Why Has Regional Income Convergence in the U.S. Declined?

Peter Ganong and Daniel Shoag*

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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 wealthy places. These changes coincide with (1) an increase in housing prices in productive areas, (2) a divergence in the skill-specific returns to living in those places, and (3) a redirection of unskilled migration away from productive places. We develop a model in which rising housing prices in wealthy areas deter unskilled migration and slow income convergence. Using a new panel measure of housing supply regulations, we demonstrate the importance of this channel in the data. Income convergence continues in less-regulated places, while it has mostly stopped in places with more regulation.

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*Email: ganong@fas.harvard.edu (Harvard University) and dan_shoag@hks.harvard.edu (Harvard Kennedy School). We would like to thank Marios Angeletos, Robert Barro, George Borjas, Gary Chamberlain, Raj Chetty, Gabe Chodorow-Reich, David Dorn, Bob Ellickson, Emmauel Farhi, Bill Fischel, Dan Fetter, Edward Glaeser, Claudia Goldin, Joe Gyourko, Larry Katz, and seminar participants at Harvard, Tel Aviv, Bar Ilan, Dartmouth and the NBER Summer Institute for their valuable feedback. Shelby Lin provided outstanding research assistance. We thank Erik Hurst for alerting us to the end of regional convergence and spurring us to work on an explanation. Peter Ganong gratefully acknowledges residence at MDRC when working on this project and funding from the Joint Center for Housing Studies and the NBER Pre-Doctoral Fellowship in Aging and Health. Daniel Shoag and Peter Ganong gratefully acknowledge support from the Taubman Center on State and Local Government. Animations illustrating the changes in income convergence, directed migration, and regulations can be found at http://www.people.fas.harvard.edu/~ganong/motion.html.

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.[1] Over the past thirty years, this relationship has weakened dramatically (see Figure 1).[2] 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.

During the century-long era of strong convergence, population also flowed from poor to rich states. Figure 2 plots "directed migration": the relationship between population growth and income per capita across states. Prior to 1980, people were moving, on net, from poor places to richer places. Like convergence, this historical pattern has declined over the last thirty years.

We link these two fundamental reversals in regional economics using a model of local labor markets. In this model, changes in housing regulation play an important role in explaining the end of these trends. Our model analyzes two locations that have fixed productivity differences and downward-sloping labor demand. When the population in a location rises, the marginal product of labor (wages) falls. When the local housing supply is unconstrained, workers of all skill types will choose to move to the productive locations. This migration pushes down wages and skill differences, generating income convergence. Unskilled workers are more sensitive to changes in housing prices. When housing supply becomes constrained in the productive areas, housing becomes particularly expensive for unskilled workers. We argue that these price increases reduce the labor and human capital rebalancing that generated convergence.

The model's mechanism can be understood through an example. Historically, both janitors and lawyers earned considerably more in the tri-state New York area (NY, NJ, CT) than

[1] See Barro and Sala-i Martin [1992], Barro and Sala-i Martin [1991], and Blanchard and Katz [1992] for classic references.

[2] Figure 1 plots convergence rates (change in log income on initial log income) for rolling twenty-year windows. The standard deviation of log per capita income across states also fell through 1980 (sigma convergence), and then held steady afterward. The end of this type of convergence demonstrates that the estimated decline in convergence rates is not due to a reduction in the variance of initial incomes relative to a stationary shock process.The strong rate of convergence in the past as well as the decline today do not appear to be driven by changes in measurement error. When we use the Census measure of state income to instrument for BEA income, or vice-versa, we find similar results. The decline also occurs at the Labor Market Area level, using data from Haines [2010] and U.S. Census Bureau [2012]. We report additional results connected to these measures in the Appendix. The decline of convergence has been observed at the metro-area level in Berry and Glaeser [2005]. See also chapter 2 of Crain [2003] and Figure 6 of DiCecio and Gascon [2008].

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.[3] Migration responded to these differences, and this labor reallocation reduced income gaps over time.

Today, though nominal premiums to being in the NY area are large and similar for these two occupations, the high costs of housing in the New York area has changed this calculus. Though lawyers still earn much more in the New York area in both nominal terms and net of housing costs , janitors now earn *less* in the NY area after housing costs than they do in the Deep South.[4] This sharp difference arises because for lawyers in the NY area, housing costs are equal to 21% of their income, while housing costs are equal to 52% of income for NY area janitors. While it may still be "worth it" for skilled workers to move to productive places like New York, for unskilled workers, New York's high housing prices offset the nominal wage gains.

We build on research showing that differences in incomes across states have been increasingly capitalized into housing prices (Van Nieuwerburgh and Weill [2010], Glaeser et al. [2005b] Gyourko et al. [2013]). In this paper, we show that the returns to living in productive places net of housing costs have fallen for unskilled workers but have remained substantial for skilled workers. In addition, we show that skilled workers continue to move to areas with high nominal income, but unskilled workers are now moving to areas with *low* nominal income but high income net of housing costs. Each of these stylized facts represents the aggregate version of the lawyers and janitors example above.

To better understand the causes and consequences of housing price increases, we construct a new panel measure of land use regulation. Our measure is a scaled count of the number of decisions for each state that mention "land use," as tracked through an online database of state appeals court records. We validate this measure of regulation using existing cross-sectional survey data. To the best of our knowledge, this is the first national panel measure of land use regulations in the US.[5]

Using differential regulation patterns across states, we report five empirical findings that

[3] In 1960, wages were 42% and 85% higher in NY than in the Deep South for lawyers and janitors respectively. After adjusting for housing costs (12 times monthly rent of .05 of home value), these premia were 41% and 68%.

[4] In nominal terms, the wages of lawyers and janitors are 45% and 32% higher in NY respectively in 2010. After adjusting for housing prices, these premia are 37% and -6%.

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

connect housing supply limits to declines in migration and income convergence. 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. With constrained housing supply, the net migration of workers of all skill types from poor to rich places is replaced by skill sorting. Skilled workers move to high cost, high productivity areas, and unskilled workers move out. Finally, income convergence persists among places unconstrained by these regulations, but it is diminished in areas with supply constraints.

To assess whether these patterns reflect a causal relationship, we conduct three tests designed to address omitted variable bias and possible reverse causality. First, we repeat our analysis using a placebo measure of all court cases, not just those restricted to the topic of land use. In contrast to our results for land use cases, we find no impact on the outcomes of interest using this measure. Second, we use a state's historical tendency to regulate land use as measured by the number of cases in 1965 and study the differential impact of broad national changes in the regulatory environment after this date.[6] We find that income convergence rates fell after 1985, but only in those places with a high latent tendency to regulate land use. We repeat this exercise using another predetermined measure of regulation sensitivity based on geographic land availability from Saiz [2010] at both the state and county levels. 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 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.[7] We build on an older tradition of work by economic historians (Easterlin [1958] and Williamson [1965]) as formalized by Braun [1993], in which directed migration drives convergence. Similarly, much of the existing literature on recent regional patterns in the US emphasizes changes in labor demand from skill-biased technological change and its place-based variants (Autor and Dorn [2013], Diamond [2012], Moretti [2012b]). Our explanation, which is complementary to these other channels, emphasizes the role of housing supply constraints. In Section 5, we discuss thse alternate channels and their inability to fully account for the data in the absence of housing supply constraints.

The remainder of the paper proceeds as follows. In Section 2, we develop a model to ex-

[6]Many authors use a region's historical features interacted with national changes. For example, Bartik [1991] uses historical industry shares, Card [2009] uses historical ethnicity shares, and Autor and Dorn [2013] use historical occupation shares.

[7]See Barro and Sala-i Martin [1992], Caselli and Coleman [2001], Michaels et al. [2012], and Hseih et al. [2013].

plore the role of labor migration and housing supply in convergence. Section 3 demonstrates that this model is consistent with four stylized facts about migration and housing prices. Section 4 introduces a new measure of land use regulation and directly assesses its impact on convergence, Section 5 considers alternative forces at work during this period, and Section 6 concludes.

2 A Simple Model of Regional Migration, Housing Prices, and Convergence

In this section, we develop a simple model to structure our study of the interaction between directed migration, housing markets, and income convergence. 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 combines elements from Braun [1993] and Gennaioli et al. [2013b], who solves a dynamic model of migration and regional convergence, and Gennaioli et al. [2013a], who study a static regional model with heterogeneous skill types.

Our model considers two locations within a national market: a more productive North and a less productive South. Tradable production employs the local labor supply and has decreasing returns to scale.[8] As a consequence of this assumption, more workers in a location drives down average wages. We solve a similar model without decreasing returns in production in Appendix B. Workers are endowed with a skill level, and skilled and unskilled labor are imperfect substitutes in the production of tradables.

Workers in each location consume two goods: non-tradable housing and a tradable numeraire. All workers must consume a baseline, non-utility producing amount of housing in their respective location. This non-homotheticity, which we implement using a Stone-Geary utility function, ensures that housing accounts for a smaller share of skilled workers' consumption baskets.

Next, we consider the interregional allocation of labor. We begin from initial productivity levels such that real 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 in production. Conversely, wages rise in the South as labor becomes more scarce. The positive impact on

[8] We view this assumption as a reduced form representation of a more complicated process. An alternative way of motivating downward-sloping labor demand could use constant returns to scale in production, each region producing a unique good, and a taste for variety in consumption.

wages in the South and negative impact in the North generate interregional convergence in incomes. If there is a shock that causes the cost of new construction to rise, however, housing prices rise in North, and migration flows become smaller and biased towards skilled workers. Because fewer people move to the North – and because the people who move there are more skilled – income convergence slows. We demonstrate these effects in an illustrative simulation below and in calibration exercises in Appendix A.

Our interpretation of the data relies on two crucial features of the model:

1. Regional labor demand slopes downward. A few examples from the economic history literature help illustrate this concept. First, Acemoglu et al. [2004] study labor supply during and after World War II. States which had more mobilization of men had increased female labor force participation. 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. We present two methods of deriving this downward sloping labor demand in the paper (Appendix B contains a version without decreasing returns in production), and while our results do not depend on the derivation, they do rely upon the concept. While the extent of this effect is an open question, many papers find evidence for downward-sloping labor demand and our interpretation of the data is consistent with this view.[9]

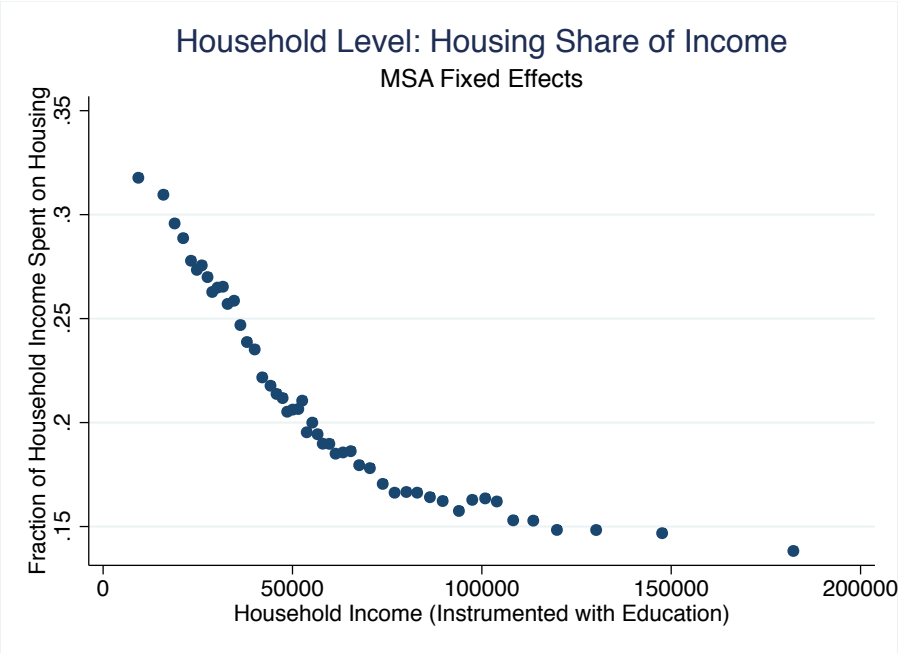
2. Housing is an inferior good *within* a city; meaning that within a labor market, low-skill workers spend a disproportionate share of their income on housing.[10] Many studies have estimated Engel curves for housing, and some find elasticities slighly below one.[11] These estimates generally differ from the parameter of interest in our model in two ways. First, they often express housing as a share of consumption rather than as a share of income (Diamond [2012]). Second, they estimate Engel curves across labor markets rather than within labor markets. These differences mute the non-homotheticity of housing demand due to the positive correlation between income and savings rates, and

[9] See Iyer et al. [2011], Boustan et al. [2010], Cortes [2008], and Borjas [2003].

[10] In fact, our model requires the weaker assumption that *land* within a labor market is an inferior good. The structural value of housing can be treated as non-housing consumption in our framework. The literature that has estimated the income elasticity of land consumption robustly shows income elasiticites below 1 even in the national cross-section (Glaeser et al. [2008]). Glaeser and Gyourko [2005] and Notowidigdo [2013] provide indirect evidence of non-homotheticity in migration patterns.

[11] See Harmon [1988] for an example. Similarly, Davis and Ortalo-Magné [2011] demonstrates that expenditure shares on housing are relatively flat when not adjusting for skills.

due to the positive correlation between incomes and house prices across cities. Below we plot the relevant *within*-city Engel curve using housing as a share of household income and instrumenting for household income with education to address measurement error (Ruggles et al. [2010]). As is evident in the figure, there is a considerable degree of non-homotheticity within labor markets when measuring housing as a share of income. We calibrate our model to match this degree of non-homotheticity in Appendix A.



Note: This figure plots the relationship between the share of household income spent on housing and average household income in the 2010 ACS, conditional on MSA-level fixed effects. Annual income is volatile, meaning that the baseline non-homothetic cross-sectional relationship between housing share and annual income might not reflect the true relationship between housing share and permanent income. To address this issue, we instrument for household income using the education level of its prime age members (25-65). We construct predicted income for each household by summing the average wages associated with the detailed education level of all the household's prime age members. To make this non-homothetic relationship easier to see, we then divide the sample into 50 bins based on household predicted income and plot the average housing share for each bin, controlling for the MSA fixed effects. This data presentation technique is widely used (see Chetty, Friedman, and Rockoff 2013 for an example). Housing expenditure is computed as twelve times monthly rents or 5% of housing costs. Housing shares above 100% and below zero are excluded.

We now describe our model for each state's economy, before turning to the model's interregional dynamics.

2.1 Within-state equilibrium

Each location consists of three markets: a market for labor, a housing market, and a goods market that clears implicitly.

Individual Decisions: Goods Demand and Indirect Utility There are n_{jkt} agents are endowed as either skilled or unskilled in production $k \in \{s, u\}$, and have utility in state $j \in \{N, S\}$ at every date t of

$$\max_{\{c_{jkt}, h_{jkt}\}} \sum_t e^{-rt} ln(u_{jkt})$$
$$\text{where } u_{jkt} = c_{jkt}^{\beta} \left(h_{jkt} - \bar{H}\right)^{1-\beta}$$
$$\text{subject to } c_{jkt} + p_{jt} h_{jkt} = w_{jkt} + \pi_t \tag{1}$$

Workers' preferences take the Stone-Geary functional form with a baseline housing requirement $\bar{H}$ that is common for both skilled and unskilled workers. This functional form generates non-homothetic housing demand.[12] To keep things simple, we assume inelastic labor supply and abstract from intertemporal markets by imposing a static budget constraint.[13] Workers receive the local wage w_{jkt} for their skill type k and the price of housing relative to tradables is p_{jt}. Profits from both the housing sector and the tradable sector in North and South (π_t) are rebated lump-sum nationally. We can therefore write each agent's indirect utility as a function of the wage, price and preference parameters:

$$v_{jkt}(w_{jkt}, p_{jt}) = ln \left(\left(w_{jkt} + \pi_t - p_{jt}\bar{H}\right) \beta^{\beta} \left(\frac{1-\beta}{p_{jt}}\right)^{1-\beta} \right)$$

Labor Market Next, we turn to the production of tradables. State-level production is given by

$$Y_{jt} \quad = \quad A_j \left(n_{jut}^{\rho} + \theta n_{jst}^{\rho}\right)^{\frac{1-\alpha}{\rho}}$$

where n_{jk} is the number of people of type k residing in state j.[14] We normalize $A_S = 1$ throughout, and assume $A_N > 1$. This term can encompass capital differences, natural advantages, institutional strengths, different sectoral compositions, amenities, and agglomeration benefits. Assuming labor earns its marginal product, we have:

[12] See Mulligan [2002] and Kongsamut et al. [2001] for other examples of papers using Stone-Geary preferences.

[13] We allow for endogenous labor supply in a calibration exercise in Appendix A.

[14] This widely used form of imperfect substitution ensures an interior solution for skill ratios in equilibrium.

$$w_{jut} = A_j (1-\alpha) \left(n_{jut}^{\rho} + \theta n_{jst}^{\rho}\right)^{\frac{1-\alpha-\rho}{\rho}} (n_{jut})^{\rho-1} \tag{2}$$

$$w_{jst} = A_j (1-\alpha) \theta \left(n_{jut}^{\rho} + \theta n_{jst}^{\rho}\right)^{\frac{1-\alpha-\rho}{\rho}} (\theta n_{jst})^{\rho-1} \tag{3}$$

Equilibrium in each these markets is given by the wage such that $l_{jkt}^{demand}(w_{jkt}) = n_{jkt}$.

Housing Market Define the quantity of housing in place j at time t as H_{jt}. Every state is endowed with a housing supply at time zero equal to the demand of the initial population. Regulations can only affect new construction. Because they are designed to minimize the amount of cumulative development, we model them as imposing a convex cost as a function of the existing housing stock, where η, the measure of regulatory constraints, governs the elasticity of supply in growing regions. The marginal cost per unit of construction is

$$c(H_{jt}, H_{jt-1}) = \begin{cases} 0 & H_{jt} < H_{jt-1} \\ H_{jt}^{1/\eta} & H_{jt} \geq H_{jt-1} \end{cases}$$

All housing has a fixed maintenance cost to be habitable which we normalize to 1. So long as a city is growing, the price of all housing is equal to marginal cost of construction plus maintenance, so prices are:

$$p_{jt} = \begin{cases} 1 & if\ H_{jt} \leq H_{jt-1} \\ 1 + H_{jt}^{1/\eta} & if\ H_{jt} > H_{jt-1} \end{cases} \tag{4}$$

Regulations affect the dynamics of the system only in places where the population would otherwise be increasing. Demand for housing for each individual is equal to $\bar{H}+(1-\beta)\left(\frac{w_{jkt}+\pi_t}{p_{jt}}\right)$, and therefore aggregate demand is

$$H_{jt} = n_{jut}\left(\bar{H} + (1-\beta)\left(\frac{w_{jut}+\pi_t}{p_{jt}}\right)\right) + n_{jst}\left(\bar{H} + (1-\beta)\left(\frac{w_{jst}+\pi_t}{p_{jt}}\right)\right) \tag{5}$$

We model regulations as affecting the elasticity of supply rather as a direct cost shock. This choice is motivated by empirical evidence that regulations affect the relationship between income and prices and not merely the price itself (see Figure 8 and Table 2). This choice is also consistent with the existing empirical work on regulations and housing (Saiz [2010]and Saks [2008]), and the dominant interpretation in the legal literature (Ellickson [1977]).

Equilibrium Taking $\{n_{jut}, n_{jst}\}$ as given, prices $\{w_{jut}, w_{jst}, p_{jt}\}$ and allocations $\{c_{jkt,}H_{jkt}\}$ that satisfy equations 1-5 constitute an equilibrium in the housing and labor markets. This equilibrium also allows us to write indirect utility as a function of the local population

$(v_{jkt}(n_{jut}, n_{jst}))$.

2.2 Migration and Dynamics

Having characterized the equilibrium within a location, we turn to cross-location dynamics. Normalizing the national population of each skill type to 1, we define $\Delta_{kt} = v_{Nkt}(n_{Nut}, n_{Nst}) - v_{Slt}((1 - n_{Nut}), (1 - n_{Nst}))$ as the flow utility gains to living in the North. Note that when land supply is perfectly elastic ($\eta \to \infty$), Δ_{kt} does not depend on the skill type k.[15] We can now define the present discounted value of migrating from South to North as:

$$q_k(t) = \sum_{\tau=t}^{\infty} e^{-r\tau} \Delta_{k\tau} \tag{6}$$

These expressions depend upon exogenous parameters and shocks, as well as two state variables n_{Nut} and n_{Nst}.

Given these gains to migration, how many people migrate each period? We follow Braun [1993] in assuming that the migration rate is proportional to the present-discounted value of migrating:

$$\Delta ln(n_{Nkt}) - \Delta ln(n_{Skt}) = \psi q_k(t) \tag{7}$$

This equation holds exactly for i.i.d. migration cost draws from a specific distribution derived in Appendix C, or viewed as a linear approximation of a more general class of processes.

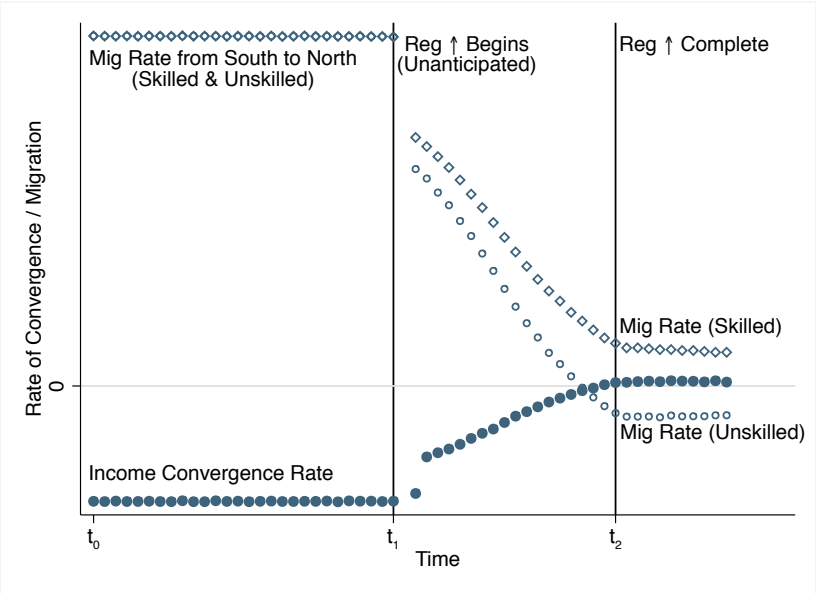
The equations represented in (6) and (7) constitute a dynamic system in terms of two endogenous variables and exogenous shocks and parameters. To illustrate the dynamics of the system, we consider a numeric example. We plot the dynamics in a simulation where (1) the population of skilled and unskilled workers are evenly divided between North and South, (2) the housing supply in the North is completely elastic ($\eta \to 0$), and where (3) the productivity parameter A_N is significantly greater than 1. Given these assumptions, the initial population in the South exceeds the steady-state population values.

The figure below illustrates the dynamics of the system from these conditions until time t_1.[16] When the housing supply in the North is completely elastic, the relative gains to migration are independent of skill type, and hence both high and low productivity workers migrate away from the South at the same constant rate. This directed migration makes labor

[15] This holds under the normalization that $\bar{H} = \pi$.

[16] This graph is meant to illustrate the model's dynamics. To do this, we set $\theta = 1.7$, $\alpha = 0.33$, ρ=0.9, β=0.25, H=0.25, $A_n = 2$, $\psi = 0.005$, and r=0.05. We then simulated a falling housing supply elasticity by having $1/\eta$ ascend from a value near zero to 0.25.

more scarce in the South and more plentiful in the North, which yields a constant rate of convergence in per capita incomes between the regions. Additionally, if there were a larger fraction of unskilled workers in the South, then migration would have driven convergence by equating average human capital levels as well.



At date t_1, the elasticity of housing supply, η, begins to fall and reaches a new, permanently lower level at time t_2. This unanticipated shock increases housing prices in the growing North, and alters the value of living in the North in the future. Both skilled and unskilled migration rates fall, but they do not fall to the same degree. Skilled workers continue to find it worthwhile to move from South to North, but the increase in housing prices actually makes the North relatively unattractive to unskilled workers who begin to move in the opposite direction. The joint effect is that, by t_2, there is no more net migration from South to North and no further convergence in incomes per capita. Instead, migration flows lead to skill-sorting and segregation by skill type.

This model lays out a theory that can account for the changing migration and convergence patterns reported in the beginning of the paper. We assess the validity of this explanation in two ways; we first present stylized facts that suggest housing markets have played a key role in altering migration patterns, and then we introduce a new measure of housing supply restrictions to test this model directly.

3 Motivating Facts on Housing Prices and Migration

In this section, we highlight four stylized facts on the evolution of the flows of and returns to migration in the U.S. These facts motivated the model laid out in the previous section and its emphasis on the elasticity of housing supply.

Fact 1: Differences in Housing Prices Have Grown Relative to Differences in Incomes

In the last fifty years, there has been a shift in the relationship between prices and incomes across states. Figure 3 plots 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 were 1 log point higher in a state with 1 log point higher income. By 2010, the slope had doubled, with housing prices 2 log points higher in a state where income was 1 log point higher.

Fact 2: Housing Prices Have Lowered the Returns to Living in Productive Places For Unskilled Workers

We test for changing returns by examining the relationship between unconditional average income in a state and skill-group income net of housing prices (Ruggles et al. [2010]).[17] With i indexing households and j indexing state of residence, we regress:

$$\underbrace{Y_{ij} - P_{ij}}_{\text{Income-Housing Cost}} = \alpha + \beta_{unskilled} \underbrace{Y_j}_{\text{Nominal Income}} \times (1 - S_{ij}) + \beta_{skilled} Y_j \times S_{ij} + \eta S_{ij} + \gamma X_{ij} + \varepsilon_{ij}$$

where Y_{isj} is household wage income, P_{ij} is a measure of housing costs defined as 12 times the monthly rent or 5% of house value for homeowners, and S_{ij} is the share of the household that is skilled, and Y_j is the mean nominal wage income in the state.[18]

Figure 4 shows the evolution of $\beta_{skilled}$ and $\beta_{unskilled}$ decade by decade. These coefficients measure the returns by skill to living in a state that is one dollar richer. For example,

[17] Ideally, we would have a cost index for the price of all goods and services and use this to deflate income. Moretti [2012a] finds a strong positive correlation between housing prices and the price of other consumer goods. Unfortunately, we are unaware of any regional price indices going back to 1940.

[18] 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 skilled 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.

$\beta_{unskilled}$ is 0.88 in 1940, meaning that for unskilled workers, income net of housing costs was \$0.88 higher in states with \$1.00 higher nominal income. $\beta_{unskilled}$ shows a secular decline from 1970 forward. The decade-specific coefficients on $\beta_{skilled}$ show a different pattern. In 1940 and 1960, skilled and unskilled households had similar returns to migrating. By 2010, income net of housing costs is three times more responsive to nominal income differences by state for skilled households than for unskilled households. The returns to living in high income areas for unskilled households have fallen dramatically when housing prices rose, even as they have remained stable or grown for skilled households.[19]

Fact 3: Migration Flows Respond to Skill-Specific Gains Net of Housing Prices

Next, we examine the extent to which people moved from low to high income places. We estimate income in both nominal terms and using the income net of housing cost measure developed above. We estimate net migration using the Census question "where did you live 5 years ago?", which was first asked in 1940 and last asked in 2000. We use the most detailed geographies available in public use microdata: State Economic Areas in 1940 (467 regions) and migration PUMAs in 2000 (1,020 regions).

In Figure 5, we examine migration patterns from 1935 to 1940. As is evident from the graphs, both skilled and unskilled adults moved to places with higher nominal income.[20] The same relationship holds true for income net of housing cost.[21] In Figure 6, we examine migration patterns from 1995 to 2000. Although skilled adults are still moving to high unconditional nominal income locations, unskilled adults are actually weakly migrating *away*

[19] In the Appendix, we report the results of two robustness checks. First, 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. To be precise, we estimate $Y_{is} - P_{is} = \alpha + \beta_{unskilled}\hat{Y}_j \times (1 - S_{ij}) + \beta_{skilled}\hat{Y}_j \times S_{ij} + \eta S_{ij} + \gamma X_{ij} + \varepsilon_{ij}$, 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 $\hat{Y}_j \times S_{ij}$. Second, we demonstrate that housing costs have differentially changed housing prices in high nominal income places for low-skilled workers.

[20] Migration and education are person-level variables, while income net of housing cost is a household-level variable. We conduct our analysis at the individual level, merging on area-by-skill measures of income net of housing cost. To construct area-by-skill measures, we define households as skilled if the adult labor force participants in said household are skilled, and as unskilled if none of them are skilled. See notes to Figure 5 for details. The specifications shown in Figures 5 and 6 involve some choices about how to parameterize housing costs and which migrants to study. In the Appendix, 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 skilled workers. For unskilled workers, the coefficients broadly fit the patterns in Figure 6, although only sometimes are statistically significant.

[21] These results are similar to work by Borjas [2001], who finds that immigrants move to places which offer them the highest wages.

from these locations.[22] This finding sharply contrasts with the results from the earlier period in which there was directed migration for both groups to high nominal income areas. It is an apparent puzzle that unskilled households would be moving away from productive places. However, this seeming contradiction disappears when we adjust income to reflect the group-specific means net of housing prices. High housing prices in high nominal income areas have made these areas prohibitively costly for unskilled workers. Changes in observed migration patterns are consistent with the changes in the returns to migration shown above.

Fact 4: Migration Used to Generate Substantial Human Capital Convergence Across Regions

We now examine the effect of migration flows on aggregate human capital levels. We present evidence that the transition from directed migration to skill sorting appears to have substantially weakened human capital convergence due to migration. We follow the growth-accounting literature (e.g. Denison [1962], Goldin and Katz [2001]) and estimate a Mincer regression in the IPUMS Census files. 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.[23] We construct predicted income as $\widehat{Inc}_k$ for each education level k and $Share_{kj}$ as the share of people in human capital group k living in state j. A state-level index is Human Capital$_j \equiv \sum_k \widehat{Inc}_k \times Share_{kj}$. Our research design exploits the fact that the Census asks people about both their state of residence and their state of birth. We can then compute the change in the human capital index due to migration as

$$\Delta HC_j \equiv \underbrace{\sum_k \widehat{Inc}_k Share_{kj,residence}}_{\text{Realized Human Capital Allocation}} - \underbrace{\sum_k \widehat{Inc}_k Share_{kj,birth}}_{\text{No-Migration Counterfactual}}$$

Next, we take the baseline measure of what human capital would have been in the absence of migration ($HC_{j,birth}$) and examine its relationship with how much migration changed the

[22] 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.

[23] Formally, we estimate the specification $\log Inc_{ik} = \alpha_k + X_{ik}\beta + \varepsilon_{ik}$ where Inc_{ik} is an individual's annual income, and X_{ik} includes demographic covariates 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+). X_{ik} includes a dummy for Hispanic, a dummy for Black, a dummy for female and four age bin dummies. There is a substantial literature showing that the South had inferior schooling quality conditional on years attained (e.g. Card and Krueger [1992]). Thus this measures is, if anything, likely to underestimate the human capital dispersion across states.

skill composition of the state (ΔHC_j). Specifically, we regress

$$\Delta HC_j = \alpha + \beta HC_{j,birth} + \varepsilon_j$$

Figure 7 shows the results of this regression for different years in the U.S. Census. We focus our analysis on people ages 25 to 34 to focus on people who have completed their education but are likely to have migrated recently.[24] We estimate a slope of $\hat{\beta} = -0.33$ in the 1960 Census. Of the human capital dispersion by state of birth, migration of low human capital workers to high human capital places was sufficient to eliminate 33% of the disparities in human capital. By 2010, migration would have eliminated only 8% of the remaining disparity.[25]

4 A Panel Measure of Housing Regulations

These stylized facts suggest that changes in housing prices were an important contributor to changing migration and convergence patterns. The model formalized this idea and highlighted the importance of changes in the elasticity of housing supply in growing regions. In this section, we explore the role of regulations directly. We develop a new measure of housing supply regulations based on state appeals court records. Past empirical work has shown tight links between prices and measures of land use regulation in the cross-section, and these regulations are a good proxy for the parameter η in the model.[26] This new measure is, to the best of our knowledge, the first panel of housing supply regulations covering the United States and we validate it against existing cross-sectional regulation measures.[27] We use this measure to test for the entire causal chain of the model by showing that housing supply constraints reduce permits for new construction, raise prices, lower net migration, slow human capital convergence and slow income convergence.

[24] To the extent that people migrate before age 25 (or their parents move them somewhere else), we may pick up older migration flows. Nevertheless, this statistic still has a well-defined interpretation as the amount of human capital convergence due to migration within a cohort.

[25] This figure shows that migration contributed to convergence in human capital levels. Looking at convergence in average human capital levels, including native-born residents human capital investment decisions, we do not see the same decline in human capital convergence for the same aged sample. This occurs in part because the fraction of natives completing high school rose sharply among low human capital Southern states in the 1970's and 1980's, while this fraction was already high for the rest of the country.

[26] Examples 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.

[27] In a similar spirit, Hilber and Vermeulen [2013] analyze a panel of land use regulations in the UK.

4.1 Measuring Land Use Regulations

Our measure of land use regulations is based upon the number of state 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. We also show similar results for the phrase "zoning" in the Appendix. Municipalities use a wide variety of tactics for restricting new construction, but these rules are often controversial and any such rule, regardless of its exact 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 searched the state appellate court records for each state-year using an online legal database 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. Figure 8 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.

We validate our measure against the existing cross-sectional measures that focus on supply constraints. The first 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]).[28] 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 Figure 8, the 1975 values of our measure are strongly correlated with this measure. Similarly, our measure is highly correlated with the 2005 Wharton Residential Land Use Regulation Index (WRLURI).[29] Finally, state-years with high levels of regulation show increased capitalization of income into housing prices.

4.2 Why Did Land Use Regulations Change?

Since Ellickson [1977]'s seminal article, it has been widely accepted that municipalities' land use restrictions serve to raise property values for incumbent homeowners.[30] In this section, we examine the institutional and demographic factors which may have led such regulations

[28] Saks [2008] also uses this survey as a measure of land use regulations.

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

[30] Blanchflower and Oswald [2013] demonstrate the link between homeownership and land use regulation empirically.

to become more widespread and more effective in constraining supply across an entire region.

Many land use scholars point to a landmark shift toward new stringencies in regulations in the 1960's and 1970's. Fischel [2004] argues that in the wake of racial desegregation, land use restrictions allowed suburban residents to keep out minorities using elevated housing prices, and that environmentalism provided a sanitized language for this ideology. He writes "I submit that neighbour empowerment and double-veto systems, in conjunction with local application of environmental laws, changed metropolitan development patterns after 1970." In a book on land use regulation, Garrett [1987] writes

> A changing public attitude toward growth and development within many local communities emerged in the early 1960s. Two factors were simultaneously responsible for this change. First, there was an increasing concern over environmental issues, and it was apparent that certain types of economic development were detrimental to the environment. Second, economic analysis began to demonstrate that all forms of economic development did not generate a positive fiscal impact in every community.

Along similar lines, the American Land Planning Law textbook (Taylor and Williams [2009]) write that, after a period in the 1900's during which courts typically held the application of restrictions to particular tracts of land to be invalid, the courts "went to the other extreme, tending to uphold anything for which there was anything to be said." Our statistical regulation measure is broadly consistent with this argument, although the change in the intellectual climate described above somewhat preceded the run-up in our measure – the flow of new land use cases rose sharply from 1970 to 1990.

Because land use rules are administered at the local level, there are no seminal Supreme Court cases which marked this new era of jurisprudence. Among state cases, scholars typically cite *Mount Laurel vs. National Association for the Advancement of Colored Persons* (NAACP) as among the most important. Philadelphia suburb Mount Laurel, at the time composed primarily of single family houses, adopted rules which required that developers of multi-family units provide in leases that (1) no school-age children may occupy a one-bedroom unit and (2) no more than two children may occupy a two-bedroom unit. In addition, should a development have more than 0.3 children per unit on average, the developers were required to pay any additional tuition costs. The NAACP sued, and in 1975, the New Jersey Supreme Court ruled in its favor, finding that each community had to provide its "fair share" of "low- and moderate-income housing."

While the NAACP won the case, Mount Laurel and like-minded suburbs won the war. Mount Laurel's new planning ordinance rezoned only 20 of its 14,300 acres, choosing locations such that "the new zones had serious physical difficulties and restrictions created by the ordinance that rendered their actual development for low-cost housing virtually impossible" (Garrett [1987]). In 1977, the state Supreme Court issued a new ruling in the *Oakwood at Madison* decision, which substantially rolled back its prior decision, finding instead that that courts were not competent to determine what constituted a "fair share". These cases led to the "Mount Laurel Doctrine," wherein judges began to play a continuing role in monitoring local zoning policies, but the sea change had already occurred in New Jersey. From 1970 to 2010, its urban population grew at an annual rate of 0.4%, less than half the national average for this period.[31]

New state and regional environmental restrictions on land use, detailed in a White House report titled "The Quiet Revolution in Land Use Control", added another constraint on new construction. These restricions played a crucial role in preventing construction on a metro-wide level, an argument highlighted by Ellickson [1977]. In a Tiebout model where consumers choose locations, if some municipalities restrict construction as Mount Laurel did, and other places respond by issuing more permits, then the aggregate impact on new units and average prices could be zero. For example, in the East Bay region in California, while many municipalities restricted construction, the coastal city of Emeryville adopted developer-friendly policies, yielding much higher-density units. In 1969, the California Legislature gave the San Francisco Bay Conservation and Development Commission the power to require permits from anyone seeking to develop land along the shoreline (Bosselman and Callies [1971]). The Commission then blocked a plan by Emeryville to fill the Bay and construct large developments there.[32] The East Bay has remained an attractive place to live, but with no municipality willing to allow new construction, housing prices across the East Bay have soared in recent years.

Local variation in regulations is not randomly assigned; it is the product of substantial work by local governments and regulatory bodies. There is some recent work on the political economy of the regulations. Kahn [2011] shows that in California, cities which vote Democratic tend to issue fewer housing permits. Hilber and Robert-Nicoud [2013] and Schleicher [2013] develop political economy stories where changes in the share of developed land, and in the structure of city politics, respectively, cause changes in land use policies.

[31] Urban population is defined as population living in a Primary Metropolitan Statistical Area.

[32] A change in town leadership in the election of 1987 also led to a slowdown in new development. Nevertheless, Emeryville today still has some of the highest-density construction in the East Bay and this new regional authority further limited Tiebout competition.

In our empirical analysis, we first examine the relation between regulation and regional economic outcomes. Then, cognizant of the fact that regulations do not arise randomly, we address concerns about causality by studying the heterogeneity of states' responses to the national change in the regulatory environment described above. We test whether this aggregate change had a different impact on the convergence rates of states with larger or smaller historical tendencies to regulate land use, and for states with more or less severe geographic limits on development. We also consider the main alternative interpretations of the data in Section 5, and find that housing supply constraints are required to make sense of the data.

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4.3 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. Before turning towards regressions, we first demonstrate the effect of land-use regulations on convergence graphically. Figure 9 shows differential convergence patterns among the high and low regulation states. The convergence relationship within the low regulation states remains strong throughout the period. 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 convergence coefficients among states with tight regulations display a pronounced weakening over time (although convergence reappears briefly among high-regulation states during the recent recession). 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]. Again, we find that convergence continues among states without supply constraints, but has stopped primarily in states with constraints.

We now turn towards regressions and explore the effect of regulations more rigorously on the entire convergence mechanism described above. It is not obvious 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:

$$Reg_{s,t} = Rank\{\frac{LandUseCases_{st}}{Pop_{st}}\}$$

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.[33] Regulations are rising over time, from an average of 0.15 in 1950 to 0.64 in 1990.

Our baseline specifications are of the following form:

$$Y_{s,t} = \alpha_t + \alpha_t Reg_{s,t} + \beta Inc_{s,t} + \beta_{\text{high reg}} Inc_{s,t} \times Reg_{s,t} + \varepsilon_{s,t} \tag{8}$$

The coefficients of interest, β and $\beta_{\text{high reg}}$, measure the effect of lagged income in low and high regulation state-years and are reported in Table 2.[34]

First, we examine housing supply. Absent land use restrictions, places with higher income will face greater demand for houses and will permit at a faster rate. Accordingly, the base coefficient on income in column 1 is positive, indicating that places with 10% higher incomes had a .5% higher annual permitting rate. 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. This reduction in housing supply in high-income places means that housing prices should rise in those places. 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), but that the slope of the relationship doubles in high regulation state-years. Income differences are increasingly capitalized into prices.[35]

Columns 3 and 4 explore migration responses to this change in prices. In our model, states with high income per capita will draw migrants when regulation is low, consistent with the baseline coefficient in column 3 that shows 0.17% higher annual population growth

[33] We conduct robustness tests on alternate scaling of the regulation measure in the appendix. We also explore the robustness of the relationship between declining income convergence and regulations in alternate regression models in Appendix Table 6. Specifically, this table reports the following specifications in the correspondingly numbered columns: (1) Our baseline convergence relationship; (2) A specification where the regulation variable is interacted with a dummy for greater than median income. This follows our model in assuming that regulations only bind in growing locations; (3) A specification that controls for the percent of the population with a BA and the interaction of this share with initial income. This specification, like Section 5.1, is designed to show the robustness of the regulation result to controls for skill-biased technological change; (4) A specification with log income squared, accounting for potential nonlinearity in convergence; (5) A specification that includes Census division fixed effects interacted with regulations to account for differential regulation growth across regions; (6) A specification that includes year fixed effects interacted with initial income, which allows for different baseline convergence rates across time. In all of these models, the relationship between tighter regulation and slower convergence remains statistically significant.

[34] 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.

[35] 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. Davidoff writes "Unfortunately, a panel of regulations is not available, so there is no way to determine if time series changes in regulations are associated with changes in supply."

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. We also examine how the composition of migration responds to income, using the change in the log of the human capital measure from Section 3. When housing supply is elastic, the negative baseline coefficient in column 4 indicates that migration undoes any initial human capital advantage held by productive places. The interaction coefficient is positive, indicating that human capital convergence slows among high regulation observations.

Finally, Column 5 brings this analysis full circle by directly looking at the effect of high regulations on the convergence relationship. The uninteracted coefficient (-2.0) captures the strong convergence relationship that exists absent land use restrictions shown in the early years in Figure 1. 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.

One potential concern is that our 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 repeat the analysis above substituting placebo measure

$$RegPlacebo_{s,t} = Rank\{\frac{Cases_{st}}{Pop_{st}}\}$$

This measure also exhibits secular growth, from an average of 0.30 in 1950 to 0.66 in 1990. This means that if our results above were due to changes in the overall state-level regulatory climate or due to time trends, then we should expect them to also appear as part of this placebo test. Instead, however, we find that the interaction coefficients on $RegPlacebo_{s,t}$ are small in magnitude and not statistically significant.

Table 2 tightly links the theory from Section 2 to the observed data. The first row of coefficients describe a world where population flows to rich areas, human capital converges across places, and regional incomes converge quickly as in the model before the regulatory shock. The second row of coefficients is consistent with the high regulation regime described in the model after the shock, with increased capitalization, no net migration, and much less income convergence.

4.4 Identification from National Changes and Preexisting Regional Differences

This section analyzes evidence in favor of a causal relationship between land use regulations and convergence. In the 1970s there was a dramatic change in the prevalence of land use regulations in the US, as described by land use scholars in Section 4.2. Though our regulation measure is lower across the board prior to the 1970s, states nevertheless differed in their legal cultures regarding land use and in their natural supply constraints. This heterogeneity made some states more likely to be affected by change in the national climate towards land use regulations. 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], and Autor and Dorn [2013]).

We estimate specifications of the form

$$\Delta Inc_{s,t} = \alpha_t + \alpha_t LatentConstraint_s + \beta Inc_{s,t} + \beta_{\text{constrained}} Inc_{s,t} \times LatentConstraint_s + \varepsilon_{s,t}$$

where $LatentConstraint_s$ are measures of a state's susceptibility to regulations that are fixed across time. We split 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 1965-1985 through 1990-2010. Statistically, this takes the form of testing whether $\beta_{\text{constrained}}$ is the same in the pre and the post period. Before turning to preexisting measures, we first demonstrate the result of this test when using a recent cross section of regulations. Columns 1 and 2 demonstrate that states with high and low-regulation in 2005 had similar convergence rates in the first half of the sample, but that convergence slowed in high-regulation states after these restrictions were enacted. A potential concern raised above is that changes in skill composition, demographics or industrial patterns raised regulations and independently affected migration and convergence patterns. To gauge the importance of this bias, Columns 3 and 4 re-estimate this relationship controlling for a wide variety of state level measures of industry and skill composition from Autor and Dorn [2013] and show similar results.[36]

Controlling for potentially confounding covariates does not address the possibility of reverse causality through unobserved channels. Although regulation was low across the board in 1965, there is still cross-sectional variation in our measure for that year. This variation in permissiveness to laws regarding land use is predictive of subsequent increases in regulation,

[36]Specifically, we control for their measures of the share of workers in routine occupations, the college to non-college population ratio, immigrants as a share of the non-college population ratio, manufacturing employment share, the initial unemployment rate, the female share, the share age 65+, and the share earning less than the 10 year ahead minimum wage. We aggregate their data to the state level via population weighting.

and the correlation between the measures in 1965 and 2005 is 0.47. Though this measure is correlated with eventual regulation outcomes, variation in this measure cannot be plausibly explained by a subsequent shock affecting migration and convergence. Nevertheless, we find that states with low and high regulation values displayed similar convergence behavior in the first half of the sample. In the second half, once these latent tendencies had been activated in the form of high regulations, these states experience a sizeable drop in their degree of income convergence.

Finally, we classify counties based upon the geographic availability of developable land using data from Saiz [2010].[37] This measure can not be affected by any shock altering migration or convergence, yet it too should predict the severity of supply constraints after a nationwide rise in building restrictions. Again, the table demonstrates that counties with low geographic land availability did not display different convergence behavior in the past. In the period with tight building restrictions, however, these counties also experience a reduction in their rates of income convergence.

We interpret these results as consistent with a change in housing supply constraints over time, with a latent tendency to regulate that was higher among states with more land use cases in 1965.[38] Table 3 shows that if housing supply restrictions did not affect income convergence, then regulations must be correlated with a non-related convergence-ending shock, and this new shock must also be correlated with both states' geography and historical legal structures. Moreover, such an explanation would have to explain why neither feature influenced convergence rates prior to the period of high land use regulation. Although it is possible to generate such an explanation, articulating such a story is sufficiently complicated that we feel the weight of the evidence supports a role for housing supply restrictions.

5 Other Factors Affecting Convergence

Our analysis thus far has explored the role that housing regulations have played in changing skill-specific labor mobility and income convergence. Of course, other factors are likely to

[37] Saiz [2010] produces a metro-area level measure of developable land. Using data from the Census, we build a consistent series for median household income at the county-level. While the unit of observation is the county, we cluster our standard errors at the metro area level.

[38] One alternative interpretation is that our 1965 empirical measure detects fixed, heterogeneous elasticities across places. This interpretation is inconsistent with the secular increase in land use cases shown in Figure 8. It is also inconsistent with sustained income convergence and directed migration observed in the data from 1880 to 1980. If the North had substantial barriers to new construction before 1980, then its population could not have grown so rapidly beforehand.

affect both patterns, and in this section, we consider how these forces relate to the results in the previous section.

5.1 Skill Biased Technological Change

Conceptually, skill-biased technological change (SBTC) could slow the rate of convergence for several reasons.

Consider an increase in the skill premium. This change would have two effects on convergence rates. It mechanically widens the income gaps between richer, more educated states and poorer, less educated ones. Additionally, in our model, it raises the returns to migration for skilled workers living in low-income states. The change in the returns to migration is complementary to our supply constraints story – both forces serve to make migration to rich places more heavily weighted towards skilled workers. As for the magnitude of the mechanical effect, Autor et al. [2008] estimate that the college-high school premium rose from 0.40 in 1980 to 0.64 in 2000. The share of people with a BA (henceforth "share BA") in 1980 had a standard deviation of 3 percentage points across states, and the mechanical increase in the skill premium would have reduced the annual convergence rates by roughly 0.18. The observed change in annual convergence rates was 1.11, meaning that the mechanical effect of SBTC provides a partial but incomplete account for the change.

Finally, it is possible that as skills have become more important, incomes of everyone in high share BA places would rise due to agglomeration externalities. We know from the work of Gennaioli et al. [2013a] that human capital levels play a central role in determining the level of regional development (see also Moretti [2012b], Glaeser and Saiz [2004], Berry and Glaeser [2005]). Under this theory, incomes would grow more quickly in these places, slowing convergence. One testable prediction which differentiates this story (a demand shock in productive areas) from our housing supply constraints story comes from skill-specific migration patterns. A positive demand shock should *raise* in-migration rates for all workers. If this demand shock mostly affected skilled workers, then it should raise the migration rate for skilled workers. In contrast, a negative housing supply shock predicts sharply falling in-migration by low-skill workers and a smaller decline in in-migration for skilled workers. Although information-economy cities such as San Francisco, Boston and New York offer high nominal wages to all workers (typically in the top quintile nationally), after adjusting for housing costs all three cities offer below average returns to low-skill workers (typically in the bottom decile). In Table 4, we examine the flows of unskilled and skilled workers in 1980 and 2010 to high skilled states as measured in 1980. This period and independent variable

were chosen to be consistent with the literature on skill agglomerations.

There has been a marked shift in the composition of migration to high share BA places. From 1980 to 2010, there was a large decrease in the in-migration rate of low-skilled workers to high share BA states, and no change or a small decline in the in-migration rate of skilled workers to high share BA states. These results suggest that rising share BA in areas with a high initial share of BAs documented by other researchers may partially be the result of out-migration by unskilled workers and increased domestic human capital production, rather than increasing in-migration by skilled workers. Overall, SBTC and its place-specific variants are complementary with the supply constraints story developed here. When supply is constrained, increases in demand for skilled labor serve to further slow convergence.

5.2 Different Steady States: Convergence Has Already Happened

Income gaps across states are smaller today than they were in the past. Perhaps differences in incomes today reflect steady-state differences. While possible, two pieces of evidence are inconsistent with this suggestion. First, a close examination of Figure 1 shows that from 1940 to 1960 there was within-group convergence among the rich states as well as among the poor states. The income differences between Connecticut and Illinois or Mississippi and Tennessee in 1940 are smaller than the differences between Connecticut and Mississippi in 1990, and yet there was substantial within-group convergence from 1940 to 1960 and much less from 1990 to 2010. Second, our analysis with the regulation measure (e.g. Figure 9) shows substantial within-group convergence in the low regulation group, suggesting that existing income differences today are sufficiently large and transitory as to make convergence possible.

5.3 Racial Migration Patterns

In parts of the previous analysis, we did not distinguish between the income convergence and migration patterns of different racial groups. A possible interpretation of the migration patterns we observe over this period might attribute them to black mobility for non-economic motives. If changes in racial discrimination were correlated over time and across places with changing land use regulations, then our results may falsely attribute a causal role to housing prices in ending convergence. To check this possibility, we re-create the top two panels of Figures 1, 2, and 9 using income and population growth rates for whites only. These results

(presented in Appendix A.3) show that outcomes for whites closely follow the aggregate pattern.

5.4 Land Constraints, Productive Land and Physical Capital

Our analysis abstracted from considerations about the role of land and physical capital and in this section, we consider these factors briefly.

While there are certainly technological and physical constraints to urban growth, we believe that regulatory constraints have been the primary barrier to new construction. Our view is based on two sets of facts: growth has fallen in some wealthy areas very heterogeneous densities, and there is a strong correlation between growth slowdowns and our measure of regulations.

Perhaps the most striking example of a growth slowdown comes from the Primary Metropolitan Statistical Area (PMSA) formed by Bergen and Passaic counties in New Jersey, which are located directly across the Hudson River from New York City. Starting from a density of about 1,700 people per square mile in 1940, this area's population grew at a rate of over 2% a year. Then, having reached a density of about 3,200 people per square mile in 1970, over the next thirty years, its population grew by 0.04% at an annual rate. Perhaps 3,200 people per square mile is a technological cutoff to feasible density, or Americans have a strong preference for density to be less than this value. However, the data show a pattern of low population growth rates among urban areas with very heterogeneous densities. Annual population growth from 1990 to 2010 was 0.5% or lower in the PMSAs of Jersey City (with density of 11,800 people per square mile in 1990), San Francisco (density: 1,600), and Boston (density: 1,600). If Bergen-Passiac's density were the natural limit, then we would have expected to see continued growth in San Francisco and Boston. Further, while there might be heterogeneity in natural density limits across places, it seems unlikely that these limits would be naturally correlated with both the time and cross-sectional pattern of regulations. Thus, while the baseline migration and convergence facts might be consistent with heterogeneous, fixed supply curves, this evidence suggests policy-driven supply changes.

Our analysis also abstracted from the role of land in production, but it is straightforward to incorporate this factor as a complement in production by setting $Y_{jt} = A_j \times \left(n_{jut}^{\rho} + \theta n_{jst}^{\rho}\right)^{\frac{1-\alpha-\beta}{\rho}} Land^{\beta}$. If regulations reduced the availability of residential and productive land, then the marginal product of labor would fall in areas with tighter restrictions. Given that the rise in regulations is correlated with income, this would increase the speed of convergence. We have shown that convergence has actually slowed considerably, meaning

that the countervailing forces described in our model must be sufficient to overcome this channel.

Past work, most notably Barro and Sala-i Martin [1992], has also explored the role of physical capital accumulation in convergence. Empirical measures of the state-level capital stock are quite difficult to obtain.[39] One alternative measure of the returns to capital comes from regional interest rates. Landon-Lane and Rockoff [2007] report that regional interest rates largely converged by the end of World War II, relatively early in the time period of our study. This makes changes in the accumulation of physical capital a less likely candidate to explain changes in post-war convergence we study.

5.5 Amenities

In addition to differing in their productivity and housing supply, locations also differ in the non-productive amenities they offer workers. The value of these amenities have surely changed over time (Diamond [2012]), yet in the absence of housing supply constraints, amenity shocks alone are unlikely to explain the changing convergence patterns we observe. To see this, note that the model in Section 2 can be modified to accommodate these differences or shocks to these consumption amenities by rewriting the per-period utility function $u_{jkt} = c_{jkt}^{\beta}\left(h_{jkt} - \bar{H}\right)^{1-\beta} + amenity_{jt}$. The model can then map changes in a region's amenities into changes in migration patterns, housing prices, and rates of income convergence.[40]

Consider, first, a positive amenity shock in the more productive North. Such a shock raises the benefit of migrating from South to North. While this shock would raise housing prices in the North, it would also increase migration and speed income convergence, which is inconsistent with the data in our paper. Alternately, consider a positive amenity shock in the less productive South. This shock would indeed reduce migration rates from South to North and do so disproportionately for unskilled workers. By reducing the population in the North, however, it would predict a relative decline in housing prices in that region, rather than the increase that we see in the data. Therefore, while amenities are certainly important for understanding migration patterns, an amenity shock to North or South in our model produces testable predictions inconsistent with the data.

There is also little evidence that weather-related amenities can explain the changes in migration patterns documented here. Research by Glaeser and Tobio [2007] suggests that

[39] Garofalo and Yamarik [2002] constructed indirect state-level capital estimates by combining state-level industry employment composition with national industry-level capital-labor ratios.

[40] These dynamics are presented in an illustrative simulation in Appendix A.4.

population growth in the South since 1980 is driven by low housing prices rather than good weather. Though average January temperature is predictive of population growth, it is not correlated with high housing prices. Moreover, the relationship between temperature and population growth has remained stable or declined in the post-war period.

6 Conclusion

For more than 100 years, per-capita incomes across U.S. states were strongly converging and population flowed from poor to wealthy 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 productive 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 in the relationship between income and housing prices. Although housing prices have always been higher in richer 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 productive areas fall for unskilled households, and their migration patterns diverge from the migration patterns of the skilled 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 identify the effect of these price movements, we introduce a new panel instrument for housing supply. Prior work has noted 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 appellate court records. First, we find that tighter regulations raise the extent to which income differences are capitalized into housing prices. Second, tighter regulations impede population flows to rich areas and weaken convergence in human capital. Finally, we find that tight regulations weaken convergence in per capita income. We see this same link between rising regulations and declining convergence using a "shift-share" Bartik-like approach as well. Indeed, though there has been a dramatic decline in income convergence nationally, places that remain unconstrained by land use regulation continue to converge at similar rates.

These findings have important implications not only for the literature on land use and regional convergence, but also for the literature on inequality and segregation. A simple

back of the envelope calculation shown in the Appendix finds that cross-state convergence accounted for approximately 30% of the drop in hourly wage inequality from 1940 to 1980 and that had convergence continued apace through 2010, the increase in hourly wage inequality from 1980 to 2010 would have been approximately 10% smaller. The U.S. is increasingly characterized by segregation along economic dimensions, with limited access for most workers to America's most productive cities and their amenities. We hope that this paper will highlight the role land use restrictions play in supporting this segregation.

References

Daron Acemoglu, David H Autor, and David Lyle. Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Midcentury. *The Journal of Political Economy*, 112(3), 2004.

David H Autor and David Dorn. The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market. *American Economic Review*, 2013.

David H Autor, Lawrence F Katz, and Melissa S Kearney. Trends in U.S. Wage inequality: Revising the Revisionists. *Review of Economics and Statistics*, 90(2):300–323, 2008.

Robert J Barro. Convergence and Modernization Revisited. 2012.

Robert J Barro and Xavier Sala-i Martin. Convergence across States and Regions. *Brookings Papers on Economic Activity*, (1):107–182, 1991.

Robert J Barro and Xavier Sala-i Martin. Convergence. *Journal of Political Economy*, 100(2):223–251, 1992.

Timothy Bartik. *Who Benefits from State and Local Economic Development Policies?* W.E. Upjohn Institute for Employment Research, Kalamazoo, Michigan, 1991.

Christopher R Berry and Edward Glaeser. The Divergence of Human Capital Levels across Cities. *Papers in Regional Science*, 84(3):407–444, 2005.

Olivier Jean Blanchard and Lawrence F Katz. Regional Evolutions. *Brookings Papers of Economic Activity*, 23:1–76, 1992.

David Blanchflower and Andrew Oswald. Does High Home Ownership Impair the Labor Market? 2013.

George J Borjas. Does Immigration Grease the Wheels of the Labor Market? *Brookings Papers on Economic Activity*, 1:69–133, 2001.

George J Borjas. The Labor Demand Curve Is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market. *Quarterly Journal of Economics*, 118(4):1335–1374, 2003.

Fred Bosselman and David Callies. *The Quiet Revolution in Land Use Control*. White House Council on Environmental Quality, 1971.

Leah Platt Boustan, Price V Fishback, and Shawn Kantor. The Effect of Internal Migration on Local Labor Markets: American Cities during the Great Depression. *Journal of Labor Economics*, 28(4):719–746, 2010.

Juan Braun. *Essays on economic growth and migration*. PhD thesis, Harvard, 1993.

Jan K. Brueckner and Kala Seetharam Sridhar. Measuring welfare gains from relaxation of land-use restrictions: The case of India's building-height limits. *Regional Science and Urban Economics*, 42(6):1061–1067, November 2012. ISSN 01660462. doi: 10.1016/j.regsciurbeco.2012.08.003. URL `http://linkinghub.elsevier.com/retrieve/pii/S0166046212000737`.

Bureau of Economic Analysis. State Personal Income, Tables SA1-SA3, 2012.

David Card. Immigration and Inequality. *American Economic Review: Papers and Proceedings*, 99(2):1–21, 2009.

David Card and Alan B Krueger. Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States. *The Journal of Political Economy*, 100(1):1–40, 1992.

Francesco Caselli and Wilbur John Coleman. The U.S. Structural Transformation and Regional Convergence: A Reinterpretation. *Journal of Political Economy*, 109(3):584–616, 2001.

Raj Chetty. Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply. *Econometrica*, 2013.

Patricia Cortes. The Effect of Low-Skilled Immigration on U . S . Prices : Evidence from CPI Data Patricia Cortes. *Journal of Political Economy*, 116(3):381–422, 2008.

W. Mark Crain. *Volatile States: Institutions, Policy, and the Performance of American State Economies*. University of Michigan Press, Ann Arbor, MI, 2003.

Thomas Davidoff. What Explains Manhattan's Declining Share of Residential Construction? *Journal of Public Economics*, 94(7-8):508–514, August 2010. ISSN 00472727. doi: 10.1016/j.jpubeco.2010.02.007. URL `http://linkinghub.elsevier.com/retrieve/pii/S0047272710000137`.

Morris a. Davis and François Ortalo-Magné. Household expenditures, wages, rents. *Review of Economic Dynamics*, 14(2):248–261, April 2011. ISSN 10942025. doi: 10.1016/j.red.2009.12.003. URL `http://linkinghub.elsevier.com/retrieve/pii/S1094202509000830`.

Edward F. Denison. *The Sources of Economic Growth in the United States and the Alternatives Before Us*. Comittee for Economic Development, New York, 1962.

Rebecca Diamond. The Welfare Effects of Changes in Local Wages, Prices and Amenities Across US Cities. *Harvard Working Paper*, 2012.

Riccardo DiCecio and Charles S Gascon. Income Convergence in the United States: A Tale of Migration and Urbanization. *Annals of Regional Science*, 45:365–377, 2008. doi: 10.1007/s00168-008-0284-1.

Richard A. Easterlin. Long Term Regional Income Changes: Some Suggested Factors. *Papers in Regional Science*, 4(1):313–325, 1958.

Robert C. Ellickson. Suburban Growth Controls: An Economic and Legal Analysis. *The Yale Law Journal*, 86(3):385–511, January 1977. ISSN 00440094. doi: 10.2307/795798. URL `http://www.jstor.org/stable/795798?origin=crossref`.

Joseph P Ferrie. Internal Migration. In Susan Carter, editor, *Historical Statistics of the United States, Millennial Edition*, volume 1776. 2003.

WA Fischel. An economic history of zoning and a cure for its exclusionary effects. *Urban Studies*, pages 317–340, 2004. URL `http://usj.sagepub.com/content/41/2/317.short`.

Price V Fishback, William Horrace, and Shawn Kantor. The Impact of New Deal Expenditures on Mobility During the Great Depression. *Explorations in Economic History*, pages 179–222, 2006.

Gasper A Garofalo and Steven Yamarik. Regional Convergence: Evidence from a New State-by-State Capital Series. *Review of Economics and Statistics*, 84(May):316–323, 2002.

Martin Garrett. *Land use regulation: the impacts of alternative land use rights*. Praeger Publishers, New York, 1987.

Nicola Gennaioli, Rafael La Porta, Florencio Lopez-de silanes, and Andrei Shleifer. Human Capital and Regional Development. *Quarterly Journal of Economics*, (forthcoming), 2013a.

Nicola Gennaioli, Rafael La Porta, Florencio Lopez-de silanes, and Andrei Shleifer. Growth in Regions. *mimeo*, 2013b.

Edward Glaeser and Bryce Ward. The causes and consequences of land use regulation: Evidence from Greater Boston. *Journal of Urban Economics*, 65:265–278, 2009.

Edward L Glaeser and Joseph Gyourko. Urban Decline and Durable Housing. *Journal of Political Economy*, 113(2):345–375, 2005.

Edward L. Glaeser and Albert Saiz. The Rise of the Skilled City. *Brookings-Wharton Papers on Urban Affairs*, pages 47–105, 2004. ISSN 1533-4449. doi: 10.1353/urb.2004.0005. URL `http://muse.jhu.edu/content/crossref/journals/brookings-wharton_papers_on_urban_affairs/v2004/2004.`

Edward L Glaeser and Kristina Tobio. The Rise of the Sunbelt. *NBER Working Paper 13071*, 2007.

Edward L Glaeser, Joseph Gyourko, and Raven Saks. Why is Manhattan So Expensive? Regulation and the Rise in House Prices. *Journal of Law and Economics*, pages 1–50, 2005a.

Edward L. Glaeser, Joseph Gyourko, and Raven E Saks. Why Have Housing Prices Gone Up? *American Economic Review*, 95(2):329–333, 2005b.

Edward L. Glaeser, Joseph Gyourko, and Raven E Saks. Urban growth and housing supply. *Journal of Economic Geography*, 6:71–89, 2006.

Edward L Glaeser, Matthew E Kahn, and Jordan Rappaport. Why do the Poor Live in Cities? The Role of Public Transportation. *Journal of Urban Economics*, 63:1–24, 2008.

Claudia Goldin and Lawrence F Katz. The Legacy of U. S. Educational Leadership: Notes on Distribution and Economic Growth in the 20th Century. *American Economic Review: Papers and Proceedings*, 91(2): 18–23, 2001.

Joseph Gyourko, Albert Saiz, and Anita Summers. A New Measure of the Local Regulatory Environment for Housing Markets: Regulatory Index. *Urban Studies*, 45:693–729, 2008.

Joseph Gyourko, Christopher Mayer, and Todd Sinai. Superstar Cities. *American Economic Journal: Economic Policy*, forthcomin, 2013.

Michael R. Haines. *Historical, Demographic, Economic, and Social Data: The United States, 1790-2002 [Computer file]. ICPSR02896-v3.* Inter-university Consortium for Political and Social Research, Ann Arbor, MI, 2010.

Oskar R Harmon. The Income Elasticity of Demand for Housing : An Empirical Reconciliation. *Journal of Urban Economics*, 24:173–185, 1988.

Christian Hilber and Fredric Robert-Nicoud. On the Origins of Land Use Regulations: Theory and Evidence from US Metro Areas. *Journal of Urban Economics*, 75:29–43, 2013.

Christian Hilber and Wouter Vermeulen. The Impact of Supply Constraints on House Prices in England. *mimeo*, 2013.

Richard Hornbeck. The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustments to Environmental Catastrophe. *American Economic Review*, 102(4):1477–1507, 2012.

Chang Tai Hseih, Erik Hurst, Charles I Jones, and Peter J Klenow. The Allocation of Talent and U.S. Economic Growth. *mimeo*, 2013.

Lakshmi Iyer, Xin Meng, Nancy Qian, and Xiaxue Zhao. The General Equilibrium Effects of Chinese Urban Housing Reforms on the Wage Structure. *mimeo*, 2011.

Matthew E. Kahn. Do Liberal Cities Limit New Housing Development? Evidence from California. *Journal of Urban Economics*, 69(2):223–228, March 2011. ISSN 00941190. doi: 10.1016/j.jue.2010.10.001. URL `http://linkinghub.elsevier.com/retrieve/pii/S0094119010000720`.

Lawrence Katz and Kenneth T. Rosen. The Interjurisdictional Effects of Growth Controls on Housing Prices. *The Journal of Law and Economics*, 30(1):149, January 1987. ISSN 0022-2186. doi: 10.1086/467133. URL `http://www.journals.uchicago.edu/doi/abs/10.1086/467133`.

Piyabha Kongsamut, Sergio Rebelo, and Danyang Xie. Beyond Balanced Growth. *Review of Economic Studies*, 68(869-882), 2001.

John Landon-Lane and Hugh Rockoff. The origin and diffusion of shocks to regional interest rates in the United States, 1880 to 2002. *Explorations in Economic History*, 44:487–500, 2007.

Peter Lindert and Richard Sutch. Consumer Price Indexes for All Items, 1774-2003. In Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright, editors, *Historical Statistics of the United States*, pages Table Cc1–2. Cambridge University Press, New York, 2006.

Robert A Margo. Wages in California During the Gold Rush. 1997.

Guy Michaels, Ferdinand Rauch, and Stephen J Redding. Urbanization and Structural Transformation. *Quarterly Journal of Economics*, 127:535–586, 2012.

Enrico Moretti. Real Wage Inequality. *American Economic Journal: Applied Economics*, 2012a.

Enrico Moretti. *The New Geography of Jobs*. Houghton Mifflin Harcourt, Boston, 2012b.

Casey Mulligan. A Century of Labor Leisure Distortions. *NBER Working Paper 8774*, 2002.

Matthew J Notowidigdo. The Incidence of Local Labor Demand Shocks. *NBER Working Paper 17167*, 2013.

Henry O Pollakowski and Susan M Wachter. The Effects of Land-Use Constraints on Housing Prices. *Land Economics*, 66(3), 1990.

John Quigley and Steven Raphael. Regulation and the High Cost of Housing in California. *American Economic Review*, 95(2):323–328, 2005.

Jennifer Roback. Wages, Rents, and the Quality of Life. *The Journal of Political Economy*, 90(6):1257–1278, 1982.

Sherwin Rosen. Wages-based Indexes of Urban Quality of Life. In Peter Mieszkowski and Mahlon Straszheim, editors, *Current Issues in Urban Economics*. John Hopkins University Press, 1979.

Jonathan Rothwell. Housing Costs, Zoning, and Access to High-Scoring Schools. *Metropolitan Policy Program at Brookings*, 2012.

Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. 2010.

Albert Saiz. The Geographic Determinants of Housing Supply. *Quarterly Journal of Economics*, 125(3): 1253–1296, 2010.

Raven E Saks. Job Creation and Housing Construction: Constraints on Metropolitan Area Employment Growth. *Journal of Urban Economics*, 64:178–195, 2008. doi: 10.1016/j.jue.2007.12.003.

David Schleicher. City Unplanning. *Yale Law Journal*, 122(7):1670–1737, 2013.

Todd Sinai. Feedback Between Real Estate and Urban Economics. *Journal of Regional Science*, 50(1): 423–448, 2010.

John Taylor and Norman Williams. *American Land Planning Law: Land Use and the Police Power*. West Group, Eagan Minnesota, 2009.

The American Institute of Planners. *Survey of State Land Use Planning Activity*. 1976.

Charles M. Tolbert and Molly Sizer. US Commuting Zones and Labor Market Areas. *Rural Economy Division, Economic Research Service, U.S. Department of Agriculture*, Staff Pape, 1996.

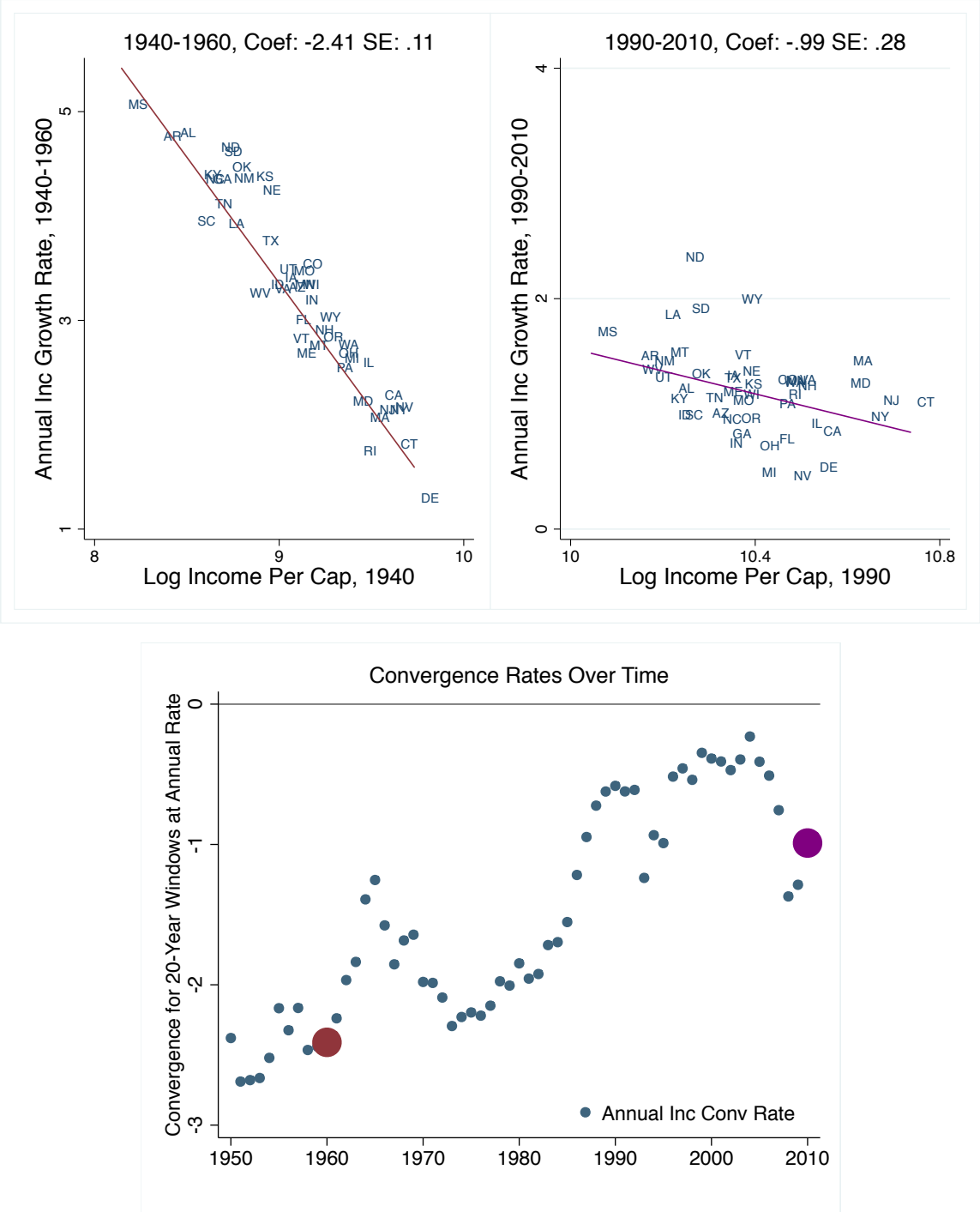
U.S. Census Bureau. USACounties, 2012.

Stijn Van Nieuwerburgh and Pierre-Olivier Weill. Why Has House Price Dispersion Gone Up? *Review of Economic Studies*, 77(4):1567–1606, October 2010. ISSN 00346527. URL `http://restud.oxfordjournals.org/lookup/doi/10.1111/j.1467-937X.2010.00611.x`.

Jeffrey G Williamson. Regional Inequality and the Process of National Development: A Description of the Patterns. *Economic Development and Cultural Change*, 13(4):1– 84, 1965.

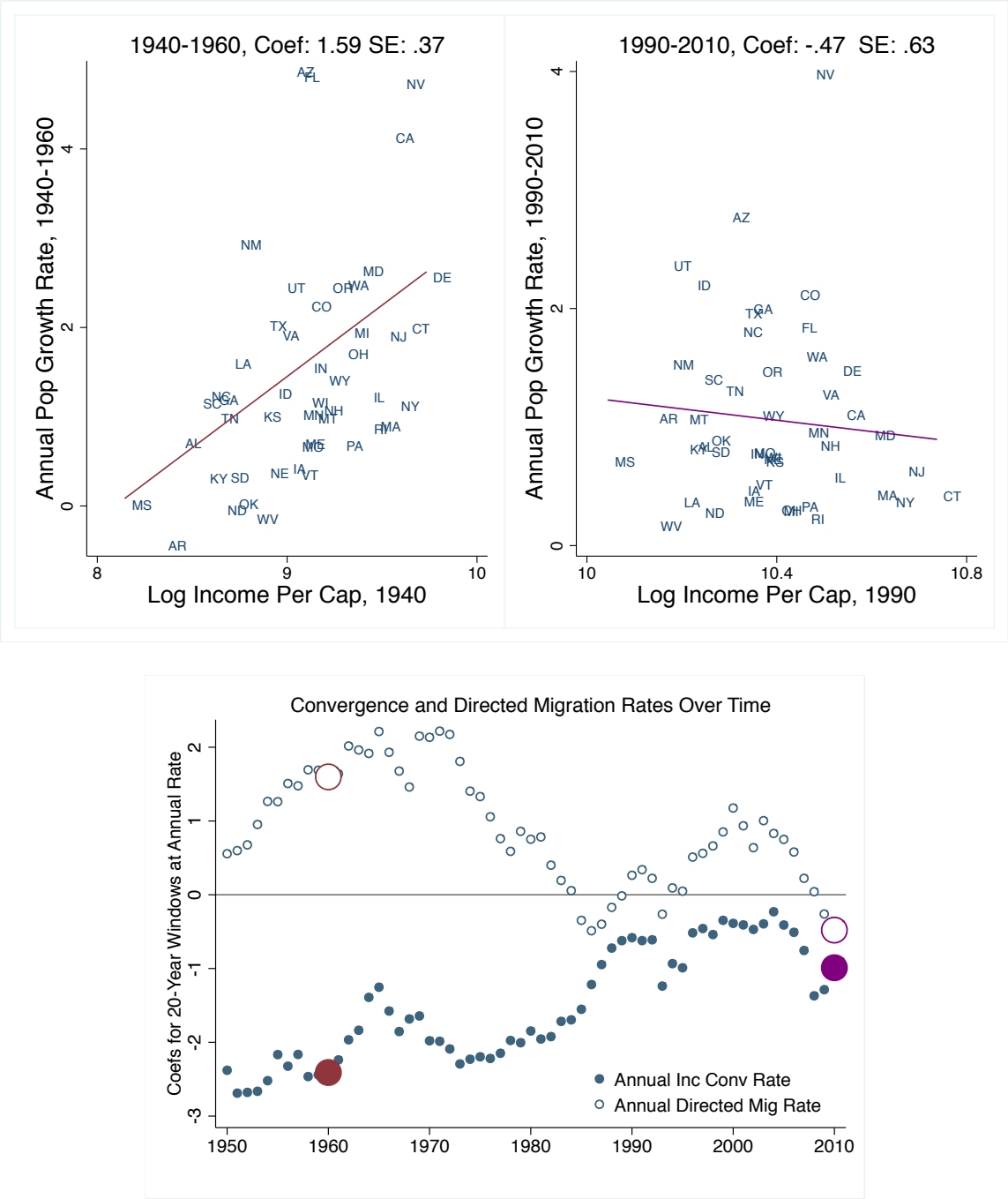
Cristobal Young, Charles Varner, and Douglas S Massey. Trends in New Jersey Migration: Housing, Employment, and Taxation. *Policy Research Insitute at the Woodrow Wilson School*, (September), 2008.

FIGURE 1
The Decline of Income Convergence



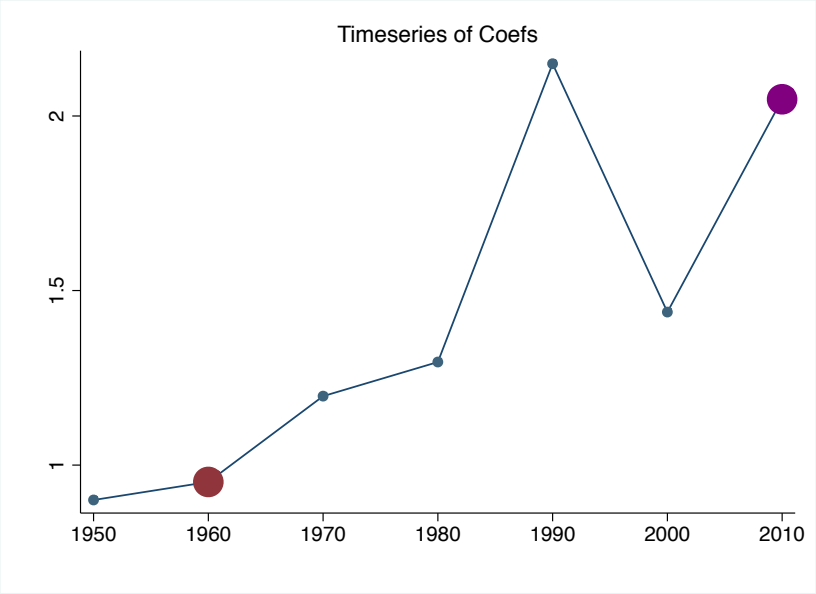
Notes: The y-axis in the first two panels is the annual growth rate of income per capita. The third panel plots coefficients from 20-year rolling windows. The larger red and purple dots correspond to the coefficients from the top two panels. Income data from the Bureau of Economic Analysis [2012]. Alaska, Hawaii, and DC are omitted here, and in all subsequent figures and tables.

FIGURE 2
The Decline of Directed Migration



Notes: The y-axis in the first two panels is the annual growth rate of log population. The third panel plots coefficients from 20-year rolling windows for population changes and income changes. The larger red and purple dots correspond to the coefficients from the top two panels.

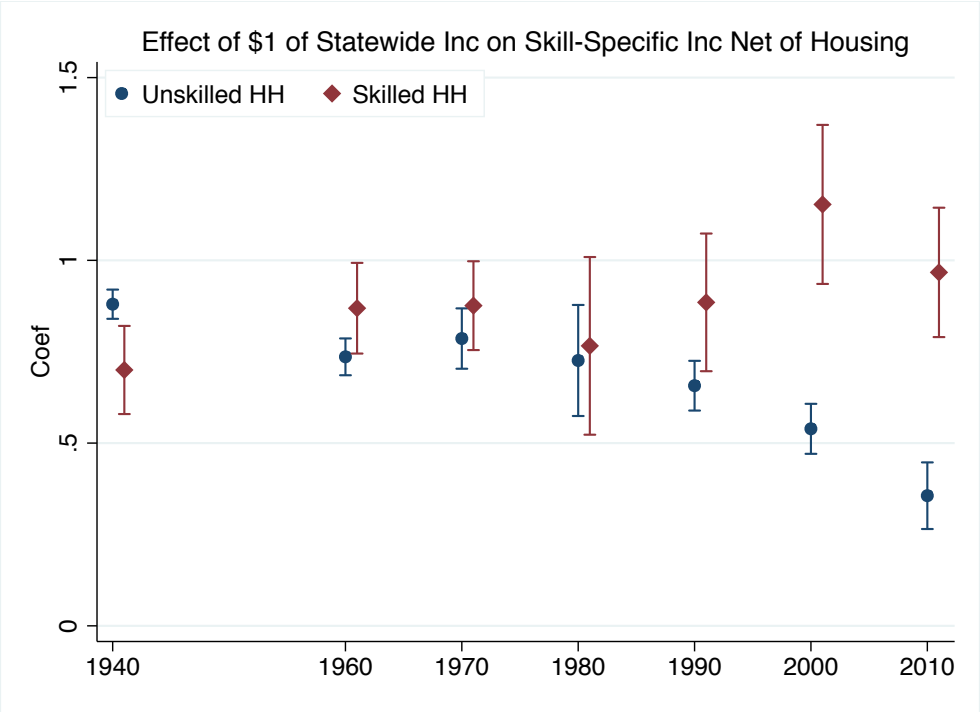
FIGURE 3
Rising Prices in High Income States



Notes: The first two panels regress median housing value on income per capita at the state level. The third panel plots coefficients from 20-year rolling windows. The larger red and purple dots correspond to the coefficients from the first two panels.

FIGURE 4

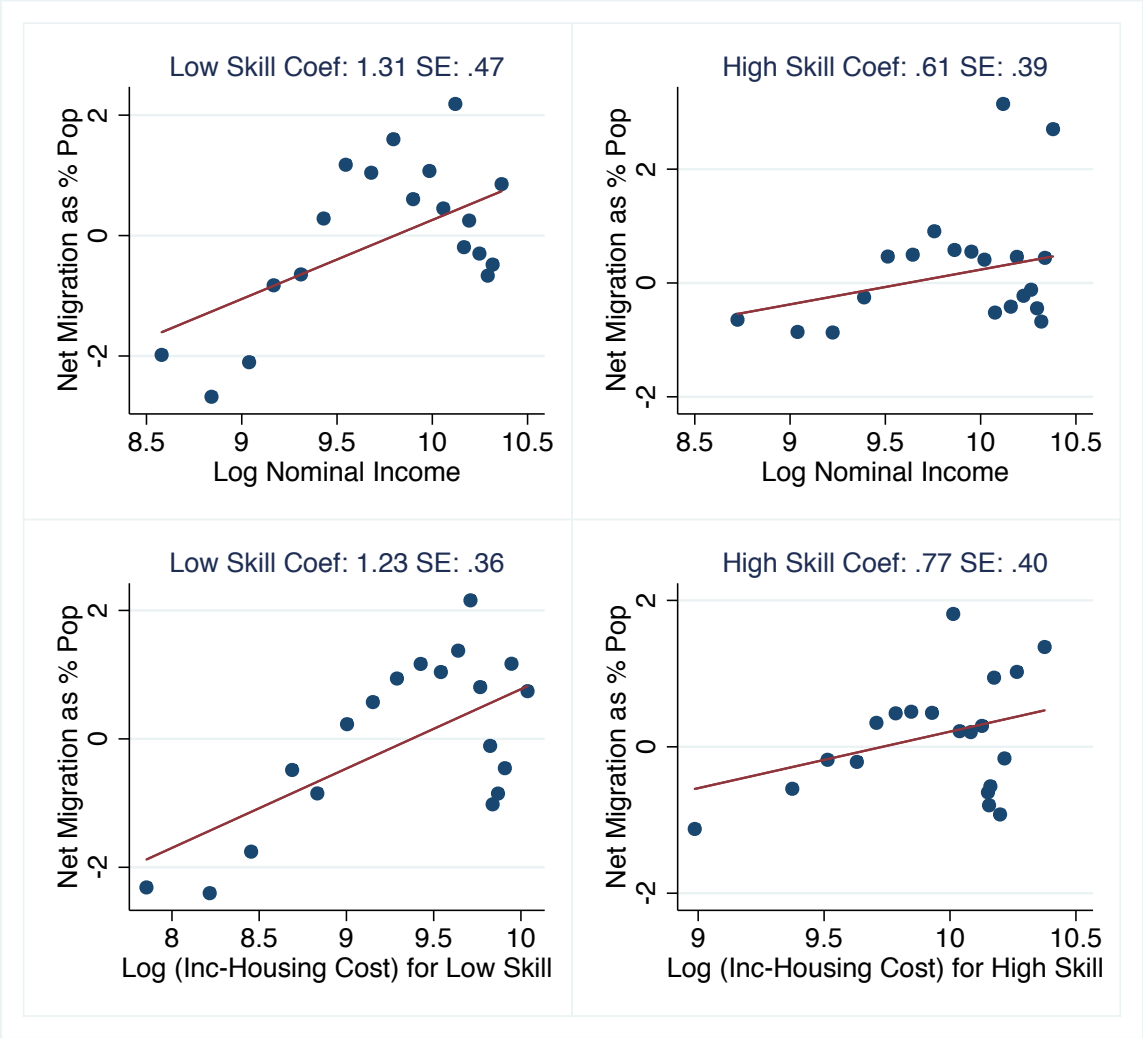
Returns to Migration: Skill-Specific Income Net of Housing Cost



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 $Y_{ij} - P_{ij} = \alpha + \beta_{unskilled} Y_j \times (1 - S_{ij}) + \beta_{skilled} Y_j \times S_{ij} + \eta S_{ij} + \gamma X_{ij} + \varepsilon_{ij}$ for households with at least one labor force participant aged 25-65. See Section 3.2 for details. We report 95% confidence intervals for $\beta_{unskilled}$ and for $\beta_{skilled}$. 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 IPUMS USA sample for this year does not include housing cost data. High-skilled 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-skilled 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. 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.

FIGURE 5

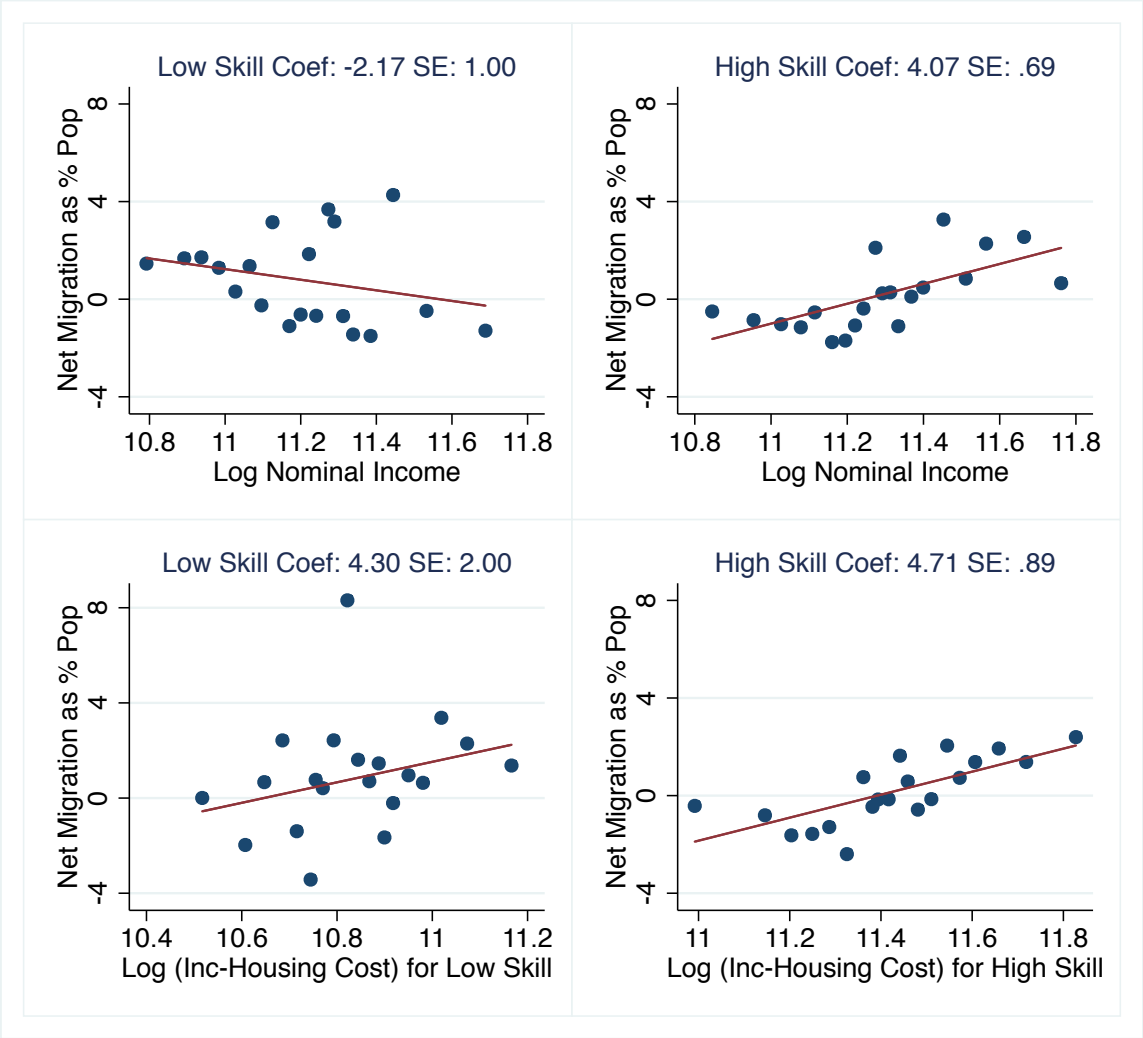
Net Migration Flows by Skill Group: Nominal Income vs. Income Net of Housing Cost, 1935-1940



Notes: These panels plot net migration over a five-year horizon as a fraction of the population ages 25-65 for 466 State Economic Areas (SEA) in the 1940 IPUMS Census extract. Each panel stratifies the SEAs into 20 quantiles by income, weighting each SEA by its population, and then computes the mean net migration within each quantile. The two top panels plot net migration as a function of the log household wage income in the destination SEA, for individuals with less than 12 years of education (left) and those with 12+ years (right). The two bottom panels plot the migration rates for these skill groups against the log skill-group mean value of household wage income net of housing costs. Housing costs are defined as 5% of house value for homeowners and 12X monthly rent for renters. All x-axis variables are computed for non-migrating households with at least one labor force participant aged 25-65.

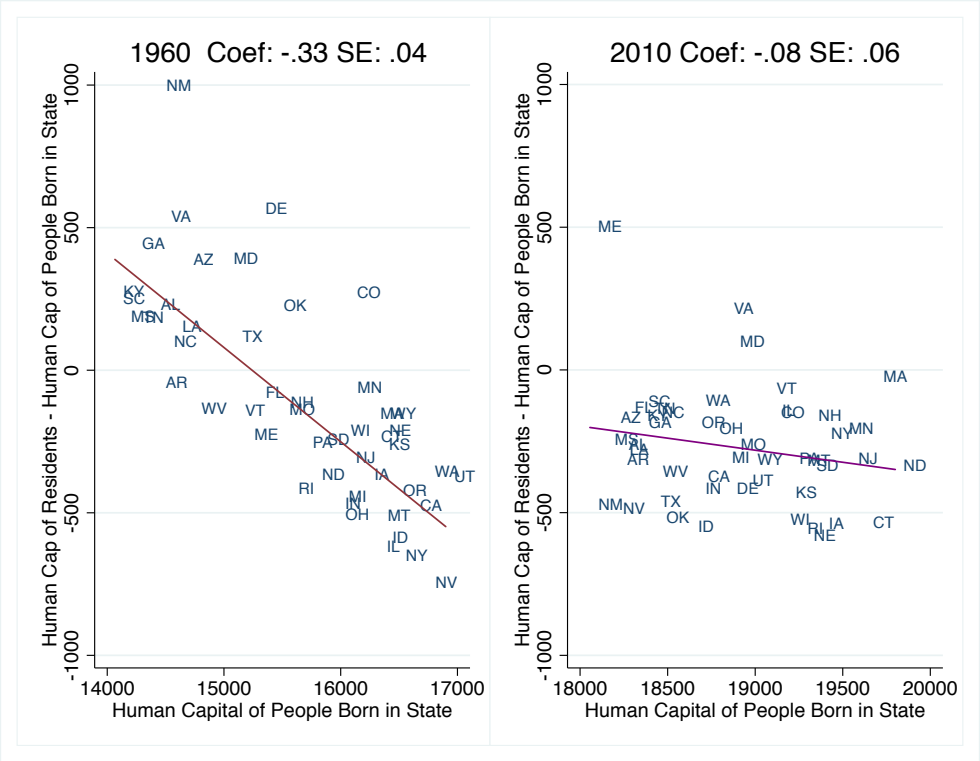
FIGURE 6

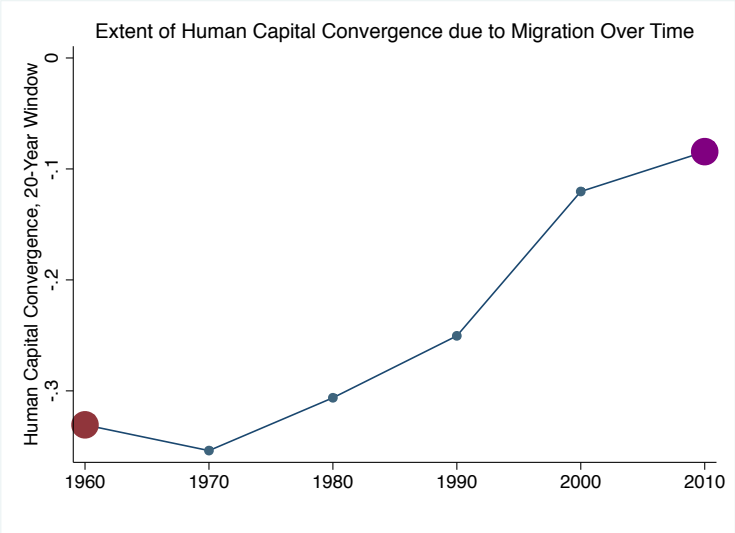
Net Migration Flows by Skill Group: Nominal Income vs. Income Net of Housing Cost, 1995-2000



Notes: These panels plot net migration over a five-year horizon as a fraction of the population ages 25-65 for 1,020 3-digit Public Use Microdata Area (PUMA) in the 2000 IPUMS 5% Census extract. 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 as a function of log household wage income in the PUMA, for individuals with less than a bachelor's degree (left) and with at least a bachelor's (right). The two bottom panels plot the migration rates for these skill groups against the skill-group mean value of household wage income net of housing costs. Housing costs are defined as 5% of house value for homeowners and 12X monthly rent for renters. All x-axis variables are computed for non-migrating households with at least one labor force participant aged 25-65.

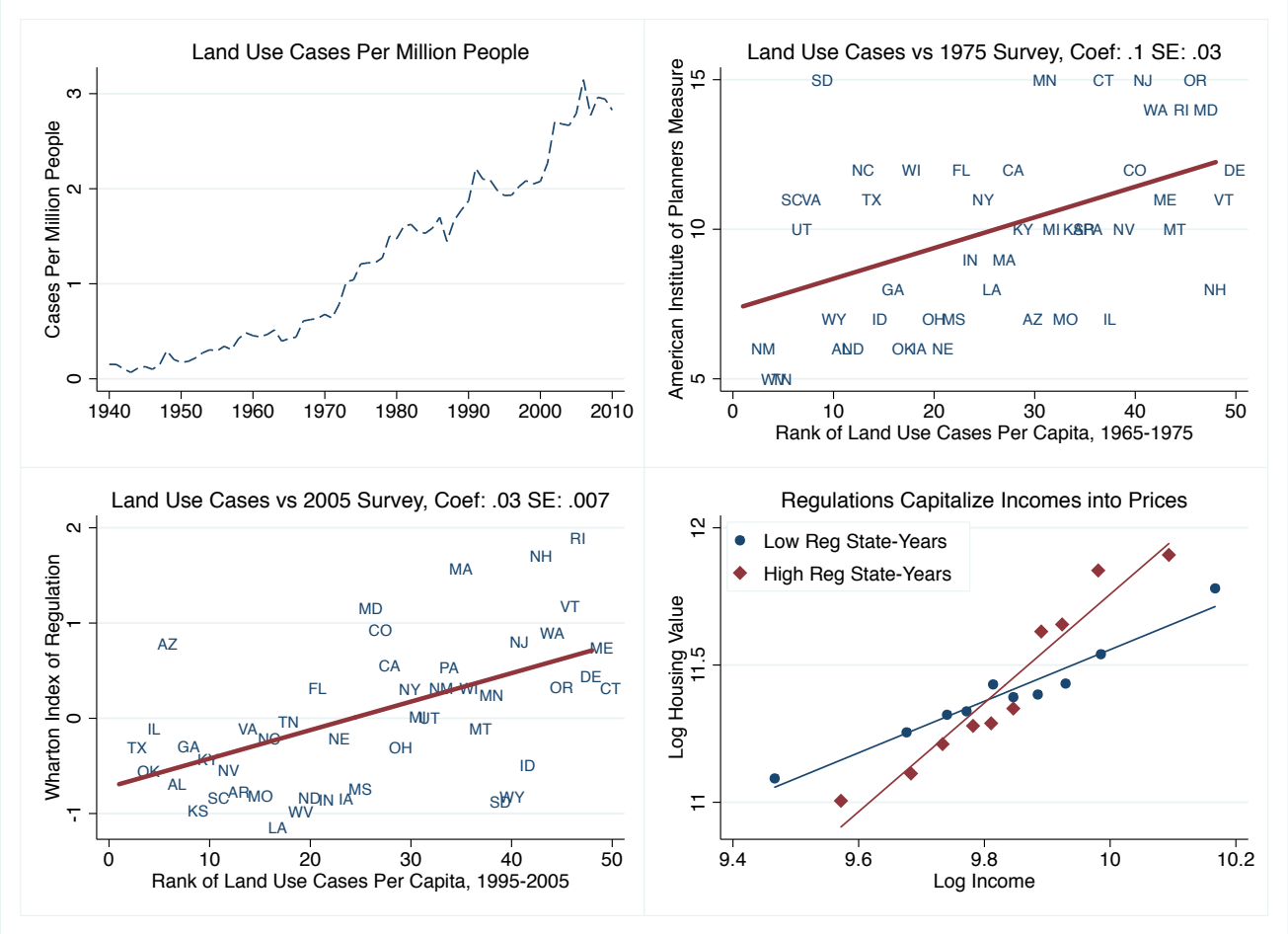
FIGURE 7
The Decline of Human Capital Convergence





Notes: Human capital index is estimated by regressing $\log Inc_{ik} = \alpha_k + X_{ik}\beta + \varepsilon_{ik}$ in the 1980a Census, where α_k is a set of seven education indicators, and then constructing Human Capital$_j = \sum_k exp(\hat{\alpha}_k) \times Share_{kj}$. We separately estimate the human capital index by state of residence and by state of birth, to develop a no-migration counterfactual. The top panels show figures from a regression of $HumanCap_{j,res} - HumanCap_{j,birth} = \alpha + \beta HumanCap_{j,birth} + \varepsilon_j$ in 1960 and 2010. Sample is people ages 25-34, see Section 3 for details. The bottom panel plots a time-series of coefficients. The larger red and purple dots correspond to the coefficients from the first two panels.

FIGURE 8
Regulation Measure: Timeseries and Validity



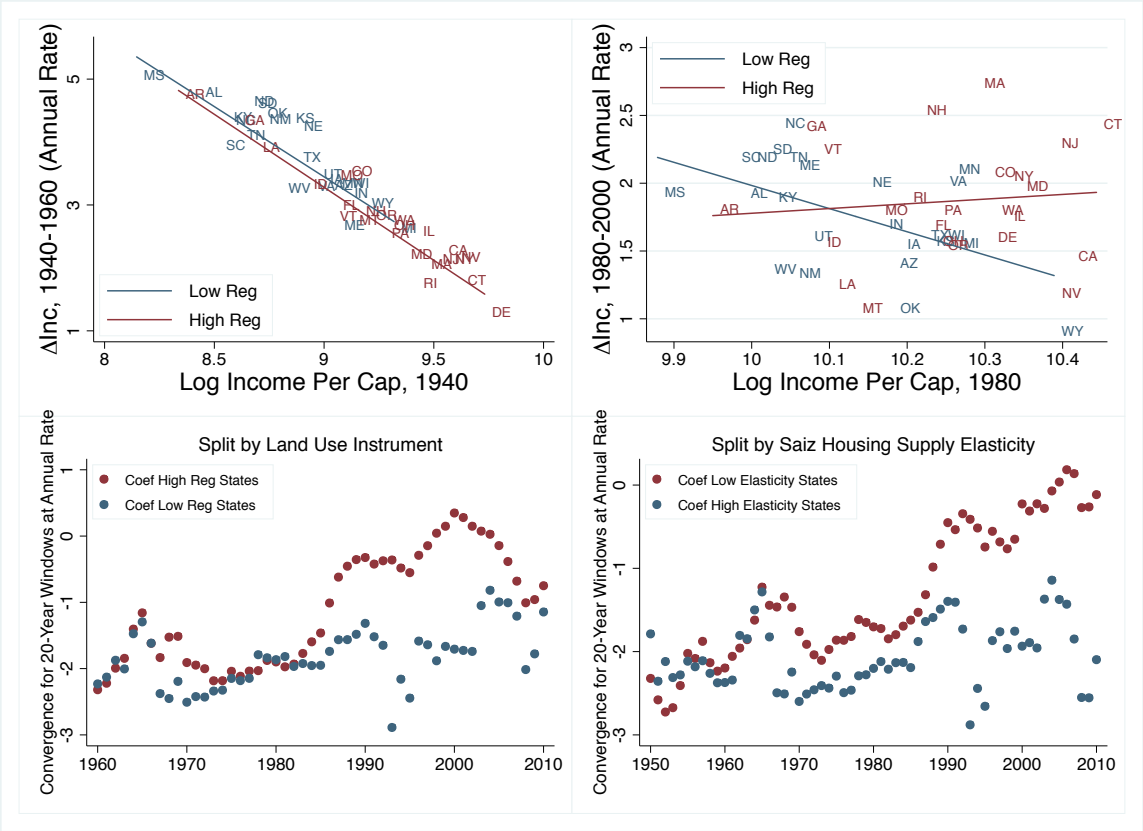
Notes: The top left panel plots the number of cases containing the phrase "land use" in the state appeals court databases in per capita terms.

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 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 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 yaxis.

FIGURE 9
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]. We weight the time-invariant MSA-level measures from Saiz by population to produce state-level estimates and impute a value for Arkansas based on neighboring states.

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
Median House Price ($000, 2012 $)	39.7	15.4	85.2	18.6	129.4	32.1	152.3	44.5
Regulation Measure (land use cases per capita*10^6)	0.17	0.56	0.32	0.50	2.18	2.59	3.77	6.15

Sources: IPUMS Census extract, BEA Income estimates, and an online database of state appellate court documents.
Notes: n=48 states, excluding Alaska, Hawaii, and DC. Dollar amounts are in real 2012 dollars deflated using the Lindert and Sutch price index (2006).

TABLE 2

Impacts of Regulation on Permits, Prices, Migration, and Convergence

	Annual Construction Permits$_t$	Log House Price $_t$	ΔLog Population$_{t,t+20}$	Δ Log Human Capital	Δ Log Income Per Cap$_{t,t+20}$
	% of Housing Stock		Annual Rate in %		Annual Rate in %
	(1)	(2)	(3)	(4)	(5)
Regulation Measure: Rank of Land Use Cases Per Capita scaled [0,1]					
Log Inc Per Cap$_{it}$	5.039**	0.774***	1.688**	-0.0434***	-2.034***
	(2.106)	(0.105)	(0.637)	(0.00744)	(0.102)
	-5.868**	0.833***	-1.875***	0.0400**	1.304***
Log Inc Per Cap$_{it}$ *Reg$_{it}$	(2.290)	(0.255)	(0.608)	(0.0157)	(0.393)
Year*Reg FEs	Y	Y	Y	Y	Y
R^2	0.217	0.891	0.142	0.249	0.811
N	1,536	384	2,448	288	2,448
Placebo Measure: Rank of Total Cases Per Capita scaled [0,1]					
Log Inc Per Cap$_{it}$	1.313	0.984***	1.017	-0.0292*	-1.707***
	(1.627)	(0.148)	(0.813)	(0.0157)	(0.206)
	-1.029	0.269	0.380	0.000479	0.202
Log Inc Per Cap$_{it}$ *Reg$_{it}$	(2.396)	(0.267)	(2.616)	(0.0295)	(0.400)
Year*Reg FEs	Y	Y	Y	Y	Y
R^2	0.164	0.871	0.179	0.191	0.791
N	1,536	384	2,448	288	2,448

Notes: The table reports the coefficients β and β_{reg} from regressions of the form: $lny_{it}=\alpha_t+\alpha_t reg_{it}+\beta lny_{it}+\beta_{reg} lny_{it} reg_{it}+\varepsilon_{it}$. The regulation measure is rank of land use cases per capita and its construction is described in the text. The dependent variables are new housing permits from the Census Bureau, the median log housing price from the Census, population change, the change in log human capital of people ages 25-34 due to migration, and the change in log per-capita income. Construction of the human capital index is described in Section 3. 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

TABLE 3

Latent Tendency to Regulate, Geographic Land Availability, and Convergence

	Δ Log Income Per $Cap_{t,t+20}$ (Annual Rate in %)							
Year	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Inc Per Cap_t	-1.93***	-1.80***	-2.47***	-3.06***	-2.05***	-1.97***	-2.49***	-1.20***
	(0.11)	(0.33)	(0.20)	(0.57)	(0.15)	(0.47)	(0.06)	(0.08)
Log Inc Per Cap_t * Constraint	0.22	2.01***	0.14	2.00***	0.20	1.91***	-0.09	0.71***
	(0.27)	(0.66)	(0.25)	(0.68)	(0.27)	(0.69)	(0.10)	(0.17)
pre interaction = post interaction (pval)		0.002		0.005		0.003		<0.001
Year*Constraint Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Controls	--		Autor-Dorn Skill Measures		--		--	
R^2	0.84	0.45	0.87	0.60	0.84	0.46	0.72	0.91
N	1,248	1,200	1,248	1,200	1,248	1,200	8,413	9,194
Unit of Observation	State	State	State	State	State	State	County	County
Constraint Measure	Land Use Cases Per Capita, 1996-2005		Land Use Cases Per Capita, 1996-2005		Land Use Cases Per Capita, 1956-1965		Share of Land Unavailable (Saiz, 2010)	

Notes: This table uses time-invariant measures of the housing supply elasticity, while Table 2 used time-varying measures of the elasticity. The table reports the coefficients β and $\beta_{constraint}$ from regressions of the form $\Delta lny_{it,t+20}=\alpha_1+\alpha_2 Constraint_i+\beta lny_{it}+\beta_{Constraint} lny_{it} \times Constraint_i+\varepsilon_i$. 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 number of land use cases per capita 1996-2005 in columns (1)-(4), the number of land use cases per capita 1956-1965 in (5)-(6), and land availability constructed from Saiz (2010) in columns (7)-(8). The availability measure assumes that all land is available for construction in non-urban counties. Columns (3)-(4) control for skill measures in Autor and Dorn (2013): the share of workers in routine occupations, the college to non-college population ratio, immigrants as a share of the non-college population ratio, manufacturing employment share, the initial unemployment rate, the female share, the share age 65+, and the share earning less than the 10 year ahead minimum wage. We aggregate their data to the state level via population weighting.

Standard errors clustered by state for columns (1)-(6) and by metro area for columns (7)-(8) in parentheses. *** p<0.01, **

TABLE 4

Migration By Skill Group and Share BA

Panel A: Total Migration (Extensive + Intensive Margin)

	# Residents - # Born in State as % of Total State Pop			
	Low-Skill (1)	High-Skill (2)	Total Mig (2) + (1)	Difference (2)-(1)
1980 Census, n=48				
Share BA, 1980	2.624***	0.762***	3.386***	-1.862***
	(0.479)	(0.131)	(0.550)	
2010 American Community Survey, n=48				
Share BA, 1980	0.490**	0.614***	1.104***	0.124
	(0.235)	(0.138)	(0.354)	
Coef 2010 - Coef 1980	-2.134***	-0.148	-2.282***	

Panel B: Choice of Destination | Decision to Leave Birth State (Intensive Margin)

	# Migrants to state j from state of birth j' - Pop j / (Pop National - Pop j')		
	Low-Skill (1)	High-Skill (2)	Difference (2)-(1)
1980 Census, n=2256			
Share BA, 1980	0.116*	0.173***	0.057**
	(0.0608)	(0.0460)	
2010 American Community Survey, n=2256			
Share BA, 1980	-0.0297	0.129***	0.149***
	(0.0400)	(0.0326)	
Coef 2010 - Coef 1980	-0.136**	-0.044	

Notes: This table examines differences by skill group and over time in migration to high BA states.
Panel A measures net migration of 25-44 year olds relative to state of birth as a share of the state's total population. There is one observation per state, and robust SE are in parentheses. This measure is attractive because it captures both the decision to migrate and the choice of destination, but it is sensitive to differential trends in domestic BA production.
Panel B corrects for this issue and focuses on choice of destination among those who choose to migrate within the 48 continental states. Each observation is a state of origin by state of destination pair. We examine whether people who migrate are disproportionately attracted to states with high share BA. We normalize each observation by subtracting the ratio of the population of the destination state to the population of all states (dropping the population of the state of origin). Observations are weighted by the total number of migrants from the origin state, and the standard errors are clustered by destination.
Share BA is calculated using people ages 25-65. Low-skill is defined as having less than a BA. High skill is defined as having a BA or higher. *** p<0.01, ** p<0.05, * p<0.1

A Calibration

In this section we extend the model to allow for a more realistic calibration and the simulation of additional shocks. Specifically, we add elastic labor supply and non-productive, time-varying amenities to the individuals decision problem. Given that the reminder of model matches the model presented in the text, we do not reproduce those equations here. Further variations on the model, such as a setup with regionally differentiated goods and constant returns in production, are avaliable online.

A.1 Individual Decisions

Once again, agents are either skilled or unskilled $k \in \{u, s\}$, and have utility in state $j \in \{N, S\}$ of

$$U = \max_{\{c_{jkt}, l_{jkt}\}} c_{jkt}^{\beta} \left(h_{jkt} - H\right)^{1-\beta} - \frac{\xi l_{jkt}^{1+\frac{1}{\epsilon}}}{1 + 1/\epsilon} + amen_{jt}$$

$$\text{subject to } c_{jkt} + p_{jt} h_{jkt} = w_{jkt} l_{jkt} + \pi_t$$

Labor supply is now elastic and governed by the elasticity parameter ϵ. Non-productive amenities, $amen_{jt}$ can vary over time, but are not skill specific.[41] The first order condition on labor supply implies:

$$l_{jkt} = \left(\beta^{\beta} \left(\frac{1-\beta}{p_{jt}}\right)^{1-\beta} w_{jkt}\right)^{\epsilon}$$

Profits from both the housing sector and the tradable section in North and South are again rebated lump-sum nationally. We can therefore write each moment's indirect utility as a function of the wage, price and these parameters:

$$v_{jkt}(A, n_{jlt}, n_{jht}, amenity_{jt}) = \left(w_{jkt} + \pi_t - p_{jt} H\right) \beta^{\beta} \left(\frac{1-\beta}{p_{jt}}\right)^{1-\beta} - \frac{\left(\beta^{\beta} \left(\frac{1-\beta}{p_{jt}}\right)^{1-\beta} w_{jkt}\right)^{1+\epsilon}}{1 + 1/\epsilon} + amen_{jt}$$

A.2 Calibration

Despite the simplicity of the model, there are a large number of parameters to calibrate. Thankfully, many of them can be inferred from the data or sourced from the literature. We set θ, the premium for skilled versus unskilled workers, equal to 1.7. This is representative of the BA/non-BA relative wages in data, holding race and gender constant. We set the elasticity of subsitution between skilled and unskilled workers, ρ, equal to 0.6 as in Card [2009]. The initial share of skilled workers living in the North is set to 0.69, and the initial share of unskilled workers is set to 0.63. This matches

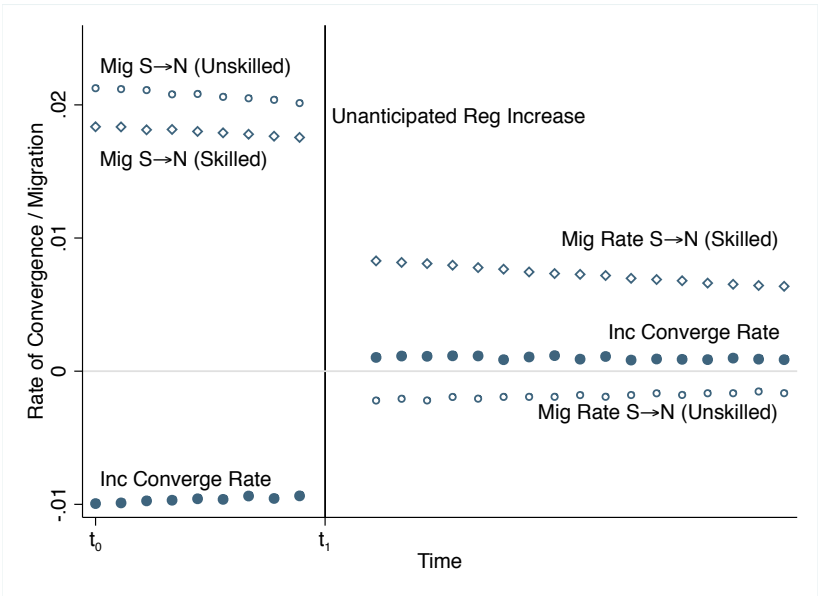
[41] Recent work, such as Diamond [2012], has looked at the impact of time-varying, skill-specific amenity shocks.

the population distribution in 1950, when splitting states in to "North" and "South" at the median based on per capita incomes. The total population of each skill type is normalized to one.

We use the two parameters of the utility function, $\bar{H}$ and β, to match the Engel-curve for housing estimated in Section 2. This entails setting $\beta = .06$ and $\bar{H} = .25$ in Appendix. This parameter choice means that we can analyze whether the nonhomotheticity we observe for housing within labor markets is large enough to generate the changes we see in migration for the observed change in housing prices. The discount rate r , treating each period as one year, and the labor share of production $(1 - \alpha)$ are set to 0.05 and 0.65 as in much of the literature. The elasticity of labor supply ϵ is set to 0.6 as in Chetty [2013]. We set A, the relative productivity parameter, equal to 1.8. This is consistent with a fraction of 85% of the population residing in the North in the steady state given equalized skill distributions.

Finally, we are left to calibrate the moving cost parameter ψ, the elasticity parameter η, and the size of the elasticity shock. We initially set η equal to 0.4, which generates roughly a 1 to 1 relationship between log prices and log per capita income, matching the relationship in the data for 1950 and 1960 as reported in Figure 3. The parameter ψ is set equal to .002 to match the speed of directed migration observed prior to the explosion of land use regulations.

We simulate a shock that lowers η to 0.4 to 0.135 after 10 periods. This drop is calibrated to match the change in the log price to log income ratio, which in the data (Figure 3) rises to 2 from 1. The dynamics of the system to this shock displayed below.

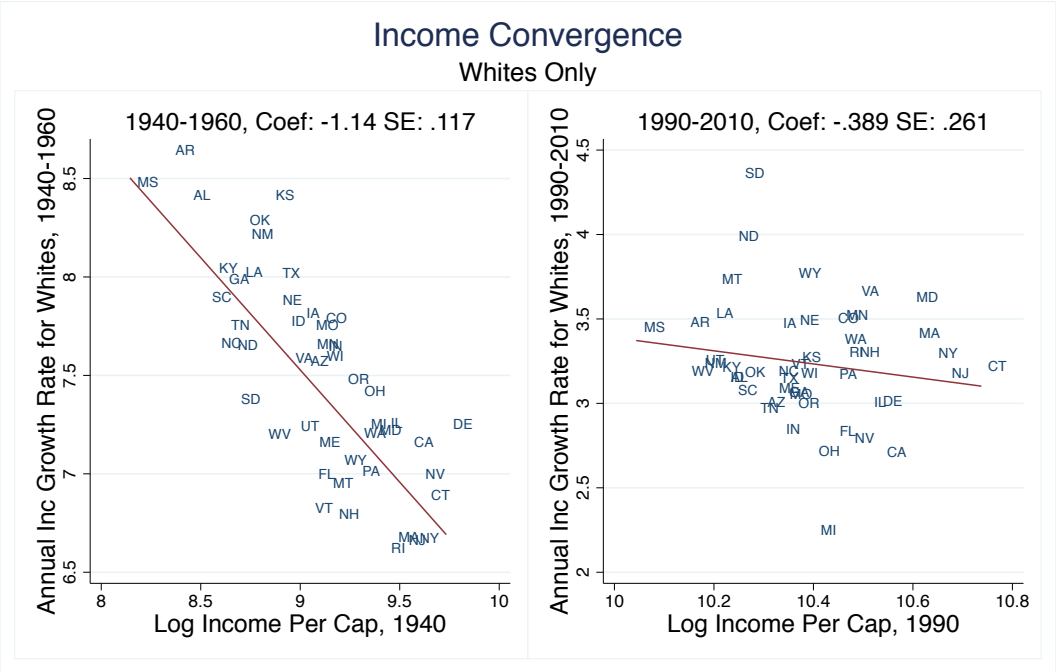


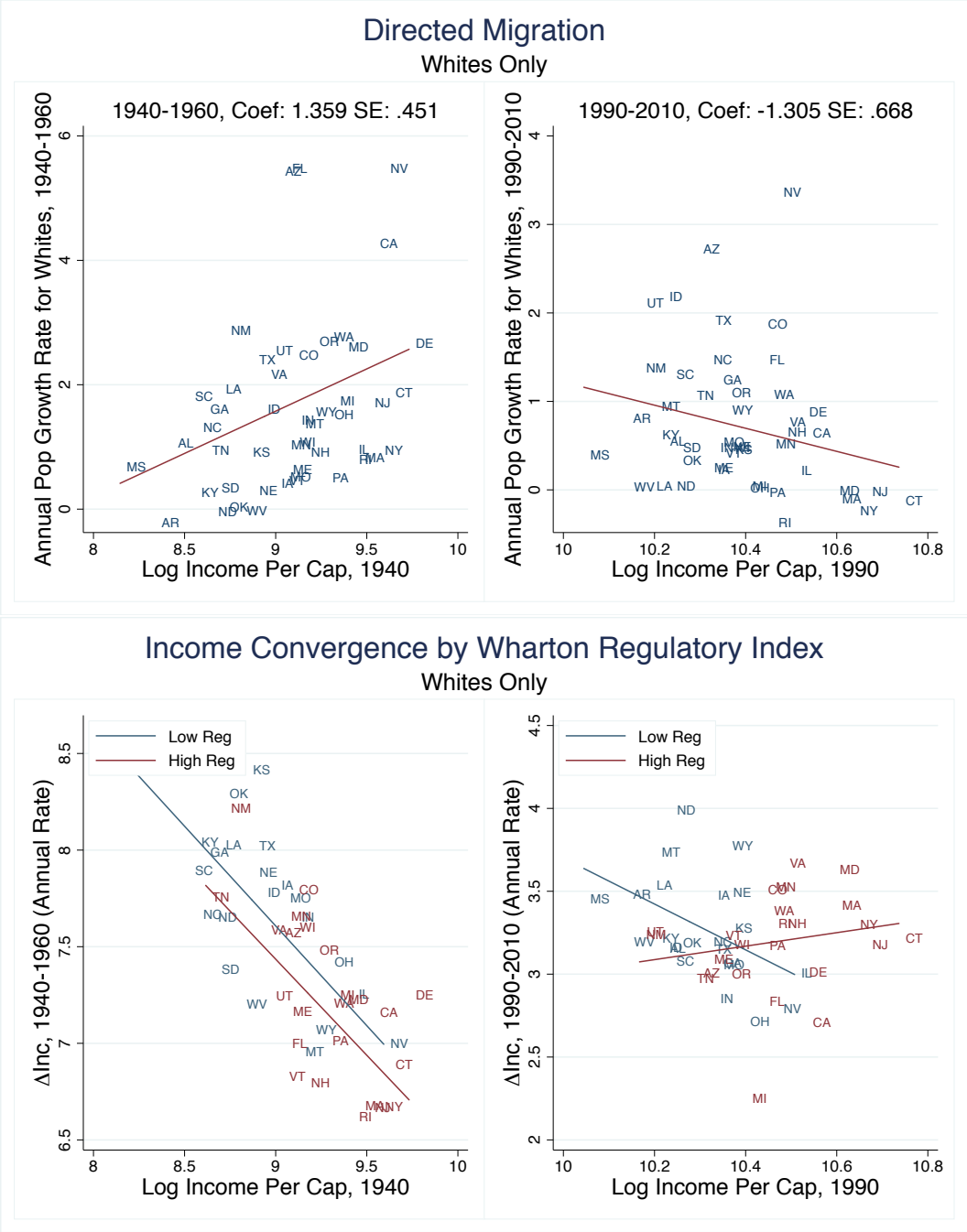
The figure shows that, before the shock, total directed migration averaged slightly less than 2% per year as in the data. Both skilled and unskilled workers migrate from South to North, with unskilled workers actually moving at a slightly faster rate due to initial skill imbalances. The

convergence rate before the shock is slightly less than 1% per year. The rate in the data is closer to 2% per year, meaning that under this calibration, the migration mechanism can account for roughly 50% of convergence prior to the regulatory shock.

When a shock calibrated to match changing price ratios hits, both directed migration and income convergence cease as in the data. The rate of income convergence falls roughly 1%, similar to the change in the rate of beta-convergence reported in Figure 1. Thus, while the migration channel can only account for half of the level of convergence, changes in migration can account for roughly 100% of the change. The cessation of total directed migration masks different trends for skilled and unskilled workers. Skilled workers continue to move from South to North at a reduced, but still significant rate. Unskilled migration, which had previously exceeded skilled migration, stops completely. Thus net migration has turned into skill-sorting across locations as in the data.

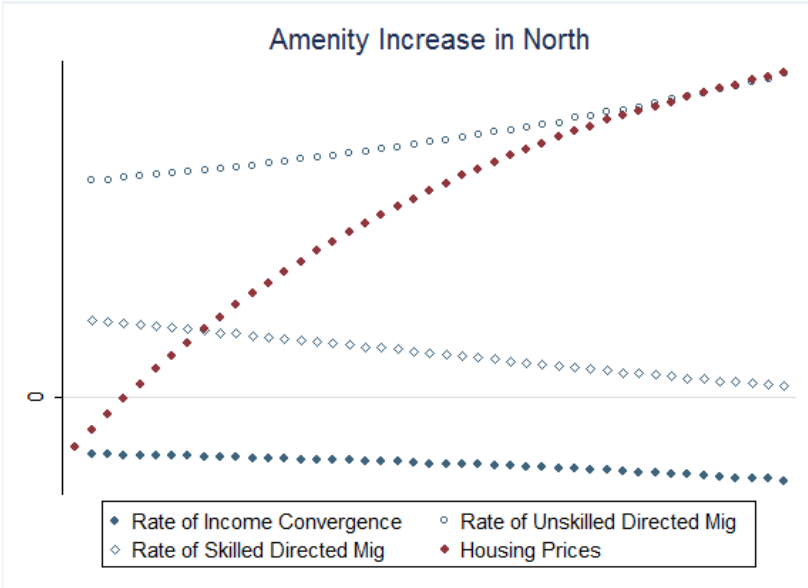
A.3 Income Convergence and Directed Migration of Whites





Notes: The horizontal axis in each panel is the log of state per capita income reported by the BEA. In the top and bottom panels, the vertical axis plots the average annual per capita income growth rate for whites in the state using data from Census and ACS extracts. We measure annual per capita income using the mean wage income for workers ages 25 through 65. In the middle row of panels, the vertical axis plots the average annual population growth rate for whites in the state. The bottom panel colors states based on the population weighted value of their housing supply elasticity as measured in Saiz [2010]. Blue states have above median elasticity and red states have an elasticity below the median.

A.4 Amenity Changes



This plot shows the impact of an amenity increase in the North, using the model in Section 2. See Section 5.5 for an extended discussion of these results.

Other papers cited in notes to appendix tables: Tolbert and Sizer [1996], U.S. Census Bureau [2012], Haines [2010], Ferrie [2003], Fishback et al. [2006], Lindert and Sutch [2006].

B Constant Returns to Scale in Production

B.1 Downward-Sloping Product Demand, Population Flows, and Convergence

In Section 2, we developed a model where downward-sloping labor demand came from the assumption of a production function that had decreasing returns to scale in labor. Here we show that downward-sloping labor demand can also come from a production function with constant returns to scale ($Y = AL$), combined with elastic product demand and monopolistic competition. Previous drafts (avaliable on request from the authors) have derived this result in a model with multiple skill types.

B.1.1 Individual Decisions: Labor Supply and Product Demand

Individuals i in the region "home" consume a basket of differentiated good $\{x_j\}$ from each region $j \in [0, 1]$. Individuals solve the following problem, taking the local price for labor w and the national price for products $\{p_j\}$ as exogenous

$$U = \left(\int x_{ij}^{\rho}\right)^{\frac{1}{\rho}} - \frac{l_i^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} + \lambda\left(w_i l_i - \int p_j x_{ij} dj\right)$$

$$
\begin{aligned}
\frac{\partial U}{\partial x_j} &= \left(\left(\int x_{ij}^{\rho}\right)^{\frac{1-\rho}{\rho}}\right) x_{ij}^{\rho-1} - \lambda p_j = 0 \\
\frac{\partial U}{\partial l} &= -l_i^{1/\varepsilon} + \lambda w_i = 0
\end{aligned}
$$

$$
\frac{\left(\left(\int x_{ij}^{\rho}\right)^{\frac{1-\rho}{\rho}}\right) x_{ij}^{\rho-1}}{p_j} = \frac{l_i^{1/\varepsilon}}{w_i} \Rightarrow
$$

$$
l_i^{supply}(w) = w_i^{\varepsilon}\left(\frac{x_{ij}^{\rho-1}}{p_j}\left(\left(\int x_{ik}^{\rho} dk\right)^{\frac{1-\rho}{\rho}}\right)\right)^{\epsilon} \tag{9}
$$

Equation (9) holds for all markets $j \in [0,1]$. We now apply the standard Dixit- Stiglitz solution techniques to derive the demand for any individual good j in terms of its own price p_j, household income $w_i l_i$ and the aggregate price index P. The first order conditions imply that an individual's consumption of two goods must have the following ratio:

$$
\begin{aligned}
\frac{x_{ik}}{x_{ij}} &= \left(\frac{p_k}{p_j}\right)^{-\sigma} \Rightarrow x_{ik} = x_{ij}\left(\frac{p_k}{p_j}\right)^{-\sigma} \\
p_k x_{ik} &= p_k x_{ij}\left(\frac{p_k}{p_j}\right)^{-\sigma} \\
\text{Integrating } \int p_k x_{ik} dk &= \int p_k x_{ij}\left(\frac{p_k}{p_j}\right)^{-\sigma} dk \\
w l_i &= x_{ij} p_j^{\sigma} \underbrace{\int p_k^{1-\sigma} dk}_{P^{1-\sigma}}
\end{aligned}
$$

$$
x_{ij} = p_j^{-\sigma}\frac{w_i l_i}{P^{1-\sigma}} \tag{10}
$$

Recall that l_i is actually $l_i^*(w)$ from equation (9) which governed labor supply. We now substitute in for the labor supply elasticity above, to write an individual's demand for good x_j as:

$$
x_{ij}^{Demand}(p, w, \xi, P) = \frac{p_j^{-\sigma} w_i^{1+\varepsilon}}{P^{1-\sigma}}\xi_i \tag{11}
$$

where ξ_i is a scaling of household marginal utility.

B.1.2 Firm Decisions: Product Supply and Labor Demand

We assume that each region has a single firm j, which takes the national demand curve and local wages as exogenous. As before, we suppress the notation for the location of the home firm throughout. Firms produce using the constant returns to scale production function $q_j = AL_j$. The firm

serves the national market but hires labor locally (L_j) at wage w_j.

$$\max_{p_j, l_j, q_j} p_j q_j(p_j) - w_j L_j$$

$$\text{subject to (1) } q_j = \underbrace{\frac{p_j^{-\sigma}}{P^{1-\sigma}} \int w_i^{1+\varepsilon} \xi_i \mu_i di}_{national\, demand} \text{ and (2) } L_j = q_j / A$$

$$\iff \max_{p_j} p_j^{1-\sigma} \frac{\int w_i^{1+\varepsilon} \xi_i \mu_i di}{P^{1-\sigma}} - \frac{w_j}{A} (p_j^{-\sigma} \frac{\int w_i^{1+\varepsilon} \xi_i \mu_i di}{P^{1-\sigma}})$$

$$\iff \max_{p} \left(p_j^{1-\sigma} - \frac{w_j}{A} p_j^{-\sigma} \right) \frac{\int w_i^{1+\varepsilon} \xi_i \mu_i di}{P^{1-\sigma}}$$

$$\Rightarrow FOC : p_j = \frac{\sigma}{\sigma - 1} \frac{w_j}{A}$$

Having derived the optimal prices, we can determine output by substituting the price FOC back in to equation (11) for consumer demand:

$$x_{ij}^{demand} = \frac{p_j^{-\sigma} w_i^{1+\varepsilon}}{P^{1-\sigma}} \xi_i$$

We can integrate over all the individuals i to calculate an aggregate demand curve for good j:

$$x_j^{demand} = \left(\frac{\sigma}{\sigma - 1} \frac{w_j}{A} \right)^{-\sigma} \frac{\int w_i^{1+\varepsilon} \mu_i \xi_i di}{P^{1-\sigma}}$$

Inverting the production function $q = AL$ gives a company's labor demand as a function of wages and downward-sloping demand for their good.

$$L^{Demand}(w) = \frac{\left(\frac{\sigma}{\sigma-1} \frac{w_j}{A} \right)^{-\sigma} \frac{\int w_i^{1+\varepsilon} \xi_i \mu_i di}{P^{1-\sigma}}}{A} = A^{\sigma-1} \left(\frac{\sigma}{\sigma - 1} \right)^{-\sigma} w_j^{-\sigma} \frac{\int w_i^{1+\varepsilon} \xi_i \mu_i di}{P^{1-\sigma}} \tag{12}$$

B.1.3 Labor Market Equilibrium

Recall that labor supply is given by the individual labor supply decision (equation (9)) times the share of individuals μ_j in the regional market.

$$L^{Supply}(w) = \mu_j w_j^{\varepsilon} \xi_j \tag{13}$$

Now we can equate labor supply from equation (13) and demand from equation (12) to solve for the market-clearing wage

$$\begin{aligned} L^D(w) &= L^S(w) \\ \Rightarrow \mu_j w_j^{\varepsilon} \xi_j &= A^{\sigma-1} \left(\frac{\sigma}{\sigma - 1} \right)^{-\sigma} w_j^{-\sigma} \frac{\int w_i^{1+\varepsilon} \mu_i \xi_i di}{P^{1-\sigma}} \end{aligned}$$

Recall from equation (9) that

$$\xi = \left(\frac{x_{ij}^{\rho-1}}{p_{ij}} \left(\left(\int x_{ik}^{\rho} dk \right)^{\frac{1-\rho}{\rho}} \right) \right)^{\varepsilon}$$

Recall equation (10), that consumer i's demand for good j is $x_{ij} = p_j^{-\sigma} \frac{wl_i}{P^{1-\sigma}}$. Plugging the demand equation into the marginal utility expression gives

$$\begin{aligned}
\xi &= \left(p_j^{-\sigma(\rho-1)} \left(\frac{wl_i}{P^{1-\sigma}} \right)^{\rho-1} \left(\left(\int \left(p_j^{-\sigma} \frac{wl_i}{P^{1-\sigma}} dj \right)^{\rho} \right)^{\frac{1-\rho}{\rho}} \right) \right)^{\varepsilon} \\
&= \left(p_j^{-\sigma(\rho-1)} \left(\frac{wl_i}{P^{1-\sigma}} \right)^{\rho-1} \left(\frac{wl_i}{P^{1-\sigma}} \right)^{1-\rho} \left(\int p_j^{-\rho\sigma} dj \right)^{\frac{1-\rho}{\rho}} \right)^{\varepsilon} \\
&= \left(p_j^{-\sigma(\rho-1)} \left(\int p_j^{-\rho\sigma} dj \right)^{\frac{1-\rho}{\rho}} \right)^{\varepsilon}
\end{aligned}$$

This shows that ξ is a function of prices which are exogenous from the perspective of the home region, meaning that it cancels from both sides of the labor-market clearing condition. This means we can solve for the market-clearing wage in terms of exogenous parameters.

$$w_j^{\text{Market-clearing}} = A^{\frac{\sigma-1}{\varepsilon+\sigma}} P^{\frac{\sigma-1}{\varepsilon+\sigma}} \mu_j^{\frac{-1}{\sigma+\varepsilon}} \left(\frac{\sigma}{\sigma-1} \right)^{-\sigma/(\sigma+\varepsilon)}$$

With the market-clearing wage, we can go back to the individual labor supply condition (equation (8)) to solve for per capita income

$$w^* l^* = w_j^{1+\varepsilon} \xi_i = A^{\frac{(\sigma-1)(1+\varepsilon)}{\epsilon+\sigma}} P^{\frac{(\sigma-1)(1+\varepsilon)}{\epsilon+\sigma}} \mu^{\frac{-(1+\varepsilon)}{\sigma+\varepsilon}} \left(\frac{\sigma}{\sigma-1} \right)^{-\sigma(1+\varepsilon)/(\sigma+\varepsilon)} \xi_i \tag{14}$$

B.1.4 Comparative Static

We are interested in the impact of a population change in the home region on local per-capita incomes, or mathematically, $\partial w^* l^* / \partial \mu$. A, P, σ, ξ and ε are exogenous parameters or functions of nation-wide variables. From equation (14) we have an elasticity of per capita income with respect to population of :

$$\varepsilon_{\text{population}}^{\text{per cap income}} = \frac{-(1+\epsilon)}{\sigma+\epsilon}$$

where $0 < \mu < 1, \varepsilon > 0$, and $\sigma > 1$. We can interpret this elasticity intuitively. When the labor supply elasticity is high, inflows have a bigger impact on income because a small increase in labor supply greatly bids down the price of labor. When a monopolistic region faces a less elastic demand curve ($\sigma \sim 1$), then it will not increase production much in response to a migration-induced decrease in the cost of labor. As a result, incomes will fall to a greater degree if the demand curve is more inelastic (σ is lower). In this way, monopolistically competitive markets can provide a microfoundation for the result of downward-sloping labor demand.

C Distribution of Migration Costs

C.1 The Path of Income and Population Over Time

For this exercise, we abstract from different skill types, and focus on a single skill model. As before, output in an area is a function of the local population:

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

The parameter α governs the elasticity of both per capita income and the exponential of indirect utility with respect to population. Further, let A be the ratio of relative productivity in *North* relative to *South*. Here we use notation N for the Northern rich region and S for the Southern poor region. We then have per capita incomes:

$$y_{Nt} = An_{Nt}^{-\alpha} \text{ and } y_{St} = n_{St}^{-\alpha}$$

Let x be the share of people leaving place S for place N. The gap in per capita income growth rates between North and South is

$$\begin{aligned}
\Delta dln\,(y) &= dln\,(y_{Nt}) - dln\,(y_{St}) \\
&= -\alpha\left(ln\left(\frac{n_{Nt}}{n_{Nt-1}}\right)\right) - \alpha\left(ln\left(\frac{n_{St}}{n_{St-1}}\right)\right) \\
&= -\alpha\left(ln\left(\frac{n_{Nt-1}+xn_{St-1}}{n_{Nt-1}}\right) - ln\left(\frac{(1-x)n_{St-1}}{n_{St-1}}\right)\right) \\
&= -\alpha\left(ln\left(1+\frac{xn_{St-1}}{n_{Nt-1}}\right) - ln\,(1-x)\right)
\end{aligned}$$

The convergence rate is the gap in per capita growth rates divided by the gap in levels. We set this to a negative constant κ.

$$\frac{\Delta dln\,(y)}{\Delta ln(y_{t-1})} = \frac{-\alpha\left(ln\left(1+\frac{xn_{St-1}}{n_{Nt-1}}\right) - ln\,(1-x)\right)}{ln(A) - \alpha ln\left(\frac{n_{Nt-1}}{n_{St-1}}\right)} = \underbrace{\kappa}_{convergence}$$

Given this constant, we can solve for x:

$$-\alpha\left(ln\left(\frac{1+\frac{xn_{St-1}}{n_{Nt-1}}}{1-x}\right)\right) = \kappa\left(ln(A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha})\right)$$

$$e^{-\alpha}\left(\frac{1+\frac{xn_{St-1}}{n_{Nt-1}}}{1-x}\right) = e^{\kappa}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha}$$

$$x\frac{n_{St-1}}{n_{Nt-1}} = e^{\kappa+\alpha}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha}(1-x) - 1$$

$$x\left(\frac{n_{St-1}}{n_{Nt-1}} + e^{\kappa+\alpha}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\epsilon}\right) = e^{\kappa+\alpha}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\epsilon} - 1$$

$$x = \frac{e^{\kappa+\alpha}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha} - 1}{\left(\frac{n_{St-1}}{n_{Nt-1}} + e^{\kappa+\alpha}A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha}\right)}$$

Because $A\left(\frac{n_{St-1}}{n_{Nt-1}}\right)^{\alpha} = \frac{Y_{Nt-1}}{Y_{St-1}}$, we can rewrite this as

$$x = \frac{e^{\kappa+\alpha}\left(\frac{Y_{Nt-1}}{Y_{St-1}}\right) - 1}{e^{\kappa+\alpha}\left(\frac{Y_{Nt-1}}{Y_{St-1}}\right) + A^{\frac{-1}{\alpha}}\left(\frac{Y_{Nt-1}}{Y_{St-1}}\right)^{\frac{1}{\alpha}}}$$

Finally, define Y_{N0} as income in the North and Y_{S0} as income in the South at $t = t_0$. Then

$$x_t^* = x = \frac{e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)-1}{e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)+A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\epsilon\alpha}}}$$

We need optimal migration from the South to produce this fraction of the Southern population moving North for each time t. Below, we derive conditions under which this fraction is declining over time. It is intuitive that the share of the Southern population moving would fall over time, because as migration rates should fall as the benefit to moving falls. Still, the ratio between the amount of directed migration and the initial income gap will be constant, so that income convergence continues at constant rate.

C.2 Individual Migration Decisions

Consider an agent in the South deciding whether to move to the North today or stay in the South, with the possibility of moving in the future, valued at $\tilde{V_{T+1}}$. This agent discounts the future at rate r. In each period, agents draw i.i.d. moving costs $\lambda \sim F$. Define $\lambda_T^* = F^{-1}(x_T^*)$. The agent will move if

$$\begin{aligned} \text{Gain to Moving at T} - \text{Flow Cost} &> \text{Benefit to Moving Later} \\ \sum_{t=T}^{\infty} e^{-rt}\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)} - \lambda_T &> e^{-\rho r T}\tilde{V_{T+1}} \end{aligned}$$

At x_T^*, the agent is indifferent between moving and staying. This implies that

$$\lambda_T^* \equiv F^{-1}(x_T^*) = \underbrace{\sum_{t=T}^{\infty} e^{-rt}\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}}_{Gains\,to\,moving\,at\,T} - \underbrace{e^{-rT}\tilde{V_{T+1}}}_{Benefit\,to\,Staying}$$

The benefit to waiting is that expected future migration costs are lower. We know at each period how likely it is that the agent would choose to move in all future periods. So we can integrate up the value the agent gets from eventually winding up in Productiveville. The difference between that and the value of moving today is the expected savings in moving costs. This defines the distribution of moving costs for the part of the distribution hit covered by the sequence $\{x_t^*\}_{t=0}^{\infty}$.

$$\underbrace{\sum_{t=T}^{\infty}\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{-(r+\kappa)t+\kappa t_0}}_{Excess\,Gains\,to\,moving\,at\,T} - \underbrace{\sum_{t=T+1}^{\infty}\left(\prod_{j=T}^{t}(1-x_j^*)\right)x_t^*\sum_{t_2=t}^{\infty}\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{-(r+\kappa)t_2+\kappa t_0}}_{Excess\,Gains\,From\,Moving\,Eventually} = \underbrace{F^{-1}(x_T^*) - E[Future\,MC\,|T]}_{Cost\,to\,moving\,now-Eventual\,Moving\,Cost}$$

$$= F^{-1}(x_T^*) - \sum_{t=T+1}^{\infty}\prod_{j=T}^{t}(1-x_j^*)\int_0^{F^{-1}(x_t^*)}\lambda\cdot f(\lambda)\cdot d\lambda$$

C.3 Finding An Interior Solution

To finish the proof, we need to show that $\frac{dx_t^*}{dt} < 0$ for $t > 0$. Because income gaps between North and South are falling, this implies that we need the fraction of Southern residents leaving each period to be declining. This ensures that the dynamic problem described above has an interior solution. Recall from the previous section that

$$x_t^* = \frac{e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)-1}{e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)+A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}}$$

$$
\begin{aligned}
\frac{dx_t^*}{dt} &= \underbrace{\frac{e^{\kappa+\alpha}\left(\frac{Y_{N0}}{Y_{S0}}\right)\kappa e^{\kappa(t-t_0)}}{e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)+A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}}}_{P1} \\
&- \underbrace{\frac{x_t^*}{\left(e^{\kappa+\alpha}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)+A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}\right)}}_{P2} \times \\
&\underbrace{\left(e^{\kappa+\alpha}\left(\frac{Y_{N0}}{Y_{S0}}\right)\kappa e^{\kappa(t-t_0)}+\frac{A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}\left(\frac{Y_{N0}}{Y_{S0}}\right)\kappa e^{\kappa(t-t_0)}}{\alpha\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)}\right)}_{P3}
\end{aligned}
$$

$$
\frac{dx_t^*}{dt} < 0 \iff P1 < P2 \times P3
$$

Cancelling terms, we can rewrite that as:

$$
\kappa e^{\kappa+\alpha} < \kappa x_t^* \times \underbrace{\left(e^{\kappa+\alpha}+\frac{A^{\frac{-1}{\alpha}}\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}}{\alpha\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)}\right)}
$$

Define $\eta = 1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}$.

$$
\begin{aligned}
\kappa e^{\kappa+\alpha} &< \kappa x_t^* \times \left(e^{\kappa+\alpha}+\frac{A^{\frac{-1}{\alpha}}}{\alpha\epsilon}\eta^{\frac{1-\alpha}{\alpha}}\right) \\
e^{\kappa+\alpha} &> \frac{e^{\kappa+\alpha}\eta-1}{e^{\kappa+\alpha}\eta+A^{\frac{-1}{\alpha}}\eta^{1/\alpha}} \times \left(e^{\kappa+\alpha}+\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1-\alpha}{\alpha}}\right) \\
\Rightarrow \left(e^{\kappa+\alpha}\right)^2\eta+e^{\kappa+\alpha}A^{\frac{-1}{\alpha}}\eta^{1/\alpha} &> \left(e^{\kappa+\alpha}\right)^2\eta-e^{\kappa+\alpha}+e^{\kappa+\alpha}\eta\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1-\alpha}{\alpha}}-\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1-\alpha}{\alpha}} \\
\Rightarrow e^{\kappa+\alpha}\left(A^{\frac{-1}{\alpha}}\eta^{1/\alpha}+1-\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1}{\alpha}}\right) &> -\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1-\alpha}{\alpha}} \\
\Rightarrow e^{\kappa+\alpha} &> -\frac{A^{\frac{-1}{\alpha}}}{\alpha}(\eta)^{\frac{1-\alpha}{\alpha}} \setminus \left(1-\frac{\alpha-1}{\alpha}A^{\frac{-1}{\alpha}}(\eta)^{\frac{1}{\alpha}}\right) = \eta^{\frac{1-\alpha}{\alpha}} \setminus \left((1-\alpha)\eta^{\frac{1}{\alpha}}-\alpha A^{\frac{1}{\alpha}}\right)
\end{aligned}
$$

Plugging back in for η gives

$$
e^{\kappa+\alpha} > \frac{\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1-\alpha}{\alpha}}}{\left((1-\alpha)\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)e^{\kappa(t-t_0)}\right)^{\frac{1}{\alpha}}-\alpha A^{\frac{1}{\alpha}}\right)}
$$

We need this to be true at both $t = t_0$ and $t = \infty$. At $t = t_0$, $e^{\kappa(t-t_0)} = e^0 = 1$, and at $t = \infty$, $e^{-\infty} = 0$.

This gives us the conditions:

$$
\begin{aligned}
e^{\kappa+\alpha} &> \max\{\frac{\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1-\alpha}{\alpha}}}{\left((1-\alpha)\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1}{\alpha}}-\alpha A^{\frac{1}{\alpha}}\right)}, \frac{1}{\left(1-\alpha-\alpha A^{1/\alpha}\right)}\} \\
&= \frac{\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1-\alpha}{\alpha}}}{\left((1-\alpha)\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1}{\alpha}}-\alpha A^{\frac{1}{\alpha}}\right)} \\
\kappa &> \log\frac{\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1-\alpha}{\alpha}}}{\left((1-\alpha)\left(1+\left(\frac{Y_{N0}}{Y_{S0}}\right)\right)^{\frac{1}{\alpha}}-\alpha A^{\frac{1}{\alpha}}\right)}-\alpha
\end{aligned}
$$

So as long as this combination of α, A, and $1+\left(\frac{Y_{N0}}{Y_{S0}}\right)$ are sufficiently small, then there exists some moving cost distribution F such that convergence occurs at a constant rate.

APPENDIX TABLE 1

σ Convergence, IV Estimates of Convergence and Labor Market Area Convergence

Panel A: Cross-Sectional Standard Deviation of Income	1950	1960	1970	1980	1990	2000	2010
BEA Log Inc Per Cap	0.236	0.199	0.155	0.137	0.150	0.150	0.138

Panel B: Additional Convergence Regressions

$\Delta \ln y_{it}$ (Annual Rate in %) = $\alpha+\beta_t \ln y_{it-1}+\varepsilon_{it}$

	20 year period ending in…						
OLS BEA	1950	1960	1970	1980	1990	2000	2010
Coefficient	-2.38	-2.41	-1.98	-1.85	-0.58	-0.39	-0.99
Standard Error	0.16	0.11	0.16	0.15	0.31	0.46	0.29
OLS Census							
Coefficient	--	-1.82	-2.33	-2.42	-0.36	-0.26	-1.33
Standard Error	--	0.13	0.16	0.12	0.33	0.50	0.32
IV BEA with Census							
Coefficient	--	-2.46	-1.65	-1.59	-0.37	-0.22	-1.23
Standard Error	--	0.12	0.22	0.25	0.32	0.46	0.42
IV Census with BEA							
Coefficient	--	-1.81	-2.42	-2.37	-0.48	-0.27	-0.84
Standard Error	--	0.12	0.18	0.14	0.38	0.59	0.27

Panel C: Convergence at Labor Market Area Level

$\Delta \ln var_{it}$ (Annual Rate in %) = $\alpha+\beta_t \ln y_{it-1}+\varepsilon_{it}$

	20 year period ending in…						
Income Convergence	1950	1960	1970	1980	1990	2000	2010
Coefficient	--	-0.97	-1.69	-2.13	-0.21	0.23	-0.26
Standard Error	--	0.19	0.10	0.13	0.18	0.26	0.16

Notes: Panel A. This panel reports the standard deviation of log income per capita across states. This corresponds to the σ convergence concept in Barro and Sala-i-Martin (1992).

Panel B. Figure 1 calculates convergence coefficients using data on personal income from the BEA. That specification is biased in the presence of classical measurement error. We address the bias issue by instrumenting for the BEA measure using an alternative Census measure and vice versa. The Census measure is log wage income per capita for all earners, except in 1950 where it is only household heads. The first stage F-statistics range from 189 to 739. Classical measurement error is not an issue in these IV regressions, and the convergence coefficients display a similar time-series pattern.

Panel C. This panel replicates the "OLS Census" specification from this table at the Labor Market Area (LMA) level, with each LMA weighted by its population. We construct a panel of income and population at the Labor Market Area (LMA) level. LMAs are 382 groups of counties which are linked by intercounty commuting flows and partition the United States (Tolbert and Sizer, 1996). LMA income is estimated as the population-weighted average of county-level income. The income series uses median family income from 1950-2000 from Haines (2010) and USACounties (2012). In 1940 and 2010, the series is unavailable. In 1940, we use pay per manufacturing worker from Haines (2010). Pay per manufacturing worker which had a correlation of 0.77 with median family income in 1950, a year when both series were available. In 2010, we use median household income from USACounties (2012), which had a correlation of 0.98 with median family income in 2000, a year when both series were available.

APPENDIX TABLE 2

Directed Migration From Poor to Rich States and Labor Market Areas

	ΔY_{it} (Annual Rate in %) = $\alpha+\beta_t \ln y_{it}+\varepsilon_{it}$ 20 year period ending in…						
	1950	1960	1970	1980	1990	2000	2010
Y: Δ Log Pop_{it}, State Level							
Baseline, State-Level							
Coefficient	0.56	1.60	2.13	0.75	0.26	1.18	-0.48
Standard Error	0.27	0.37	0.60	0.78	1.03	1.05	0.64
Y: Net Migration (Birth-Death Method), State Level							
Coefficient	1.16	2.68	2.92	1.14	0.78	1.06	-0.49
Standard Error	0.19	0.36	0.59	0.77	0.97	1.02	0.58
Y: Net Migration (Survival Ratio Method), State Level							
Coefficient	1.29	2.04	2.20	0.67	0.05	--	--
Standard Error	0.23	0.35	0.58	0.77	0.92	--	--
Y: Δ Log Pop_{it}, Labor Market Area Level							
Coefficient	--	1.82	1.73	-0.02	-0.88	0.17	0.13
Standard Error	--	0.31	0.26	0.32	0.42	0.41	0.25

Sources: BEA Income estimates, Ferrie (2003) and Fishback et al. (2006)

Notes: Robust standard errors are shown below coefficients. Birth-death method uses state-level vital statistics data to calculate net migration as $ObservedPop_t$ - (Pop_{t-10} + $Births_{t,t-10}$ + $Deaths_{t,t-10}$). Survival ratio method computes counterfactual population by applying national mortality tables by age, sex, and race to the age-sex-race Census counts from 10 years prior. Both published series end in 1990, and we use vital statistics to construct the birth-death measure through 2010. See notes to Appendix Table 1 for details on construction of the Labor Market Area sample.

APPENDIX TABLE 3

Returns to Living in a High Income State by Skill

	1940	1960	1970	1980	1990	2000	2010
Panel A. Returns to Migration (OLS)							
			Income Net of Housing Costs				
Average State Income X Unskilled	0.880***	0.736***	0.786***	0.726***	0.657***	0.539***	0.356***
	(0.0204)	(0.0257)	(0.0421)	(0.0775)	(0.0347)	(0.0349)	(0.0465)
Average State Income X Skilled	0.700***	0.869***	0.876***	0.766***	0.885***	1.153***	0.967***
	(0.0615)	(0.0633)	(0.0620)	(0.124)	(0.0961)	(0.111)	(0.0903)
N	255,391	306,576	339,412	2,116,772	2,924,925	3,142,015	694,985
Panel B: Returns to Migration (IV for State of Residence with State of Birth)							
			Income Net of Housing Costs				
Average State Income X Unskilled	0.932***	0.776***	0.859***	0.772***	0.667***	0.488***	0.258***
	(0.0298)	(0.0381)	(0.0559)	(0.0937)	(0.0362)	(0.0358)	(0.0518)
Average State Income X Skilled	0.719***	0.740***	0.775***	0.418***	0.889***	1.196***	0.872***
	(0.0622)	(0.0814)	(0.0998)	(0.138)	(0.113)	(0.136)	(0.131)
N	255,391	306,576	339,412	2,116,772	2,924,925	3,142,015	694,985
Panel C: Differential Impacts of Housing Costs in High-Income States (OLS)							
			Log Housing Costs				
Log Average State Income X Unskilled	1.138***	1.076***	1.449***	1.755***	2.632***	2.249***	2.329***
	(0.0902)	(0.0957)	(0.160)	(0.437)	(0.284)	(0.281)	(0.284)
Log Average State Income X Skilled	1.657***	0.878***	1.274***	1.347***	2.338***	1.540***	1.802***
	(0.139)	(0.103)	(0.0935)	(0.250)	(0.285)	(0.247)	(0.238)
N	235,121	296,484	324,017	1,951,058	2,615,879	2,788,921	606,001

Notes: All standard errors are clustered by state. *** p<0.01, ** p<0.05, * p<0.1

Panel A. This panel reports the coefficients β_1 and β_2 from the regression $Y_i - P_i = \alpha + \gamma Skill_i + \beta_1 Y * (1-Skill_i) + \beta_2 Y * Skill_i + \theta X_i + \varepsilon_i$, where Y_i and P_i measure household wage income and housing costs respectively, Y measures average state income and X_i are household covariates. Household $Skill_i$ is the fraction of household adults in the workforce who are skilled, defined as 12+ years of education in 1940 and 16+ years thereafter. Household covariates are the size of the household, the fraction of adult workers who are black, white, and male, and a quadratic in the average age of adult household workers. Housing costs P_i are defined as 5% of house value or 12 times monthly rent for renters. 1950 is omitted because household-level rent data are unavailable.

Panel B. The IV regressions replicate panel A, but instrument for average state income and its interaction with household skill using the average income of the state of birth of adult household workers. The first stage F-statistics in these regressions exceed 80.

Panel C. This panel reports the coefficients β_1 and β_2 from the regression $\log(P_i) = \alpha + \gamma Skill_i + \beta_1 \log(Y) * (1-Skill_i) + \beta_2 \log(Y) * Skill_i + \theta X_i + \varepsilon_i$

APPENDIX TABLE 4

Migration Flows by Skill Group: Nominal vs. Real Income

	Dep Var: 5-Year Net Migration as Share of Total Pop				
	Baseline (1)	Double Housing Cost (2)	Exclude In-State Mig (3)	Only Whites (4)	Mig Measure Birth State (5)
Panel A: Low-Skill People, 1940					
Log Nominal Income	1.313***	--	1.049**	1.007**	1.086**
	(0.470)	--	(0.438)	(0.443)	(0.443)
Log Group-Specific Income Net of Housing	1.236***	1.109***	1.017***	0.980***	0.995***
	(0.364)	(0.274)	(0.350)	(0.352)	(0.338)
Panel B: High-Skill People, 1940					
Log Nominal Income	0.611	--	0.617	0.585	0.475
	(0.392)	--	(0.419)	(0.387)	(0.411)
Log Group-Specific Income Net of Housing	0.773*	0.899**	0.905*	0.821*	0.701
	(0.400)	(0.337)	(0.462)	(0.415)	(0.513)
Panel C: Low-Skill People, 2000					
Log Nominal Income	-2.173**	--	-2.456***	-2.377***	0.281
	(1.006)	--	(0.792)	(0.757)	(8.453)
Log Group-Specific Income Net of Housing	4.309**	6.042***	-0.357	1.725	-11.99
	(2.007)	(2.140)	(1.167)	(1.418)	(11.51)
Panel D: High-Skill People, 2000					
Log Nominal Income	4.077***	--	1.786***	2.894***	19.32***
	(0.694)	--	(0.611)	(0.649)	(5.373)
Log Group-Specific Income Net of Housing	4.715***	3.634***	1.937***	3.593***	14.06***
	(0.894)	(1.280)	(0.701)	(0.874)	(4.567)

Note: Each cell represents the results from a different regression. The table regresses 5 year net-migration rates on average income and skill-specific income net of housing. Low-skill is defined as having less than 12 years of education in 1940 and less than a BA in 2000. In 1940, the unit of observation is State Economic Area, with n=455 to 466, depending on specification. In 2000, the unit of observation is three-digit Public Use Microdata Areas, with n=1,020. The baseline case reproduces the results in Figures 5 and 6. The second column shows the effect of doubling the housing costs described in the text to control for non-housing price differences across places. The third column excludes intra-state migrants in calculating net-migration rates. The fourth column excludes non-white migrants in calculating net-migration rates. The final measure calculates migrants as the number of residents residing outside their state of birth. Additional details are presented in the text. Standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX TABLE 5

Impacts of Alternate Regulation Measures on Permits, Prices, Migration, and Convergence

	Annual Construction Permits$_t$	Log House Price $_t$	ΔLog Population$_{t,t+20}$	Δ Log Human Capital	Δ Log Income Per Cap$_{t,t+20}$
	% of Housing Stock		Annual Rate in %		Annual Rate in %
	(1)	(2)	(3)	(4)	(5)
"Land Use" Cases Per Capita, Continuous & Winsorized @ 90th Percentile, scaled [0,1]					
Log Inc Per Cap$_t$	2.042	0.907***	1.297**	-0.0370***	-1.804***
	(1.232)	(0.0882)	(0.607)	(0.00756)	(0.108)
Log Inc Per Cap$_t$ *	-2.868*	0.809***	-2.132**	0.0298	1.765***
Continuous Reg	(1.466)	(0.247)	(0.821)	(0.0218)	(0.563)
N	1,536	384	2,448	288	2,448
"Land Use" Cases Per Capita, Above/Below Median					
Log Inc Per Cap$_t$	3.200**	0.903***	1.381**	-0.0367***	-1.884***
	(1.551)	(0.0784)	(0.585)	(0.00715)	(0.0956)
Log Inc Per Cap$_t$ *	-2.984**	0.633***	-1.043**	0.0310***	1.113***
Binary Reg	(1.380)	(0.175)	(0.441)	(0.0103)	(0.244)
N	1,536	384	2,448	288	2,448
"Zoning" Cases Per Capita, Rank scaled [0,1]					
Log Inc Per Cap$_t$	5.955***	0.683***	2.507***	-0.0277**	-2.179***
	(2.165)	(0.114)	(0.690)	(0.0136)	(0.141)
Log Inc Per Cap$_t$ *	-7.246***	1.032***	-3.646***	-0.00683	1.294***
Zoning Reg	(2.456)	(0.255)	(1.064)	(0.0276)	(0.453)
N	1,536	384	2,448	288	2,448
Year*High Reg FEs	Y	Y	Y	Y	Y

Notes: The table reports the coefficients β_1 and β_2 from regressions of the form:

$\Delta lny_{it}=\alpha_t+\alpha_t reg_{it}+\beta_1 lny_{it}+ \beta_2 lny_{it} \times reg_{it}+\varepsilon_{it}$.

We use three regulation measures: (1) land use cases per capita (not the rank), scaled from zero to the 90th percentile of positive observations (2) whether land use cases per capita are above or below median, and (3) the rank of cases mentioning the word "zoning". The dependent variables are new housing permits from the Census Bureau, the median log housing price from the Census, population change, the change in log human capital due to migration, and the change in log per-capita income. Standard errors clustered by state. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX TABLE 6

Robustness Tests

	Δ Log Income Per $Cap_{t-20,t}$ (Annual Rate in %)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Inc Per Cap_{t-20}	-2.034***	-1.968***	-2.442***	-11.04***	-1.109***	
	(0.102)	(0.107)	(0.0876)	(3.108)	(0.197)	
Log Inc Per Cap_{t-20}* Reg_{it}	1.304***		0.640**	0.585*	0.516*	0.370**
	(0.393)		(0.312)	(0.313)	(0.275)	(0.140)
Log Inc Per Cap_{t-20}*1(Inc >Med)$_{t-20}$* Reg_{it}		2.002**				
		(0.799)				
Share BA_{t-20}			-19.48			
			(21.54)			
Log Inc Per Cap_{t-20} *Share BA_{t-20}			2.400			
			(2.003)			
Log Inc Per Cap_{t-20} ^2				0.478***		
				(0.165)		
Reg_{it}						-3.451**
						(1.354)
Fixed Effect	Year x Reg	Year x Reg	Year x Reg	Year x Reg	Year x Reg Census Division x Reg	Year x Inc
R^2	0.811	0.817	0.874	0.817	0.851	0.820
N	2,448	2,448	288	2,448	2,448	2,448

Column 1 reports the baseline convergence relationship from Table 2. Column 2 interacts the regulation variable with a dummy for state per capita income greater than the median. This follows our model in assuming that regulations only bind in growing locations. Column 3 includes controls for the percent of the population with a BA and the interaction of this share with initial income. This specification, like Section 5.1, is designed to show the robustness of the regulation result to controls for skill-biased technological change. Column 4 includes a control for initial log income squared, accounting for potential nonlinearity in convergence. Column 5 includes Census division fixed effects interacted with regulations to account for differential regulation growth across regions. Column 6 includes year fixed effects interacted with initial income, which allows for different baseline convergence rates across time. In all of these models, the relationship between tighter regulation and slower convergence remains statistically significant. Standard errors are clustered by state, and the construction of the variables is discussed in the text.
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX TABLE 7

Share of Unavailable Land
(Aggregated from Saiz 2010)

UT	0.698	CO	0.202
FL	0.553	MI	0.200
CA	0.532	MD	0.193
WV	0.523	DE	0.188
LA	0.507	OH	0.180
VT	0.447	AL	0.174
OR	0.427	AR	0.170
NV	0.415	AZ	0.162
WA	0.389	NM	0.156
CT	0.376	MT	0.146
ID	0.354	RI	0.139
NY	0.347	WY	0.137
ME	0.346	KY	0.133
NH	0.339	NC	0.122
MA	0.338	GA	0.113
WI	0.333	IN	0.103
IL	0.326	SD	0.101
VA	0.299	TX	0.101
MS	0.279	MO	0.089
NJ	0.274	IA	0.050
SC	0.250	ND	0.043
TN	0.236	OK	0.043
PA	0.211	KS	0.040
MN	0.209		

These data are drawn from Saiz (2010). County level estimates were weighted by population in 1960 to arrive at state-level averages. These data are used in Table 3 in the text.

APPENDIX TABLE 8

Inequality Impacts of Convergence and its Demise

Panel A: Inequality Counterfactual without Convergence (1940-1980)

	Std Dev of Log Hourly Earnings -- Full-time Males	
	State[a]	Total[b]
1940	0.300	0.781
1950	0.227	0.672
1960	0.183	0.580
1970	0.147	0.600
1980	0.106	0.618
Convergence (1940-1980)[c]	65%	
1980 No Convergence Counterfactual: SD [Y + Ystate1940*(1-0.35)		0.674
Inequality		
1980 Observed - 1940 Observed		-0.163
1980 No Convergence Counterfactual - 1940 Observed		-0.107
Share of Inequality Accounted for By Convergence		34%

Panel B: Inequality Counterfactual if Convergence Continued (1980-2010)

	Std Dev of Log Hourly Earnings -- Full-time Males	
	State	Total
1980	0.106	0.618
1990	0.125	0.622
2000	0.098	0.643
2010	0.115	0.678
2010 Convergence Counterfactual: SD [Y - Ystate1980*(1-0.35)][e]		0.674
Inequality		
2010 Observed - 1980 Observed		0.060
2010 Convergence Counterfactual - 1980 Observed		0.056
Share of Inequality Accounted for By End of Convergence		8%

Sample uses hourly earnings for men ages 18-65 with nonallocated positive earnings, who worked at least 40 weeks last year and at least 30 hours per week in the Census. Sample is winsorized at the 1st and 99th percentile in order to limit the influence of outliers.

a. Population-weighted standard deviation of mean state-by-year log hourly earnings.

b. Standard deviation of log hourly earnings. Conceptually, this measure includes both state-level and residual variation in earnings.

c. Convergence = 1-SDState1980/SDState1940. Note that this measure uses hourly earnings, and is different from the measure of Convergence developed in Appendix Table 1, which uses per capita income.

d. Rather than using observed state income in 1980, we predict state income using 1940 state income and the observed convergence rate of 65% to calculate Ystate1980hat=0.35*Ystate1940. We characterize the counterfactual distribution of earnings in the absence of state income convergence as Y + Ystate1940 - Ystate1980hat.

e. Method follows note (d), except that we calculate the counterfactual with convergence as Y - Ystate1980 + Ystate2010hat.