is $1.00 higher in a state, it estimates how much higher is income for low-skill workers after housing costs. $\beta_{high-skill}$ has the same interpretation for high-skill workers. We report results from this regression separately for each decade.

Fig. 3 shows that the return to migration to high-income states for low-skill workers has eroded in recent years.[11] $\beta_{low-skill}$ shows a secular decline from 1970 forward. The decade-specific coefficients on $\beta_{high-skill}$ show, if anything, a slight increase during the same time period. In 1940 and 1960, high-skill and low-skill households have similar returns to migrating. By 2010, income net of housing costs is three times more responsive to nominal in-

[10] Income net of housing cost is a household-level variable, while education is an individual-level variable. We conduct our analysis at the household level, measuring household skill using labor force participants ages 25–65. A person is defined as high-skill if he or she has 12+ years of education in 1940, and 16+ years or a BA thereafter. The household covariates X_{ij} are the size of the household, the fraction of household members in the labor force who are white, the fraction who are black, the fraction who are male, and a quadratic in the average age of the adult household members in the workforce.

[11] We report coefficients from estimating Eq. (1) in Online Appendix Table 3 and depict the results visually in Fig. 3. To reduce the bias arising from the endogeneity of state of residence, we also provide instrumental variables estimates using the mean income level of the household workers' state of birth as an instrument in Online Appendix Table 3. We estimate $Y_{ij} - P_{ij} = \alpha + \beta_{low-skill}\hat{Y}_j \times (1 - S_{ij}) + \beta_{high-skill}\hat{Y}_j \times S_{ij} + \eta S_{ij} + \gamma X_{ij} + \varepsilon_{ij}$, using $Y_{j,\, birth}$ and $Y_{j,\, birth} \times S_{js}$ as instruments for the two endogenous variables $\hat{Y}_j \times (1 - S_{ij})$ and $\hat{Y}_j \times S_{ij}$. This lessens the likelihood that the apparently greater premia for high-skill workers are an artifact of greater within-group sorting via migration.

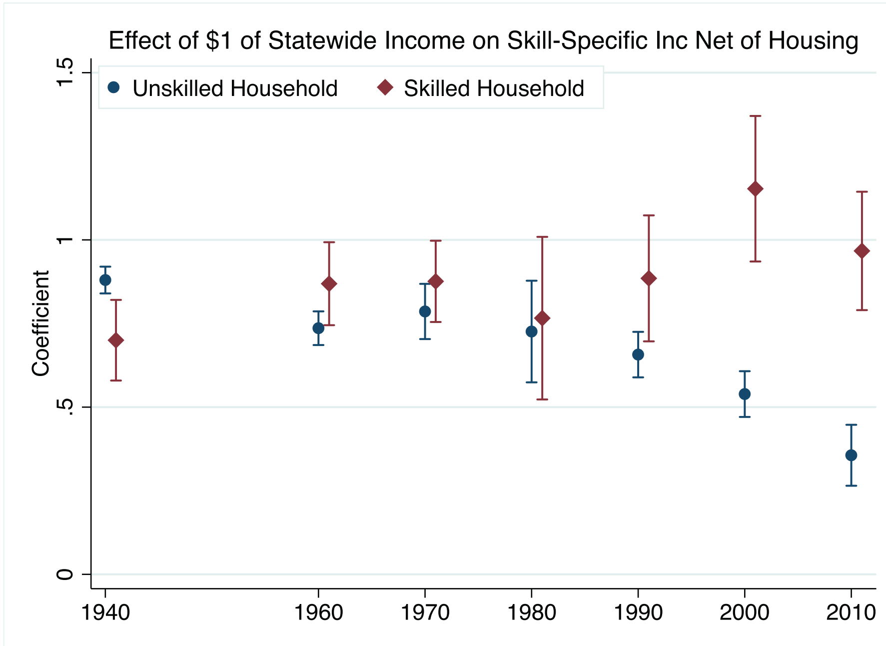


Fig. 3. Returns to migration: skill-specific income net of housing cost. *Notes:* This figure plots the relationship between unconditional mean household income and mean skill-specific income net of housing costs for several decades. The regression in each year is $Y_{ij} - P_{ij} = \alpha + \beta_{low-skill} Y_j \times (1 - S_{ij}) + \beta_{high-skill} Y_j \times S_{ij} + \eta S_{ij} + \gamma X_{ij} + \varepsilon_{ij}$ for households with at least one labor force participant aged 25–65. Housing costs are defined as 5% of house value for homeowners and 12X monthly rent for renters. No coefficient is reported from 1950 because the public use Census data for this year does not include housing cost data. High-skill households are defined as households in which all adult workers have 12+ years of education in 1940 or 16+ years of education thereafter and low-skill households are defined as households in which no worker adult worker has this level of education. Mixed skill-type households, which range from 2%-14% of households, are dropped from the regression sample, but not from the construction of unconditional state average income. Vertical bars indicate 95% confidence intervals. See Section 2 for details.

come differences by state for high-skill households than for low-skill households. Relying on Fact 1 alone, one might have thought that increased housing prices would erode the returns to migration for all workers. However, Fact 2 shows that the returns to migration have remained constant for high-skill workers and fallen only for low-skill workers. Next, we use nominal income and income net of housing costs as independent variables to explain migration flows.

Fact 3 The third fact is that while workers of both skill levels used to migrate on net to high-income areas, today low-skill workers migrate in reverse, away from high-income areas.[12] To document this fact, we regress a measure of area-level net migration on two measures of area-level income. We do this exercise separately for low-skill and high-skill workers.[13] We use the most detailed geographies for which migration data are available: State Economic Areas (SEA) in 1940 (467 regions) and migration Public Use Microdata Areas (PUMA) in 2000 (1,020 regions). Net migration is defined for people ages 25–65 as the number of people who have moved in minus the number of people who have moved out, as a percent of the total population. To estimate area-level income, we construct income using the same approach as we did for Fact 2. In order to capture the incomes of incumbents, we use only households that did not migrate.

The top panel of Fig. 4 shows that from 1935 to 1940, net migration moved people from places with low nominal income to places with high nominal income. This fact holds for low-skill and high-skill workers. This demonstrates that directed migration documented in Fig. 1 from low-income to high-income places can be replicated separately for low-skill and high-skill workers using detailed substate geographies. The bottom panel of the figure demonstrates that same relationship holds true for income net of housing cost.[14]

The top panel of Fig. 5 shows that from 1995 to 2000, high-skill adults still move to high-income locations, but net migration for low-skill adults *reverses* such that they are actually weakly migrating away from these locations.[15] Thus, Fig. 5 reveals that the absence of directed migration on average from low-income to high-income places documented in Fig. 1 masks important heterogeneity. High-skill workers are moving to high-income places, low-skill workers are moving away, and the net effect summing across skill groups is that on average, there is zero directed migration.

Low-skill workers' decision to move away from high-income places can be explained by taking into account the returns to moving as measured by income net of housing costs. The bottom panel

[12] The analysis in this paper focuses on net migration from places with persistently low income to places with persistently high income. For analysis of net migration in response to business cycle fluctuations, see Blanchard and Katz (1992), Dao et al. (2015), and (Yagan, 2016). For an analysis of the secular decline in gross migration, which is the fraction of people who moved in the past year, see Kaplan and Schulhofer-Wohl (2017) and Molloy et al. (2011). Because gross migration is an order of magnitude larger than net migration, gross migration remains sufficiently high today to allow for substantial net migration from low-income places to high-income places.

[13] To construct area-by-skill measures, we define households as high-skill if the labor force participants ages 25–65 are high-skill, and as low-skill if none of them are high-skill.

[14] This is a robust statistical relationship. In Online Appendix Table 4, we report four robustness checks: doubling housing costs for the income net of housing cost measure, excluding migrants within-state, using only whites, and using a place of birth migration measure. In 1940, all slopes are positive, and most are statistically significant. In 2000, all slopes are positive and statistically significant for high-skill workers. For low-skill workers, the coefficients broadly fit the patterns in Fig. 5, although only sometimes are statistically significant. These results are similar to work by Borjas (2001), who finds that immigrants move to places which offer them the highest wages.

[15] Young et al. (2008) similarly show that from 2000 to 2006, low-income people migrated out from New Jersey, while high-income people migrated in.

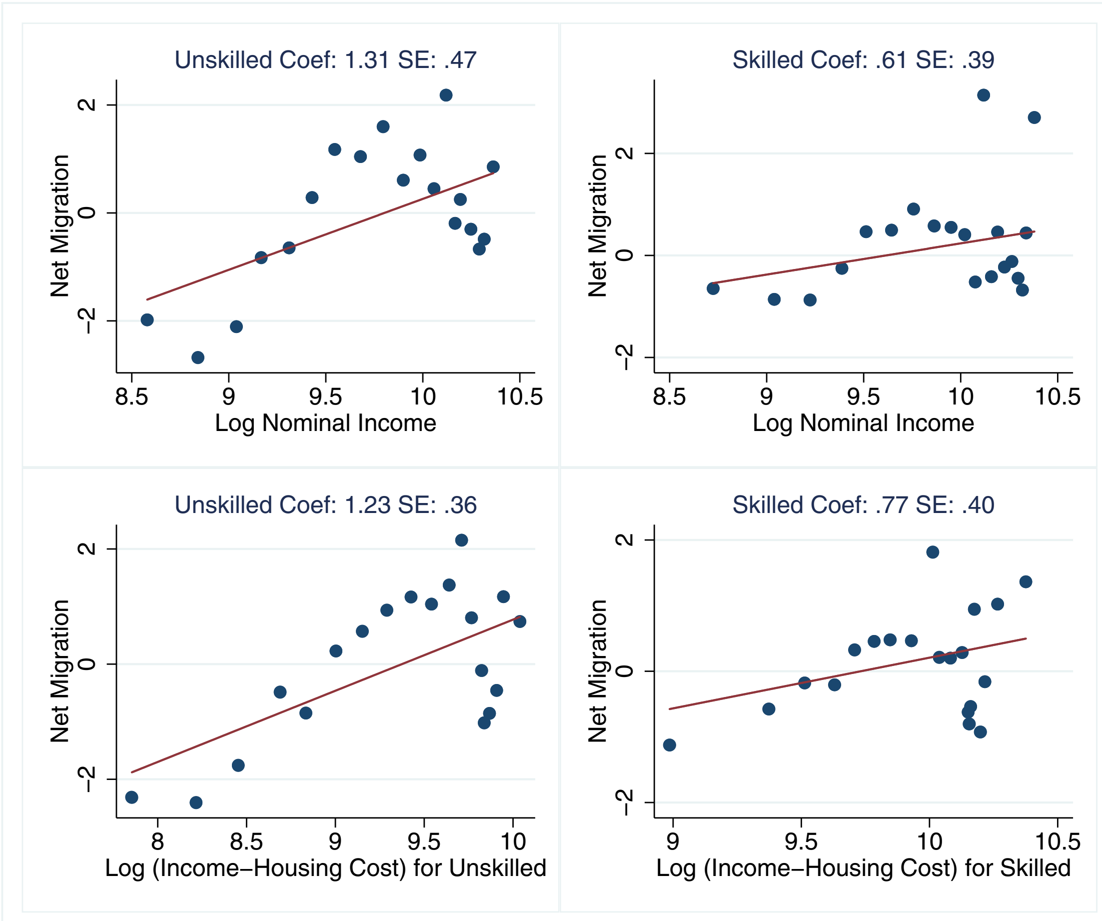


Fig. 4. Net migration flows by skill group: nominal income vs. income net of housing cost, 1935–1940. *Notes:* This figure measures net migration over a five-year horizon as a percent of the population ages 25–65 for 467 State Economic Areas (SEA) in the 1940 Census. Each panel stratifies the SEAs into 20 vingtiles by income, weighting each SEA by its population, and then computes the mean net migration within each vingtile. The two top panels plot net migration against log household wage income in the destination SEA, for individuals with less than 12 years of education (top left) and those with 12+ years (top right). The modest non-linearity amongst high-income places apparent in the 1940 results is due to Chicago and New York, both of which are very large cities that were hit hard by the Great Depression and failed to attract as many migrants as predicted. Standard errors are clustered by state. The two bottom panels plot the net migration rates against log income net of housing costs. See Section 2 for details.

of Fig. 5 shows that when we adjust income to reflect group-specific means net of housing prices, low-skill workers are continuing to move to places that offer *them* high incomes. Recall Fact 2 demonstrates that rising housing prices in high nominal income areas make these areas particularly costly for low-skill workers. Fact 3 demonstrates that these changing returns to migration are accompanied by changing migration destinations for low-skill workers.

Fact 3 shows two distinct channels by which reduced migration of low-skill workers to high-income places reduces income convergence. First, there is a reduction in population growth that may push down wages. Second, in the mid-century U.S., low-skill workers were moving from low-income to high-income places. Later in the paper, we document that this low-skill migration raised the average skill level in low-income places and lowered the average skill level in high-income places.[16] We refer to this channel as "human capital convergence". Consistent with Fact 3, human capital convergence due to migration has fallen in recent years. In the next section, we develop a model where both channels – population growth and human capital convergence – contribute to income convergence.

3. A simple model of regional migration, housing prices, and convergence

To formalize the link between housing markets, skill-specific migration, and convergence, we develop a model of regional economies. In the text of the paper, we present a simple model where downward-sloping regional labor demand curves and non-homothetic housing demand combine to generate migration and convergence patterns similar to those shown in Fig. 1. In Online Appendix A, we present a richer model that we use for quantitative calibration.[17]

Our model considers two locations within a national market: a highly productive "North" and a reservation locale "South." The

[16] Although Fact 3 is informative about the direction of migration, it does not provide a summary statistic that quantifies the change in income due to human capital movements. We develop such a measure later on in Section 4.2. Using this measure, we show that in the mid-twentieth century, interstate migration led to convergence in human capital. However, the rate of human capital convergence has slowed substantially in recent years.

[17] The Online Appendix model delivers the same substantive results as the model in the text of the paper, but it is richer in three ways: it features (1) skill types that are imperfect substitutes in production, (2) agents that hold Stone-Geary preferences over housing and consumption and (3) agents who are forward-looking in their migration decision.

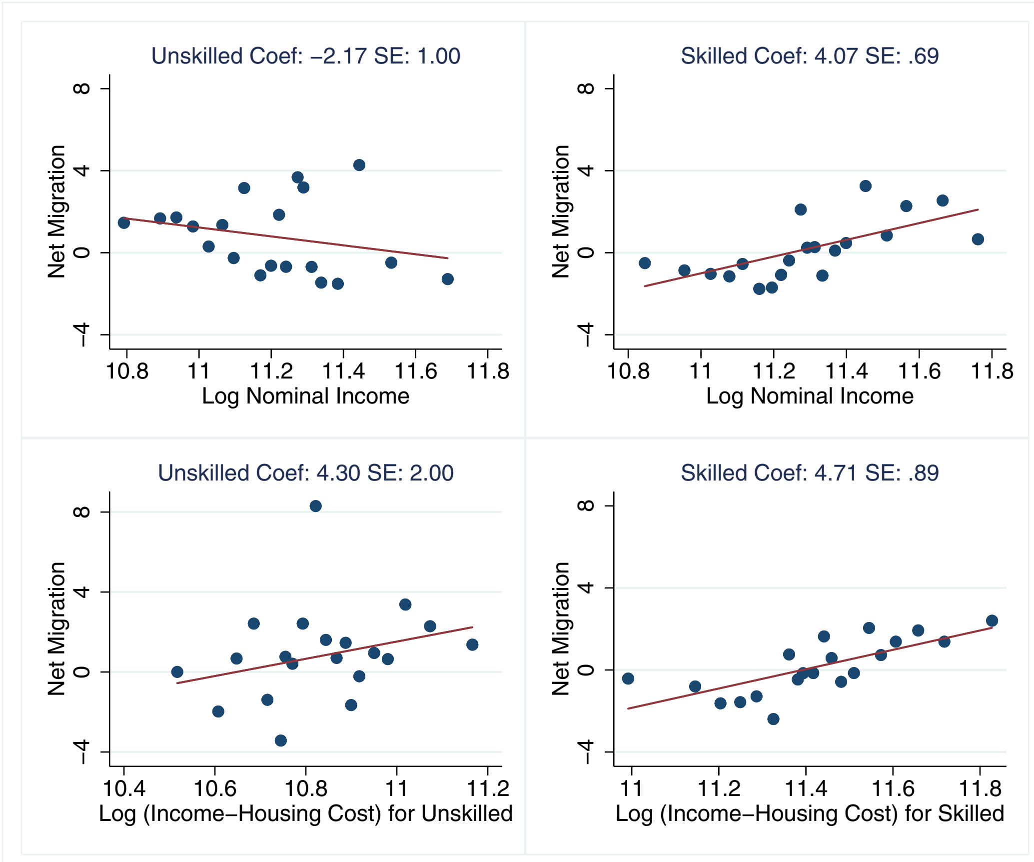


Fig. 5. Net migration flows by skill group: nominal income vs. income net of housing cost, 1995–2000. *Notes:* This figure measures net migration over a five-year horizon as a percent of the population ages 25–65 for 1020 3-digit Public Use Microdata Area (PUMA) in the 2000 Census. Each panel stratifies the PUMAs into 20 quantiles by income, weighting each PUMA by its population, and then computes the mean net migration within each quantile. The two top panels plot migration rates against log household wage income in the PUMA, for individuals with less than a bachelor's degree (top left) and with at least a bachelor's (top right). The two bottom panels plot the net migration rates against log income net of housing costs. See Section 2 for details.

productive North features a decreasing returns to scale production process, whereas the South offers a reservation utility. In the model, workers have heterogeneous skill types and choose labor supply based on local wages. Higher skill workers produce more effective labor per unit of effort, and all effective labor is perfectly substitutable. Low-skill workers in the North spend a larger share of their income on housing than high-skill workers in the North, meaning that housing demand is non-homothetic. We solve for the equilibrium in this economy, where the land and labor markets clear.

Next, we consider the interregional allocation of labor. We begin from an initial situation in which wages are lower in the South. Once we allow migration, labor inflows into the North drive down wages for all skill types due to decreasing returns to scale in production. This generates interregional convergence in incomes. After a shock that lowers the elasticity of housing supply and causes housing prices to rise in the North, migration flows become smaller and biased towards high-skill workers. Because fewer people move to the North – and because the people who move there are more high-skill – income convergence slows.

The model builds upon a long line of papers in urban economics following the spatial equilibrium framework of Rosen (1979), Roback (1982), and Blanchard and Katz (1992). It is similar to models outlined in Braun (1993) and Gennaioli et al. (2014), who solve models of migration and regional convergence, and Gennaioli et al. (2013), who study a static regional model with heterogeneous skill types.

Our interpretation of the data relies on two crucial features of the model.[18] First, regional labor demand slopes downward. Three examples of changes in the labor supply and migration of natives from U.S. economic history help illustrate this concept.[19] First, Acemoglu et al. (2004) show that states which had more mobilization of men during World War II had increased female labor force participation both during and after the war. After the war, both males and females in these places earned lower wages. Second, Hornbeck (2012) studies the impact of a major negative permanent productivity shock, the Dust Bowl. He finds that out-migration is the primary factor adjustment which allowed wages to partially recover. Third, Margo (1997) studies the impact of a positive productivity shock: the Gold Rush. At first, wages soared, but as people migrated in to California, wages declined.

Second, low-skill workers spend a larger share of their income on housing, meaning that housing is a non-homothetic good. The intuition for this assumption is that if housing has a fixed cost, then it will account for a larger share of low-skill workers' income than high-skill workers' income. This assumption can affect

[18] In Online Appendix A we show quantitatively that these assumptions are crucial by showing that our model's results do not hold when either of these assumptions is relaxed.

[19] There is considerable debate about the impact of immigrants on local wages (e.g. Card, 1990; Borjas, 2017; Peri and Yasenov, 2015), with some researchers arguing that immigrants are substitutes for native labor and others arguing that they are complements. Our model only requires that the in-migration of natives lowers wages and does not require us to take a stance on the impact of immigration.

migration because a 1% increase in housing prices will consume a larger share of household budgets for low-skill workers. To support this assumption, we calculate using Census data that expenditure shares on housing within a typical city vary from an average of 32% for the lowest-income households to an average of less than 15% for the highest-income households.[20]

We formally describe the economy in the North region in Section 3.1, before studying migration from South to North in Section 3.2.

3.1. Households, production, and housing in the north

The North is populated by agents of type k with associated skill type ψ_k and utility is defined by

$$\max_{c,\ell_k} U(c,p,\ell_k) = c - p - \frac{\ell_k^{1+1/\varepsilon}}{1+1/\varepsilon} \qquad \text{subject to } c = w\psi_k\ell_k + \pi$$

The wage rate w is the cost of one unit of effective labor, and π are lump-sum federal transfers of profits. ℓ_k indexes effort. With a statewide wage of w, a worker with numeraire skill ($\psi = 1$) will optimally supply $\ell_1 = w^\varepsilon$ units of labor. In comparison, a worker with skill ψ_k will optimally supply

$$\ell_k^{Supply} = (\psi_k w)^\varepsilon \tag{2}$$

for an effective labor supply of $\psi_k^{1+\varepsilon}\ell_1$.

We assume that every worker inelastically demands one plot of land. We denote the number workers of type k as μ_k. Since each worker requires one plot, housing demand is equal to the total number of workers and is insensitive to the price and housing demand can be expressed as $H^{Demand} = \sum_k \mu_k$.

We assume a state-level production function with decreasing returns to scale.

$$Y = AL^{1-\alpha}$$

The first term A can encompass capital differences, natural advantages, institutional strengths, different sectoral compositions, amenities, and agglomeration benefits. Each skill group k has average labor supply of ℓ_k. Different types of effective labor are perfect substitutes. Using the labor supply Eq. (2) we can write the labor demand equation as effective labor (γ) times the amount of labor supplied by a worker with numeraire skill. This yields

$$Y = AL^{1-\alpha} = A\left(\sum_k \mu_k\psi_k\ell_k\right)^{1-\alpha} = A\left(\underbrace{\sum_k \mu_k\psi_k^{1+\varepsilon}}_{\gamma:\text{ effective labor}}\ \ell_1\right)^{1-\alpha}$$

Effective labor gets its marginal product $w = (1-\alpha)A(\gamma\ell_1)^{-\alpha}$. We solve for labor demand:

$$\ell_1^{Demand}(w) = \left(\frac{(1-\alpha)A}{w\gamma^\alpha}\right)^{1/\alpha} \tag{3}$$

Every state owns a continuum of plots of land, with heterogeneous costs to occupying each plot. The lowest cost plots are occupied first. Defining the number of plots needed as H, the cost to occupying the marginal plot is $c(H) = H^{1/\xi}$, which implies that when setting price equal to marginal cost,

$$H^{Supply}(p) = p^\xi$$

State-level production and land profits are returned to consumers as a nationwide lump-sum rebate.

Given this setup, an equilibrium within a state is a price p, a wage w, and allocations such that individuals choose their labor supply optimally, workers earn their marginal product, and the land and labor markets clear.

Land: Using the land market-clearing condition, we compare p as a function of $\{\mu_k\}$ and ξ,

$$H^{Demand} = H^{Supply}(p)$$
$$\Rightarrow p^{Market-Clearing} = \left(\sum_k \mu_k\right)^{1/\xi}.$$

Labor: Before, we derived labor supply and demand schedules as a function of individual supply and firm production. Now, we impose the labor market-clearing condition for the numeraire worker:

$$\ell_1^{Demand}(w) = \ell_1^{Supply}(w)$$
$$\Rightarrow w^{Market-clearing} = \left((1-\alpha)A\gamma^{-\alpha}\right)^{\frac{1}{1+\alpha\varepsilon}}.$$

Multiplying this by equilibrium labor demand in Eq. (3) gives earnings for the numeraire worker as $w\ell_1 = ((1-\alpha)A\gamma^{-\alpha})^{\frac{1+\varepsilon}{1+\alpha\varepsilon}}$, while workers from skill group k earn $w_k\ell_k = \psi_k^{1+\varepsilon}((1-\alpha)A\gamma^{-\alpha})^{\frac{1+\varepsilon}{1+\alpha\varepsilon}}$. This gives us an expression for per capita income in the North of

$$\frac{\sum_k \psi_k^{1+\varepsilon}((1-\alpha)A\gamma^{-\alpha})^{\frac{1+\varepsilon}{1+\alpha\varepsilon}}\mu_k^N}{\sum \mu_k^N}. \tag{4}$$

We express indirect utility for a worker of type k as a function three parameters describing the economy in North: productivity A, effective labor γ, and population $N = \sum_k \mu_k$ as

$$v^k(A,\gamma,N,\psi_k) = \underbrace{\frac{\psi_k^{1+\varepsilon}}{1+\varepsilon}((1-\alpha)A\gamma^{-\alpha})^{\frac{1+\varepsilon}{1+\alpha\varepsilon}}}_{\text{income - effort cost}} \underbrace{-N^{1/\xi}}_{\text{land price}} + 1 + \pi. \tag{5}$$

This expression for indirect utility is very similar to the expression for earnings $w_k\ell_k$. It differs by a rescaling of income by $1/(1+\varepsilon)$ to account for effort costs in labor supply and subtracting housing costs.

3.2. Directed migration and convergence

Next, we consider the behavior of a worker who lives in a second region “South” and is deciding whether to migrate to the North economy described in the previous section. Flow utility in South for skill type k is equal to $\psi_k^{1+\epsilon}\Omega$ for some fixed constant Ω.[21] Migration is modeled as a one-shot choice in which stochastic moving costs x_k are rescaled by $\psi_k^{1+\epsilon}$ such that they are proportional to flow utility. People choose the location that offers them the highest indirect utility. Following this rule means they move if their indirect utility in the North is greater than the reservation utility offered in the South. We can express this decision criteria

[20] Online Appendix Figure B.1 documents this fact. When researchers have studied national U.S. data, some have found that housing is homothetic (e.g. Davis and Ortalo-Magné, 2011), which seems to be in tension with our model' s assumption of non-homotheticity. However, the fact that expenditure shares are the same between low- and high-skill workers in this prior work emerges from two empirical patterns which cancel each other out. The first empirical pattern is that high-skill workers select into places with high housing prices, which pushes up their average housing expenditure. The second pattern is that within any given city, high-skill workers spend a smaller share of their income on housing than low-skill workers.

[21] Utility for individuals of type k is proportional to $\psi^{1+\epsilon}$ when housing prices are zero. The South can thus be thought of as a less productive state with completely elastic housing supply and constant returns to scale in labor demand.

as:

$$\underbrace{\frac{\psi_k^{1+\varepsilon}}{1+\varepsilon}((1-\alpha)A_N\gamma_N^{-\alpha})^{\frac{1+\varepsilon}{1+\alpha\varepsilon}}-N_N^{1/\xi}}_{\text{Utility in Productive North}} \geq \underbrace{\psi_k^{1+\varepsilon}\Omega-1}_{\text{Reservation Utility in South}} + \underbrace{x_k\psi_k^{1+\varepsilon}\Omega}_{\text{Moving Cost}} \quad (6)$$

where indirect utility comes from Eq. (5). The cutoff x_k^* is implicitly defined when Eq. (6) holds with equality.

Proposition 1. *If (1) utility in North is sufficiently high ($v_N^1 > \Omega + 1$), (2) housing supply in the North is perfectly elastic ($\xi \to \infty$), and (3) the average effective labor is higher in the North than in South ($\gamma_N/N_N > \gamma_S/N_S$), then migration generates per capita income convergence.*

Proof. See Online Appendix A.4. □

The intuition behind Proposition 1 is that due to downward-sloping labor demand, as the number of workers in the North rises, wages fall. Further, since the cutoff moving cost x_k^* is independent of skill type, the movement of workers from the initially less high-skill South to the North will lower lead to lower average Northern human capital levels. These two channels together generate income convergence.

Proposition 2. *If the conditions from Proposition 1 hold, and $N_N > 1$, so that a decrease in ξ raises prices, lowering ξ causes*

(1) *a reduction in directed migration,*
(2) *directed migration to become biased towards high-skill workers, and*
(3) *the rate of income convergence to decline.*

Proof. See Online Appendix A.5. □

This proposition shows how changes in the housing supply elasticity affect directed migration and convergence. When the housing supply is perfectly elastic, all skill types migrate to the North due to its higher productivity. When the housing supply elasticity falls, housing prices rise. As housing prices rise, migration falls from all skill groups. The non-homotheticity of housing demand means that low-skill types are differentially discouraged from moving North, as housing is a larger share of low-skill consumption. This change in returns across skill types mirrors Fact 2 from Section 2. This means that a decrease in ξ in high-income areas reduces the magnitude of directed migration and makes it more skill biased, which corresponds to Fact 3 from Section 2. Finally, assuming the North is higher skilled to begin with, a decline in the elasticity of housing supply away from perfect elasticity slows convergence.

To test the mechanism by which housing supply affects convergence more directly, in the next section we develop a new proxy measure for the elasticity of the housing supply based on land use regulations.

4. A panel measure of land use regulations

In this section, we develop a new measure of land use regulations based on state appeals court records and use it to test the three empirical predictions made by the model. Land use regulations are a good proxy for the parameter ξ in the model. Our new measure is, to the best of our knowledge, the first panel of housing supply regulations covering the United States.[22] In Section 4.1, we validate our measure against existing cross-sectional regulation measures and show that it predicts increased capitalization of income differences into housing prices. Our empirical analysis in Section 4.2 confirms the model's three empirical predictions that regulations lower directed migration, change the skill composition of migration and lower income convergence. Finally, we conduct three robustness checks in Section 4.3.

4.1. Measuring land use regulations and their impact on housing prices

Our measure of land use regulations is based upon the number of state supreme and appellate court cases containing the phrase "land use" over time. The phrase "land use" appears 42 times in the seminal case *Mount Laurel* decision issued by the New Jersey Supreme Court in 1975.[23] Municipalities use a wide variety of tactics for restricting new construction, but these rules are often controversial and any such rule, regardless of its institutional origin, is likely to be tested in court. This makes court decisions an omnibus measure which capture many different channels of restrictions on new construction. We search the state supreme and appellate court records for each state-year using an online legal database (Westlaw) and produce counts of land use cases in per capita terms.

One immediate result from constructing this measure is that the land use cases have become increasingly common over the past fifty years. The top-left panel of Fig. 6 displays the national regulation measure over time, which exhibits strong secular growth. Growth is particularly rapid from 1970, when it stood at about 25% of its current level, to 1990, when it reached about 75% of its present day level. In Online Appendix C, we provide institutional background on possible causes for the change in land use regulations.

We validate our measure against the existing cross-sectional measures that focus on supply constraints. One survey, from the American Institute of Planners in 1975, asked 21 land use-related questions of planning officials in each state (The American Institute of Planners, 1976). To build a summary measure, we add up the total number of yes answers to the 21 questions for each state. As can be seen in the top-right panel of Fig. 6, the 1975 values of our measure are strongly correlated with this measure. Our measure is also highly correlated with the 2005 Wharton Residential Land Use Regulation Index (WRLURI), as shown in the bottom-left panel of Fig. 6.[24] Finally, our measure is correlated with a measure from Saks (2008) and another from the Wharton Urban Decentralization Project.[25]

State-years with high levels of regulation have decreased permitting and increased capitalization of income into housing prices. We are unaware of a standard in the literature for what functional form should be used to scale court cases into a regulation measure. We adopt a flexible and transparent specification – ranking state-years by their land use cases per capita:

$$Reg_{j,t} = Rank\left\{\frac{LandUseCases_{jt}}{Pop_{jt}}\right\} \quad (7)$$

[22] Examples of research using cross-sectional data on land use regulations include Glaeser et al. (2005a), Katz and Rosen (1987), Pollakowski and Wachter (1990), Quigley and Raphael (2005), and Rothwell (2012) using US data. See Brueckner and Sridhar (2012) for work on building restrictions in India. In a similar spirit to our work, Hilber and Vermeulen (2013) analyze a panel of land use regulations in the UK.

[23] We also show similar results for the phrase "zoning" to count supreme and appellate court cases in Online Appendix Table 5.

[24] To construct state-level measures, we weighted the metro estimates in Gyourko et al. (2008) by 1960 population and imputed from neighbors where necessary.

[25] We find that all of these measures correlate similarly with each other and with our index. Our measure has a correlation with the Saks measure of 0.32 and with the WUDP measure of 0.48 when using our data from a similar period.

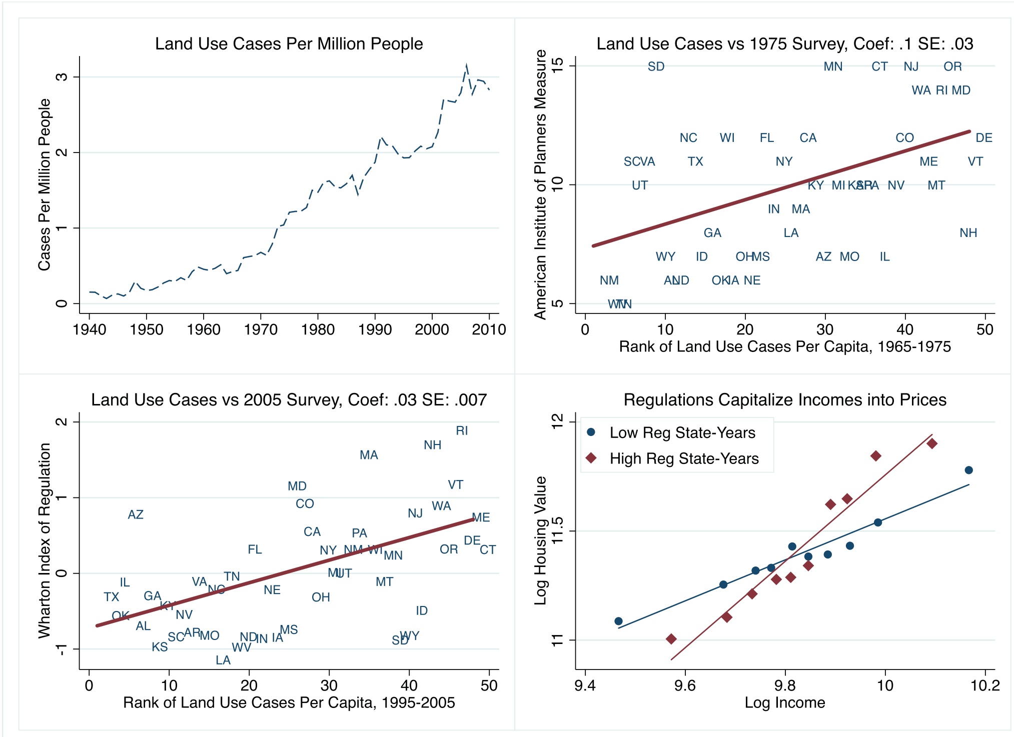


Fig. 6. Regulation measure: timeseries and validity. *Notes:* The top-left panel plots the number of cases containing the phrase "land use" in the court database in per capita terms. The top-right panel plots the relationship between the 1975 values of the regulation measure introduced in the text and the sum of affirmative answers to the regulation questions asked in the 1975 American Institute of Planners Survey of State Land Use Planning Activities. The correlation between the state regulation ranking and the AIP is 0.48 (0.36 with the rank measure from Eq. (7)). The lower-left panel plots the relationship between the 2005 values of the regulation measure introduced in the text and the 2005 Wharton Residential Land Use Regulatory Index. The correlation with the state regulation ranking is 0.54 (0.36 with the rank measure from Eq. (7)). The lower-right panel plots deciles of log income with year fixed effects on the x-axis and conditional means for housing prices for each decile on the y-axis.

Table 1
Summary statistics.

	1940		1960		1980		2000	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Personal income per capita ($000, 2012 $)	8.83	3.18	16.34	3.15	26.63	3.63	38.41	5.95
Population (Million)	2.73	2.69	3.72	3.80	4.69	4.76	5.83	6.26
Human capital level per capita (Relative to sample mean)	0.87	0.04	0.93	0.04	1.03	0.04	1.10	0.03
Median house price ($000, 2012 $)	39.75	15.37	85.15	18.56	129.39	32.11	152.25	44.51
Regulation measure (Centiles of land use cases per capita)	0.11	0.21	0.21	0.26	0.66	0.22	0.66	0.29
Fraction age 25–65 with								
12+ Years of education	0.26	0.44	0.45	0.50	0.73	0.44	0.88	0.33
16+ Years of education	0.05	0.21	0.08	0.28	0.18	0.38	0.27	0.44

Sources: IPUMS Census extract, Bureau of Economic Analysis (2012) income estimates, Price index from Lindert and Sutch (2006) and an online database of state court documents. Notes: n = 48 states, excluding Alaska, Hawaii, and DC. Dollar amounts are in real 2012 dollars. Human capital level is measured using education and race. See Section 4.2 for details on human capital construction. The regulation measure for 1941 is reported in place of the unavailable 1940 statistics.

where j indexes state and t indexes year.[26] We rescale these values to create a variable ranging from zero for the least regulated state-year to one for the most regulated state-year. This measure is rising over time, from an average of 0.11 in 1940 to 0.66 in 1980. Table 1 provides summary statistics on this and other variables.

We estimate the following specification:

$$Y_{j,t} = \alpha_t + \alpha_t Reg_{j,t} + \beta Inc_{j,t} + \beta_{\text{high reg}} Inc_{j,t} \times Reg_{j,t} + \varepsilon_{j,t}. \quad (8)$$

The coefficient β is the benchmark convergence specification estimated in prior work and it measures how differences in income affect outcomes in a state-year where there is no land use regulation.[27] The interpretation of $\beta_{\text{high reg}}$ is the relative impact of differences in income in a highly-regulated state-year.

Our results show that housing regulations lead high-income places to issue fewer housing permits and consequently see greater house price growth. Intuitively, absent land use restrictions, places with higher income will face greater demand for houses and will permit at a faster rate. Table 2, column 1 confirms this intuition empirically by estimating Eq. (8): the base coefficient is positive,

[26] Our results in Section 4.2 do not depend upon this particular scaling choice. In Online Appendix Table 6, we investigate three alternative scalings: land use cases per square mile, land use cases per local government, and land use cases as a fraction of total cases. The results are very similar, which is unsurprising given that the alternate series have a correlation of 0.87, 0.88, and 0.87 respectively with our per-capita baseline series.

[27] This specification follows the literature in not including state fixed effects. See Barro (2012) for a discussion of how state/country fixed effects can lead to misleading convergence results in short panels.

Table 2
Impacts of regulation on permits, prices, migration, and convergence.

	Annual construction permits$_t$ % of Housing stock (1)	Log house price$_t$ (2)	ΔLog population$_{t,t,t+20}$ Annual rate in % (3)	Δ Log human capital Annual rate in % (4)	Δ Log income per cap$_{t,t+20}$ Annual rate in % (5)
Regulation measure: Centiles of land use cases per capita scaled [0,1]					
Log Inc Per Cap$_{t+20}$	5.039**	0.774***	1.688**	−0.0662***	−2.034***
	(2.106)	(0.105)	(0.637)	(0.00865)	(0.102)
Log Inc Per Cap$_{it}$ *Reg$_{it}$	−5.868**	0.833***	−1.875***	0.0439**	1.304***
	(2.290)	(0.255)	(0.608)	(0.0198)	(0.393)
Year*Reg FEs	Y	Y	Y	Y	Y
R_2	0.209	0.890	0.138	0.203	0.809
N	1,536	384	2,448	288	2,448
Placebo Measure: Centiles of Total Cases Per Capita scaled [0,1]					
Log Inc Per Cap$_{t+20}$	1.313	0.984***	1.017	−0.0551***	−1.707***
	(1.627)	(0.148)	(0.813)	(0.0199)	(0.206)
Log Inc Per Cap$_{it}$ *Reg$_{it}$	−1.029	0.269	0.380	0.00905	0.202
	(2.396)	(0.267)	(2.616)	(0.0386)	(0.400)
Year*Reg FEs	Y	Y	Y	Y	Y
R2	0.167	0.871	0.179	0.170	0.792
N	1,536	384	2,448	288	2,448

Notes: The table reports the coefficients β and β_{reg} from regressions of the form: $\ln y_{it} = \alpha_t + \alpha_t \text{reg}_{it} + \beta \ln y_{it} + \beta \text{reg} \ln y_{it} \text{reg}_{it} + \varepsilon_{it}$. The regulation measure is centiles of land use cases per capita and its construction is described in Section 4.1. The dependent variables are new housing permits from the Census Bureau, the median log housing price from the IPUMS Census extracts, population change, the change in log human capital of people ages 25–34 due to migration, and the change in log per-capita income. For columns (1), (3), and (5), where we have annual data, the regulation measure is constructed using cases per capita. For columns (2) and (4), where we have decennial data, the regulation measure is constructed using average cases per capita over the last ten years. Standard errors clustered by state. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

indicating that places with 10% higher incomes had an 0.5 percentage point higher annual permitting rate as a share of the existing housing stock. The interaction term $\beta_{\text{high reg}}$ is negative and similar in size: in the high-regulation regime there is no correlation between income and permits for new construction. In column 2, we show that at baseline there is a positive correlation between income and housing prices (with 1% higher income associated with 0.8% higher prices), and that the slope of the relationship doubles in high regulation state-years. Recall from Section 2 that Fact 1 showed increasing capitalization of income differences into house prices. The estimates in column 2 imply that increased regulation can explain some of the increase in capitalization documented in fact 1.[28]

4.2. Testing the model using a panel measure of regulations

Having established that our regulation measure is a good proxy for housing supply constraints, we test its direct effect on the convergence relationship. We first demonstrate the effect of land-use regulations on convergence graphically. Fig. 7 shows in the top-left panel that from 1940 to 1960 incomes were converging within states with low and high land use regulation. In the top right panel, which shows 1990–2010, convergence continues within the group of low regulation states. Conceptually, we can think of this group of states as reflecting the model prior to the change in regulations, with within-group reallocations of people from low-income states to high-income states. In contrast, the top-right panel shows that there is no convergence at all among the high-regulation states. In order to show that these results generalize across most twenty-year windows, the bottom panel of the figure shows convergence coefficients for every twenty-year period in our sample. Convergence among states with tight regulations display a pronounced weakening over time (although convergence reappears briefly among high-regulation states during the recent recession).[29]

We compare the model to the data in terms of the model's three predictions to the impact of regulations in high-income places. In our model, states with high income per capita will draw migrants when housing prices are low (Eq. (6)). This is consistent with the baseline coefficient in column 3 that shows 0.17% higher annual population growth in places with 10% higher incomes. When income differences are capitalized into prices, the incentive to move is diminished, and directed migration slows. The positive interaction coefficient shows that directed migration almost completely disappears in the state-years with high regulation. This shows that the secular decline in directed migration shown in Fig. 1 of the paper can partly be accounted for by increased regulations high-income places, as predicted by Proposition 2 in the model.

We also show that regulations in high-income places predict a change in the human capital composition of migration. This requires a quantitative measure of how much migration-induced changes in human capital would have affected income. We follow the growth-accounting literature (e.g. Denison, 1962; Goldin and Katz, 2001) and estimate a Mincer regression in the IPUMS Census files.[30] Under the assumption of a fixed national return to schooling, a state's skill mix and these coefficients can be used to estimate its human capital. Let $\widehat{Inc}_k$ be predicted income for each education level k and $Share_{kj}$ as the share of people in human capital group k living in state j. The value for the human capital index in state j is Human Capital$_j \equiv \sum_k \widehat{Inc}_k \times Share_{kj}$.

Our approach to measuring migration exploits the fact that the Census asks people about both their state of residence and their

[28] Our findings that increases in regulation raise capitalization are similar to those by Hilber and Vermeulen (2013) for the UK. Similarly, Saks (2008) and Glaeser et al. (2006) find in the US that employment demand shocks are capitalized into prices rather than quantities in the high regulation regime. However, see Davidoff (2010) for a dissenting view about the impact of regulations on housing prices using cross-sectional data.

[29] As a robustness check, we divide the states according to a measure of their housing supply elasticity based upon land availability and the WRLURI constructed by Saiz (2010). The results are shown in the bottom-right panel of Fig. 7. Again, we find that convergence continues among states without supply constraints, but has mostly stopped in states with constraints.

[30] Formally, we estimate the specification log $Inc_{ik} = \alpha_k + \varepsilon_{ik}$ where Inc_{ik} is an individual's annual income, and α_k represent skill bins using data from the 1980 Census. We construct predicted income as $\widehat{Inc}_k = exp(\hat{\alpha}_k)$. Skill level k is defined as seven possible completed schooling levels (0 or NA, Elementary, Middle, Some HS, HS, Some College, College+), a dummy for Hispanic, and a dummy for Black.

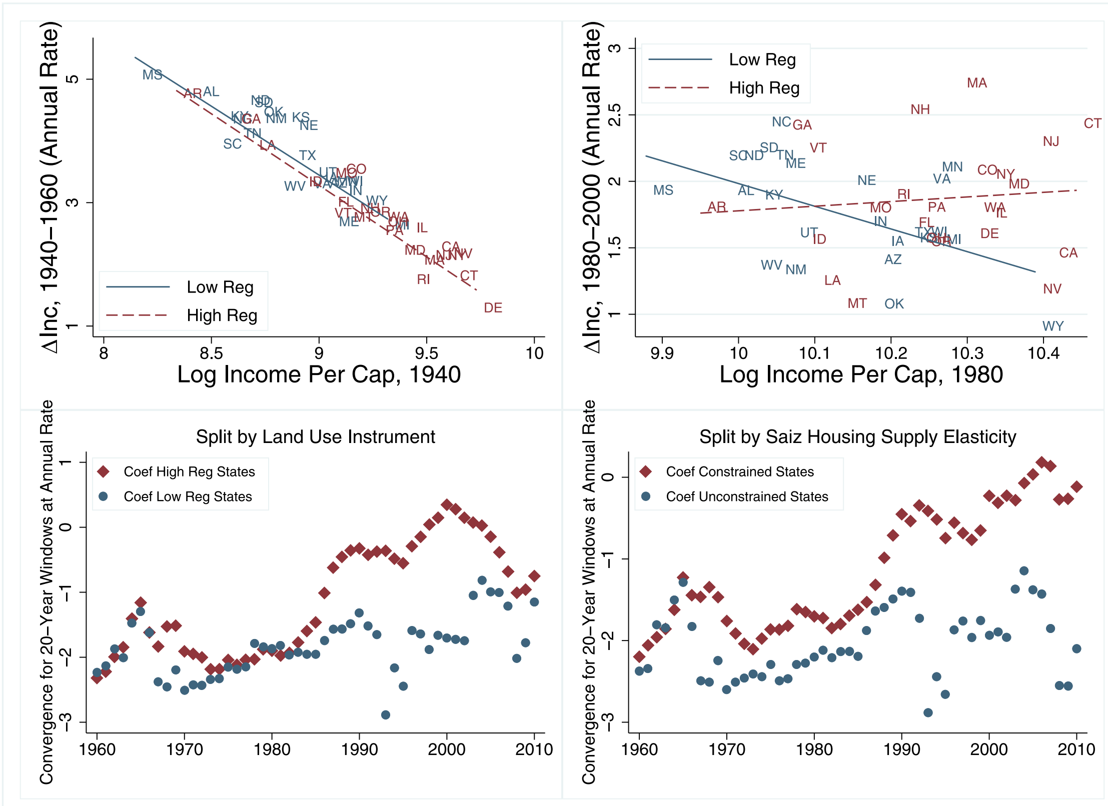


Fig. 7. Income convergence by housing supply elasticity. *Notes:* The top panels show income convergence for two different twenty-year periods, labeling states according to their estimated regulation levels in 1965. Blue states have below median housing supply regulation and red states above median regulation. The bottom-left panel depicts the coefficients from $\Delta Inc_{s,t} = \alpha_t + \beta Inc_{s,t-20} + \varepsilon_{s,t}$ over rolling twenty year windows. The regressions are estimated separately for two equally-sized groups of states, split by their 1965 measure of land use regulations from the legal database. The bottom-right panel splits states by their measure of housing supply elasticity in Saiz (2010).

state of birth. We estimate the change in the human capital index due to migration by reverting people to their birthplace, which we construct as

$$\Delta HC_{jt} \equiv \underbrace{\sum_k \widehat{Inc}_k Share_{kj,residence,t}}_{\text{Realized Human Capital Allocation}} - \underbrace{\sum_k \widehat{Inc}_k Share_{kj,birth,t}}_{\text{No-Migration Counterfactual}}. \quad (9)$$

To capture recent migration, we focus our analysis on people ages 25 to 34. This focuses on people who have completed their education, and but migrated in the not-too-distant past.[31] We examine the impact of income and regulations on the evolution of human capital ΔHC_{jt} in column 4. The interpretation of the β coefficient in Eq. (8) is that a place with 1% higher income would have β% slower growth in its human capital stock. Slower growth in the human capital stock – holding population constant – contributes to slower convergence. When housing supply is elastic, the negative baseline coefficient in column 4 indicates that migration undoes any initial human capital advantage held by high-income places, as predicted by Proposition 1 in the model. The interaction coefficient is positive, indicating that human capital convergence slows among high regulation state-years, as predicted by Proposition 2 in the model.

The data confirm our model's central prediction, which is that land use regulations reduce income convergence in high-income places. The un-interacted coefficient in column 5 (−2.0) captures the strong convergence relationship that exists absent land use restrictions, as predicted by Proposition 1 in the model. However, the interaction coefficient is large and positive (1.3). This finding indicates that the degree of convergence among states in periods of high regulation is significantly diminished, as predicted by Proposition 2 in the model.

Table 2 links the theory from Section 3 to the data. The first row of coefficients describe a world where population flows to high-income areas, human capital converges across places, and regional incomes converge as in Proposition 1 of the model. The second row of coefficients is consistent with the high regulation regime described in the model, with increased capitalization, less net migration, and less income convergence as in Proposition 2 of the model.

4.3. Robustness checks

In this section, we report results from three robustness checks: a placebo measure of all appeals court activity, a historical measure of regulations and a measure of differences in the capacity to build arising from topological features.

One potential concern is that our regulation measure is picking up changes in the overall regulatory or legal climate, rather than a change which is specific to land use. As a placebo test, we re-estimate Eq. (8) for the five outcomes analyzed in Section 4.2 sub-

[31] Online Appendix Figure B.2 shows how this summary statistic evolves over time. There was substantial human capital convergence in the mid-twentieth century, but there is much less today.

Table 3
Latent tendency to regulate, geographic land availability, and convergence.

Year	Δ Log income per cap$_{t-20,t}$ (Annual Rate in %)					
	Pre (1)	Post (2)	Pre (3)	Post (4)	Pre (5)	Post (6)
Log Inc Per Cap$_{t-20}$	−1.98***	−1.92***	−1.98***	−1.92***	−2.49***	−1.20***
	(0.13)	(0.42)	(0.13)	(0.42)	(0.06)	(0.08)
Log Inc Per Cap$_{t-20}$ * Constraint quintile	0.30	2.27**	0.37	2.18**	− 0.11	0.76***
	(0.33)	(0.91)	(0.35)	(0.83)	(0.12)	(0.18)
p-value for equality of interaction (Pre v Post)	0.003		0.002		< 0.001	
Year*Constraint fixed effects	Y	Y	Y	Y	Y	Y
Controls	–		–		–	
R_2	0.84	0.45	0.84	0.44	0.72	0.91
N	1248	1200	1248	1200	8413	9244
Unit of observation	State	State	State	State	County	County
Constraint measure	Land use cases per capita, 1956–1965		Land use cases per capita, 1996–2005		Share of land unavailable (Saiz, 2010)	

Notes: This table uses time-invariant measures of the housing supply elasticity, while Table 2 uses time-varying measures of the elasticity. The table reports the coefficients β and $beta_{\text{constraint}}$ from regressions of the form $\Delta \ln y_{it,t-20} = \alpha_1 + \alpha_2\, Constraint_i + \beta \ln y_{it-20} + \beta_{\text{Constraint}} \ln y_{it-20} x Constraint_i + \varepsilon_i$. The pre period is 20-year windows ending in 1960 through 1984. The post period is 20-year windows ending in 1985 through 2010. The constraint measures are all in quintiles normalized such that 0 means least constrained and 1 means most constrained. The constraint measures are: the cumulative number of land use cases per capita as of 1965 in (1) and (2), the number of land use cases per capita 1996–2005 in columns (3) and (4), and land availability constructed from Saiz (2010) in columns (5) and (6). The availability measure assumes that all land is available for construction in non-urban counties. Standard errors clustered by state for columns (1)–(4) and by metro area for columns (5) and (6) in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

stituting a placebo measure of total appealsand supreme court cases instead of the number of land use cases in Eq. (7). This measure also exhibits secular growth, from an average of 0.30 in 1950 to 0.66 in 1990. If our results in Section 4.2 were due to changes in the overall state-level regulatory climate or due to time trends, then we should expect to find significant results as part of this placebo test. Instead, however, the interaction coefficients on the placebo measure reported in Table 2 are small in magnitude and not statistically significant.

A second concern is that regulation in high-income areas may be a consequence of diminished income convergence rather than a cause of it. To assess this hypothesis, we study the relationship of land use cases per capita from 1956 to 1965 with convergence. This approach has two attractive properties. First, land use restrictiveness in 1965 cannot have been affected by subsequent changes in income convergence. Second, although our regulation measure is low in absolute terms everywhere in 1965, states differ in their latent tendency to regulate land use. This heterogeneity made some states more likely to be affected by change in the national climate towards land use regulations. Variation in the 1965 permissiveness of laws regarding land use is predictive of subsequent increases in regulation (the correlation between the measures in 1965 and 2005 is 0.47). Many other authors use a similar identification strategy of using historical differences across places and studying national changes in industry, ethnic composition or occupations (Bartik, 1991; Card, 2009; Autor and Dorn, 2013).

We reject the hypothesis that high regulations are a consequence of diminished income convergence using data on historical land use regulations. To demonstrate this, we re-estimate Eq. (8), splitting the sample into a pre-period, with twenty-year windows from 1940–1960 through 1965–1985, and a post-period, with twenty-year windows from 1965 to 1985 through 1990–2010. Instead of the time-varying measure of regulations from Eq. (7), we analyze regulation measures from a point in time. We find that states with low and high values of 1965 regulation displayed similar convergence behavior in the pre-period, as documented in Table 3, column 1. In the post-period, once the latent tendency to regulate land use had been activated, these states experience a sizeable drop in their degree of income convergence, as documented in column 2. As a check on the specification, we confirm that we find similar results in both periods using post-period regulations. Columns 3 and 4 demonstrate that states with high and low regulation in 2005 had similar convergence rates in the pre-period, but that convergence slowed in high-regulation states after these restrictions were enacted. The fact that the latent tendency to regulate shows the same pattern as post-period regulations, suggests that causality runs from regulations to convergence and not vice versa.

Finally, we show evidence that land use constraints based on geographic features measured by Saiz (2010) have limited convergence since 1985. In 1965, land use was permissive everywhere, so limited land supply in, for example, Manhattan, led to increased building heights. Once regulations made it difficult to build up, geographic land features became an important determinant of housing prices. To implement an empirical approach that exploits the Saiz land availability measure, we classify counties based upon the geographic availability of developable land.[32] Land availability predicts increased house price capitalization in the “post” period, giving us an alternative empirical approach to tracing out the impact of house prices on income convergence. Columns 5 and 6 demonstrate that counties with low geographic land availability did not display different convergence behavior prior to 1965. In the period with tight building restrictions, however, these counties also experience a reduction in their rates of income convergence.

5. Conclusion

For more than 100 years, per-capita incomes across U.S. states were strongly converging and population flowed from low-income to high-income areas. In this paper, we claim that these two phenomena are related. By increasing the available labor in a region, migration drove down wages and induced convergence in human capital levels.

Over the past thirty years, both the flow of population to high-income areas and income convergence have slowed considerably. We show that the end of directed population flows, and the decline of income convergence, can be explained in part by a change

[32] The Saiz index is constructed at the metro area level. We conduct our analysis at the county level because county geographies are more stable over time and so it is easier to build a consistent timeseries for income. We cluster our standard errors at the metro area level because the Saiz index varies at the metro-area level.

in the relationship between income and housing prices. Although housing prices have always been higher in higher-income states, housing prices now capitalize a far greater proportion of the income differences across states. In our model, as prices rise, the returns to living in high-income areas fall for low-skill households, and their migration patterns diverge from the migration patterns of the high-skill households. The regional economy shifts from one in which labor markets clear through net migration to one in which labor markets clear through skill-sorting, which slows income convergence. We find patterns consistent with these predictions in the data.

To estimate the effect of these housing price increases, we introduce a new panel instrument for housing supply. Prior work has argued that land use regulations have become increasingly stringent over time, but panel measures of regulation were unavailable. We create a proxy for these measures based on the frequency of land use cases in state supreme and appellate court records. Tighter regulations impede population flows to high-income areas, weaken convergence in human capital and weaken convergence in per capita income.

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Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.jue.2017.07.002.

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