Intergenerational Mobility Effects of Region-Based Education and Migration Policy in China

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Abstract

Inequality and low social mobility in China have long been causes of widespread social unrest, and region-based government policies are considered some of the major causes of these issues. We study the effects of three existing education and migration policies that produce regional inequities in quality of and access to opportunity. First, decentralized public K-12 education spending implies that richer regions have better-funded public schools. Second, the Ministry of Education allocates more seats at public colleges to richer provinces relative to the number of provincial applicants. Finally, the *Hukou*, or residential permit, system imposes substantial costs to migrate to rich areas by restricting access to local Hukou, which is required for individuals to access important public resources such as education, subsidized housing markets, and healthcare. These policies drive intergenerational persistence in education and location, leading to intergenerational persistence in income. We build a structural spatial overlapping generations model that encapsulates China's institutional setting and calibrate it to recent Chinese data. We then use the calibrated model to quantify the effects of changing these policies on intergenerational mobility, welfare, education, and the income distribution, with particular interest in outcomes for children born at the bottom of the parental income distribution. We find that lifting Hukou restrictions and equalizing public spending levels increases intergenerational mobility and improves outcomes for the poorest born in poor provinces at the expense of children born in rich provinces. Modifying college allocations to a merit-based or equity-based admissions system changes college enrollment outcomes with modest aggregate effects, and positive (and negative) effects are largely concentrated among children born to richer parents.

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1 Introduction

Understanding the mechanisms of intergenerational income mobility and inequality has long been a question of interest for economists. Previous literature has found childhood location to be a key factor, having substantial impacts on future social mobility and income. (Benabou (1993), Fernandez and Rogerson (1996, 1998), Chetty et al. (2014a), Eckert and Kleineberg (2021)). There are many channels underlying this relationship, with location-based government policies often serving as a primary factor. Many countries employ policies that generate dispersion in regional opportunity, which can have drastic consequences for inequality and intergenerational mobility. While most previous work studying this connection has focused on developed countries, higher incidence of poverty in developing countries makes it a compelling topic in low-income contexts, as low mobility implies that children born in poverty tend to stay in poverty as adults. It is thus especially important to evaluate the role and impact of regional policies on promoting social mobility and reducing inequality in developing countries.

China represents an ideal economic and institutional setting to study this question. Its rapid growth over the past 40 years has given rise to prosperous cities and lifted many out of poverty, but has also been accompanied by substantial increases in regional inequality (Kanbur and Zhang (2005), Xu (2011), Zhang and Zou (2012)). Three region-based policies have potentially contributed to this outcome. First, public K-12 education spending is decentralized to local governments, with the amount of spending in each province coming from local government revenue and community contributions. Second, the central government (specifically, the Ministry of Education) dictates the number of students from each province who are admitted to public colleges in China. Third, China's *Hukou*, or residential permit, system requires individuals to obtain a local provincial Hukou in order to access key public resources such as health care, public schooling, subsidized housing markets, social pension, and other important provisions; individuals can and often do migrate without a Hukou, but cannot access these resources.

Each of the policies affects the opportunities available to children based on birth location. Children born in richer regions receive higher levels of per-student spending on K-12 public education and receive larger allocations of seats at public colleges relative to the number of applicants in the province. The Hukou system limits migration, especially from rural to urban areas, by imposing substantial moving costs for potential migrants. Children born in low-income areas with lower-quality public and private resources thus not only face inequities in the quality of opportunities available to them at birth, but also cannot access opportunities in better-resourced regions through parental migration. These policies generate intergenerational persistence in education and location, leading to intergenerational persistence in income.

To study the impacts of these policies, we build a two-province heterogeneous-agent model of overlapping generations that captures key features of the Chinese institutional context and use it to evaluate the effects of the country's public education and migration policies on aggregate outcomes such as per capita income, inequality, intergenerational mobility, and welfare, as well as individual outcomes such as education, individual earnings, and migration. To do this, we first aggregate individual- and province-level data on college admissions, income, and migration across rich and poor provinces to generate an "aggregate rich" and an "aggregate poor" province. Second, we calibrate the model's steady state to match key features of the aggregated provinces. Finally, we use the calibrated model to carry out several counterfactual experiments to understand how China's institutional setting impacts the outcomes of interest.

We conduct four policy experiments, which we call "Hukou," "Public Spending," "Merit," and "Equity." The Hukou policy lifts Hukou migration costs, removing a longstanding barrier to regional migration in China. This allows individuals to move freely from the poor to the rich province with full access to public resources and housing markets, improving efficiency in sorting across locations. The Public Spending counterfactual equalizes per-student public spending across provinces, eliminating quality differences in childhood education.

Equity and Merit modify provincial college seat allocations, holding total seats fixed. In Equity, each province sends an equal proportion of children to each tier of college, improving college opportunities for children in the poor province. In Merit, students with the highest level of pre-college human capital are assigned seats at the top college with seats available regardless of birth region, effectively removing the provincial aspect of college allocations.

The policies interact, with education policies determine the level of opportunity within regions, and the Hukou policy determines who can take advantage of these opportunities. Together, they contribute to a widely-held notion that rural, low-income families have few options for upward mobility, leading to criticism and social unrest. While the Hukou system has been somewhat relaxed in recent years, significant obstacles remain: in June 2022, Shanghai eased Hukou requirements by waiving social pension payments for graduates of the world's top 50 universities.[1] Still, the situation leaves scope for further adjustments, motivating the analysis using our model.

We estimate the policy effects on long-run, steady state outcomes as well as short-term effects on a fixed population (namely, the baseline steady state). The former exercise examines aggregate effects on the entire population while the latter allows us to identify effects

[1] Chen (2022)

on interesting subgroups of the population (e.g. regional populations or income quartiles) without encountering selection issues regarding differences in regional compositions of human capital or income between counterfactual steady states.

For the remainder of the paper, we express welfare changes in terms of the compensating consumption equivalent as a percentage of baseline consumption.[2] We find that the Hukou and Public Spending counterfactual policies have significant effects on spatial distributions of income and education, intergenerational mobility, and welfare in the steady state. We observe that lifting Hukou migration restrictions decreases steady state inequality by 3.7% and intergenerational elasticity by 4.2%, increases population size in the rich province, and produces overall welfare gains of 8%. We also find that short-run impacts on children vary across regions and parental income quartiles. The policy increases average welfare by 14.1% for children born in the poor province and decreases welfare by 2.2% in the rich province, with children born to higher-income parents in the rich region particularly worse off. Even though the policy lifts migration costs, the primary short-term beneficiaries in the short term are not migrants themselves, but rather individuals who do *not* migrate: welfare in poor regions increases from the option value of unrestricted migration and lower housing prices after net outflow of migration.

Equalizing regional per-student public spending decreases steady state intergenerational persistence by 6.7%, produces overall welfare gains of 3.7%, and increases population size in the poor province. As expected, the policy benefits almost all children born in the poor province and harms almost all children born in the rich province, increasing welfare in the poor province by 14.5% and decreasing welfare in the rich province by 12.9%. We find that welfare gains in the poor province are driven by improved human capital accumulation and less migration, while the only beneficiaries of the policy in the rich province are children whose parents do not have a Hukou and thus cannot access the rich province's public schooling.

Changing college allocations has modest effects on steady state inequality, intergenerational elasticity, population size, and welfare, but has noticeable short-term impacts on the distribution of college admissions for children born across quartiles of parent income. Under the Merit counterfactual, we reallocate seats from the poor to the rich province, decreasing (increasing) welfare in the poor (rich) province by 4.2% (9.4%) through lower (higher) educational attainment and human capital. Under the Equity counterfactual, we reallocate seats from the rich to the poor province, increasing welfare for those born in poor provinces by 3.7% by providing better access to education. Interestingly, many children in the rich province are also better off from this policy as a smaller college allocation incentivizes greater parental investment into children's human capital by raising standards for college admission

[2]We describe this computation in more detail in the Policy Evaluation section.

from the rich province. For both of these allocations, effects are most concentrated among children of higher-income parents who are most likely to have educational attainment outcomes improved or worsened by the policy.

Previous Literature

Our work follows several strands of related literature. First, we build on an extensive body of work using overlapping-generations models to study intergenerational outcomes and the income distribution, beginning with the seminal works of Becker and Tomes (1979, 1986) and Loury (1981). Later work augments these models with spatial equilibria and various public school finance policies. Durlauf (1996) develops a theory of income inequality driven by endogenous selection into neighborhoods. Fernandez and Rogerson (1996, 1998) and Bénabou (2002) add public education expenditure policy to this theory and find that redistributive policies can improve outcomes for poor communities as well as steady-state income and welfare for the overall population. Lee and Seshadri (2019) build a model with multiple stages of human capital investment across the parent's and child's life cycle, identifying the importance of early childhood investments (when parents are most likely to face borrowing constraints) in the calibrated model. Their results suggest that education subsidies provided during early childhood have a significant effect on income persistence. In a similar vein, Eckert and Kleineberg (2021) assess the spatial general equilibrium effects of equating school funding, finding that positive effects on children's education in low-skilled families are attenuated by residential choices of those families toward locations with lower education quality in general equilibrium. Zheng and Graham (2022) find that the use of property taxes to fund public education engenders inequality and low intergenerational mobility, as low-income households cannot afford to live in neighborhoods with high housing prices and their corresponding high-quality schools. Kotera and Seshadri (2017) evaluate different education funding program options across districts within states and conclude that funding programs with more equal distributions of public school spending result in higher rank-rank intergenerational mobility. Notably, most of this literature centers around the United States and other developed countries, with much less work on developing countries. Our work adapts various features of previous models into our own, with China representing a unique institutional and economic setting to study these types of policies.

Second, we contribute to the literature estimating economic effects of policies specific to China, with the college admissions mechanism and Hukou policy attracting significant attention. Yang (2020) and Guo et al. (2018) estimate effects of merit-based rather than provincial quota-based college admissions. While they report dissenting conclusions on the change in implied regional shares of the student body and income, both acknowledge the role of college admissions in perpetuating regional inequality.

Previous studies of Hukou policy have focused on cross-sectional effects on migration, urbanization, labor force composition, or regional income disparities (Whalley and Zhang (2007); Bosker et al. (2012); Dreger and Zhang (2017); Wang et al. (2020); Dulleck et al. (2020)). Our overlapping generations model brings a fresh perspective to examine the intergenerational impacts of these policies, exploring an additional channel through which the Hukou effects occur. Sieg et al. (2020) uses a model to estimate the effect of the Hukou on migration and human capital development in a way similar to ours, but our framework includes the college admissions mechanism and studies a broader set of policies and outcomes. To our knowledge, our paper builds the richest model of China's institutions that can quantify both short- and long-term individual and economy-wide policy effects of college admissions and Hukou policies on inequality and intergenerational mobility.

Third, we build on previous literature concerning intergenerational mobility in developing countries. The question of intergenerational mobility has attracted significant attention, but has largely focused on developed countries (Chetty et al. (2014a,b), Solon (1999), Corak (2013), Patrizio (2007); see Black and Devereux (2011) for a relatively recent list of references). It is unclear whether these findings hold in developing countries, where different existing income distributions and institutions could change the mechanisms underlying income persistence. Hnatkovska et al. (2013) and Asher et al. (2018) studies the effect of the caste system on mobility in India. Alesina et al. (2020) examines intergenerational mobility in educational mobility across 27 countries in Africa, revealing that historical and geographical features had a substantial impact on mobility. Fan et al. (2021) and Yan and Deng (2022) estimate the intergenerational elasticity in China and obtain a value of .41, which we use as a target in our model. Our work builds a structural framework to better understand the institutions and other channels underlying intergenerational mobility in China.

Finally, we contribute to literature studying the effects of college admissions policies on income, welfare, and intergenerational mobility. One strand of this literature builds similar overlapping-generations models to assess policy counterfactuals (Abbott et al. (2019), Capelle (2020), Herskovic and Ramos (2019)). Abbott et al. (2019) conduct policy experiments varying the size and nature of the federal grant program and loan limits, finding increases in GDP and welfare attributed to status-quo federal aid along with greater gains from potential aid expansion. Capelle (2020) similarly experiments with financial aid and government transfers to colleges to study changes in welfare, inequality, and intergenerational mobility. Herskovic and Ramos (2019) evaluate Affirmative Action college admissions policies in Brazil, finding that these policies increase aggregate output and welfare while reducing intergenerational elasticity. This literature also includes studies of centralized college admissions systems, which are common in both developing and developed countries. These studies are largely empirical, employing changes in college admissions mechanisms or specific features of the existing mechanisms such as test score cutoffs to identify treatment effects. Otero et al. (2021) finds that affirmative action in the centralized admissions system in Brazil increased income for targeted students and decreased income for non-targeted students in almost a one-to-one manner, increasing equity without affecting overall efficiency. Mari et al. (2020) detect persistent effects on enrollment and elite formation from introducing a purely meritocratic admissions system in Japan due to displacement of rural applicants by urban applicants in higher education. We augment previous models with important characteristics of the Chinese institutional setting; namely, we integrate location-based education spending, college admissions, and Hukou policies to produce a unique framework for studying effects of college admissions policies.

Our paper proceeds as follows. Section 2 describes the institutional setting in China. Section 3 details the model. Section 4 outlines the data sets used and the model calibration process. Section 5 describes results of the model. Section 6 discusses the significance and potential policy implications of our results and concludes.

2 Background

China's economy and social structures have evolved significantly over the past 40 years, largely guided by the central government's planning and policy decisions. While the country has developed into an economic powerhouse during this period, there have been fears that growth has favored rich urban areas and left poor rural areas behind. Aforementioned regional education and migration policies exacerbate the issue by producing inequities in both levels of and access to opportunities and resources within a region, becoming a source of social discontent within the country.

Location-based education policies influence the level of opportunity within a region. Decentralized education spending causes K-12 public education funding in rich areas to be higher than that in poor areas. Tsang (1996) provides a detailed account of China's decentralization of public education finance. In 1985, China reassigned responsibility for financing of secondary education from the central government to lower-level governments.[3] As a result, poorer areas tend to have poorly-funded public schools. Figure 1 plots logged provincial per-student K-12 public education spending against logged provincial GDP per capita, revealing a clear positive relationship. The government has the capacity to mitigate gaps in public education quality by providing categorical grants and education subsidies to poorer areas. However, efforts to reduce these inequities have been insufficient to eliminate persistent gaps

[3] Financing for *primary* education was the responsibility of the provincial government.

in educational quality.[4]

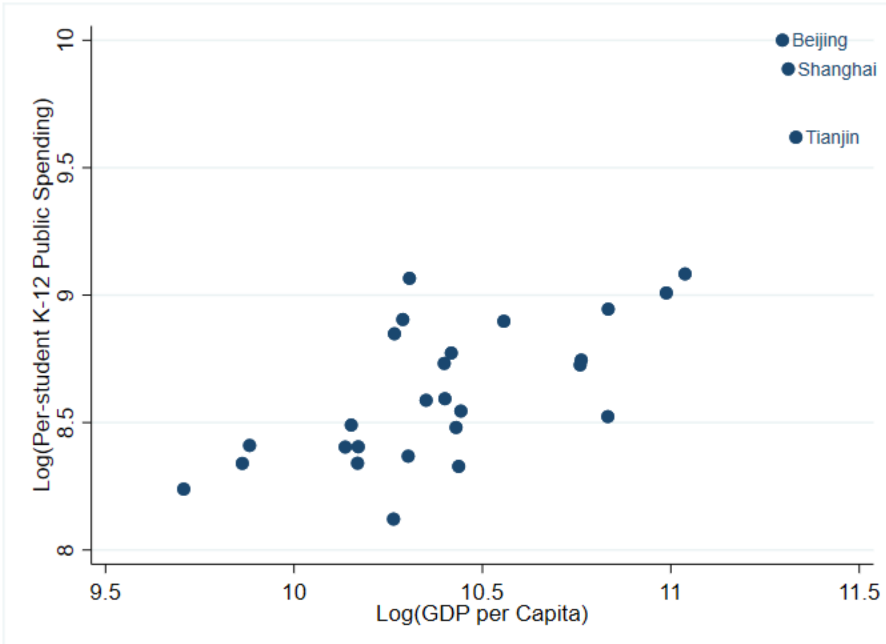


Figure 1: Provincial K - 12 Per-Student Public Spending vs. GDP per Capita

Moreover, the Ministry of Education allocates seats for admission to public colleges at the provincial level. Students are assigned to schools based on their preferences and performance on the *Gaokao*, or National College Entrance Exam (NCEE). The test varies by province, and students with the highest scores on the NCEE within their respective province receive seats at their top-choice schools until the school's provincial quota is filled.[5] Richer provinces receive more seats proportional to the number of applicants at higher-quality colleges, particularly 4-year and elite colleges. Figure 2 plots the 4-year college attendance rate (relative to the provincial age-18 population) against logged provincial GDP per capita, again showing that richer provinces send a higher percentage of their students to 4-year colleges. This is especially pertinent in China, where a cultural emphasis on higher education as a signal of both productivity and social status produces a strong correlation between an individual's schooling and his or her future success.

Previous literature (Yang (2020); loy) studying the efficiency of the allocation mechanism (in terms of allocating students with the highest human capital to the best schools) finds mixed results. Our model aligns with Yang (2020) in that eliminating provincial quotas

[4]Using 1989 data for 29 regions, Tsang (1996) calculates the correlation between per capita gross regional product with budgeted regional per-student primary and secondary education expenditures to be .9.

[5]The process of college seat allocation is detailed in the Appendix, but the mechanism itself is not important to our paper.

provides more seats to richer regions; in other words, the "marginal student" (the lowest-skilled student admitted to a college) from a rich province has higher human capital than the marginal student from a poor province.[6]

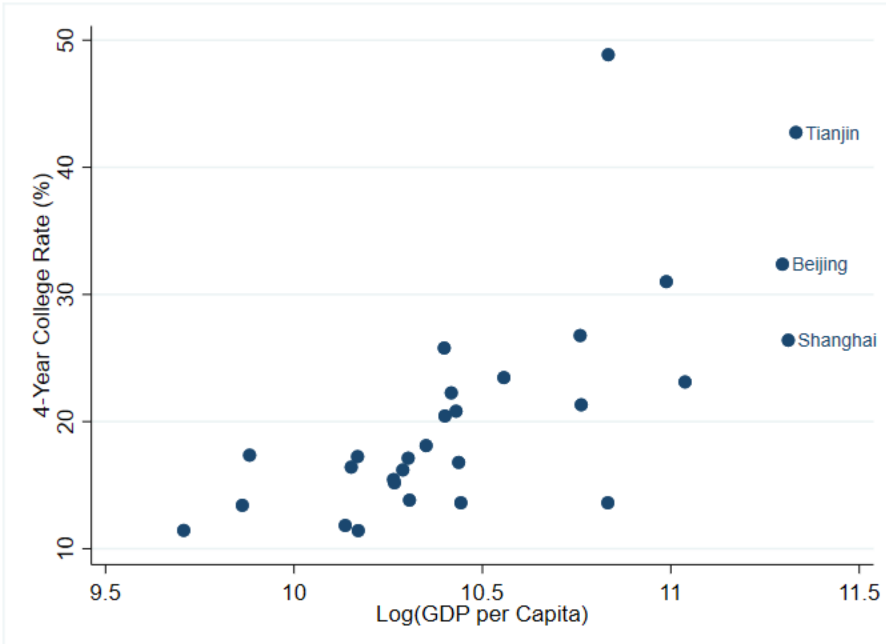


Figure 2: 4-year College Enrollment vs. GDP per Capita

China's *Hukou*, or residential permit, policy institutes barriers to migration into richer provinces, particularly from rural to urban regions. The Hukou system was originally instituted in 1958 to maintain a large rural workforce and curb urban population growth. Though the system is not as strict as it once was, it still continues to restrict rural-to-urban migration today: individuals must possess a local Hukou to access the province's college allocation, K-12 public schooling, social insurance, subsidized housing markets, healthcare, and other key public provisions. Obtaining a Hukou in a desirable location is difficult and costly, often requiring some combination of employer sponsorship, a degree from a high-ranked college, a government job, a "special talent," and contribution into the region's social pension system for a number of years. This restricts access to better public resources and educational opportunities for current and potential migrants and their children. The issue is prevalent for a large portion of China's population: rural migrant workers comprise 36% of the labor force in China, with 60% of them long-distance migrants (China Labour Bulletin (2022)).

[6]We note that development of pre-college human capital includes the effects of childhood conditions on cognitive development, which could explain the gap between the rich province's and the poor province's marginal student. This creates a challenge in defining the "fair" allocation of seats across provinces; for this reason, we describe the mechanism in terms of efficiency instead of fairness.

3 Model

In this section, we develop our spatial, heterogeneous-agent model with overlapping generations that characterizes salient features of the Chinese institutional setting. We use the model to study effects of Chinese policies on inequality, intergenerational mobility, and welfare.

The basic setup of the model comes from the standard Becker and Tomes (1979) overlapping generations framework. The economy is populated by a unit mass of dynastic households. Each household consists of two individuals, an adult and a child. Individuals live for two periods, one period as a child and one period as an adult, with each adult having one child.

We augment the model with features that encapsulate China's major regional policies. Our model has two representative provinces (a "rich," or high-productivity , and a "poor," or low-productivity, province) that differ in effective wages, housing costs, social security benefits, public education spending levels, and schooling allocations. First, we model Hukou restrictions by imposing migration costs on poor-to-rich migrants who did not attend the elite college. Individuals are permitted to migrate across provinces without a Hukou, but they receive lower wages, pay higher housing costs, and cannot access local social security benefits, college allocations, or public schooling for their children.[7]

Second, we model educational policies. The rich province receives higher public education spending, resulting in higher childhood education quality in the rich province. We model regional college quotas by distinguishing three levels of educational attainment (high school, four-year college, and tier-1, or elite, college), where the two colleges admit different shares of children from each province. Each college's provincial quota combined with the human capital distribution in each province implies a human capital threshold for each province and college, where students are admitted to a college if their pre-college human capital exceeds the respective threshold for their households' Hukou region.

In the following subsections, we detail how our model emulates the institutional setting and describe each step in individual decision-making.

[7] In reality, children of non-Hukou migrants either stay in their hometown with extended family ("left-behind" children) or migrate with their parents. In the former case, previous literature has shown that that left-behind children suffer worse human capital outcomes (Zhang et al. (2014)). In the latter case, children typically cannot attend local public schools and instead attend private migrant schools, which are expensive and lower quality than the public schools in the area. We abstract away from the difference and assume that the two options are effectively the same in terms of human capital accumulation.

3.1 Adult Consumption and Investment Decisions

At the beginning of each period, each dynasty is characterized by five state variables: its province ($r \in \{\ell, h\}$, corresponding to the low-productivity and high-productivity province, respectively), the effective human capital of the parent (H_2), an idiosyncratic income shock (ξ_y), an idiosyncratic preference shock for location (ξ_r), and Hukou status $m \in \{0, 1\}$, where $m = 0$ denotes that the parent possesses the local Hukou. Migration decisions for the child occur at the end of each period immediately before the child becomes an adult, so r designates the region where the adult works and the household resides in the current period.

Adults earn labor income y given by:

$$y = \bar{w}\alpha_r H_2 \xi_{y,r} \tag{1}$$

where $\bar{w}$ is the wage per unit of human capital, α_r represents a provincial wage premium (normalized to 1 for $r = \ell$), and H_2 is the adult's human capital after college. The idiosyncratic income shock $\xi_{y,r}$ is realized before the current period but after the migration decision in the previous period, and is lognormally distributed with mean 0 and standard deviation $\sigma_{y,r}$. It is i.i.d both across dynasties and time.

Income is taxed at a provincial rate of τ_r to fund provincial spending on primary and secondary education. Each household purchases one unit of housing at province-specific housing price P_r. Individuals maximize utility $u(c, \xi_r)$ by allocating remaining income between consumption c and private investment in child's human capital x. Government social insurance guarantees that adults holding a local Hukou for province r receive at least $\bar{y}_r$ in income after housing expenditure. They cannot save or borrow, so the dynasty's only mechanism to transfer resources to future periods is investment in the human capital of the child. Adult holders of a local Hukou ($m = 0$) thus face the following budget constraint:

$$c + x = \max\{(1 - \tau_r)y - P_r, \bar{y}_r\} \tag{2}$$

All households residing in the poor province hold the local Hukou ($m = 0$). A household without a Hukou ($m = 1$) in the rich province faces several costs:

(i) It incurs a "migrant investment tax" $\tau_{m,x}$, which represents the cost of educating their child at low-quality, private migrant schools in the rich province.[8]

[8] Equivalently, the cost of educating a "left-behind" child.

(ii) It suffers a pecuniary "migrant wage tax" $\tau_{m,y}$, which captures the lower pay relative to Hukou holders that migrants tend to receive, conditional on human capital.

(iii) It pays a "housing tax" $\tau_{m,P}$, which represents their lack of access to subsidized local housing markets.

(iv) It does not receive the rich region's social insurance $\bar{y}_h$, instead receiving $\bar{y}_\ell$.

(v) The household's child competes with children from the poor province for college seats.

This specification captures the costs of migration for individuals who move from poor to rich regions without a Hukou. We can re-express their consumption decision as simply the rich Hukou holder's problem with the following modifications. A household in the rich region with Hukou status $m = 1$ earns income y given by ($1'$):

$$y = (1 - \tau_{m,y})\bar{w}\alpha_r H_2 \xi_{y,r} \tag{$1'$}$$

and faces the alternative budget constraint ($2'$) as adults:

$$c + (1 + \tau_{m,x})x = max\{(1 - \tau_h)(1 - \tau_{m,y})y - (1 + \tau_{m,P})P_h, \bar{y}_\ell\} \tag{$2'$}$$

The adult faces these costs for one generation, and the child receives the rich province Hukou ($m = 0$) if he remains there in the next generation.

3.2 Children's Education

For the remainder of the paper, we denote the next generation with $'$ when the notation is unambiguous. Children are born in parent's province of work r, and their human capital accumulation occurs in two stages. In the first stage, they attend K-12 schooling in the region where the household resides. Their human capital from schooling depends on (i) parent's human capital H_2, (ii) private investment x, (iii) region-specific public funding $\bar{x}_r$, and (iv) human capital shock ξ'_H, occurring after the private investment decision. Pre-college human capital H'_1 is given by:

$$H'_1 = H_2^\nu (\omega x^\rho + (1 - \omega)\bar{x}_r^\rho)^{\frac{\mu}{\rho}} \xi'_H \tag{3}$$

where $\nu \in [0, 1]$, $\omega \in [0, 1]$, $\mu \in [0, 1]$, and $\rho \in [0, 1]$ are parameters.[9] ν, μ, and ρ are elasticities: ν is the elasticity of child's human capital with respect to parent's human capital;

[9] Kotera and Seshadri (2017) use a similar formulation for the US.

ρ is the elasticity of substitution between public and private education spending; and μ is the elasticity of child's human capital with respect to private and public composite investment. The constant ω is the weight on private relative to public education spending. The shock $\xi_H^{'}$ is iid across children and generations and is lognormally distributed with mean 0 and standard deviation σ_H. It is realized after the private human capital investment decision.

In the second stage, children potentially accumulate additional human capital depending upon college attendance. After completing K - 12 education, children are allocated to the four-year college ($e^{'} = 2$) or the elite college ($e^{'} = 3$) based on pre-college human capital $H_1^{'}$ and each college's provincial quota. Each quota implies a province-specific human capital cutoff $\bar{H}_{r,e}$, where children are admitted to college e if $H_1^{'}$ exceeds $\bar{H}_{r,e}$ for their birth region r. Children who do not attend either college finish with a high school education ($e^{'} = 1$). That is,

$$e^{'} = \begin{cases} 1, & \text{if } H_1^{'} \in [0, \bar{H}_{r,2}) \\ 2, & \text{if } H_1^{'} \in [\bar{H}_{r,2}, \bar{H}_{r,3}) \\ 3, & \text{if } H_1^{'} \in [\bar{H}_{r,3}, \bar{H}) \end{cases} \tag{4}$$

Children born to households in the rich province without the local Hukou cannot access local public schools or the rich province's college allocation; they accumulate human capital according to ($3^{'}$):

$$H_1^{'} = H_2^{\nu}(\omega x^{\rho} + (1-\omega)\bar{x}_{\ell}^{\rho})^{\frac{\mu}{\rho}}\xi_H^{'} \tag{$3^{'}$}$$

and compete with children in the poor province, receiving education according to the following rule ($4^{'}$):

$$e^{'} = \begin{cases} 1, & \text{if } H_1^{'} \in [0, \bar{H}_{\ell,2}) \\ 2, & \text{if } H_1^{'} \in [\bar{H}_{\ell,2}, \bar{H}_{\ell,3}) \\ 3, & \text{if } H_1^{'} \in [\bar{H}_{\ell,3}, \bar{H}) \end{cases} \tag{$4^{'}$}$$

College is assumed to be costless, and the return to college is increasing in quality so that children will attend the highest-quality school where they are admitted. Children complete college with effective human capital $H_2^{'} = \alpha_{e^{'}} H_1^{'}$.

3.3 Migration Decision and Migration Costs

After college, children realize an idiosyncratic location preference shock $\xi_r^{'} \sim N(\mu_{M,r}, \sigma_M^2)$, which represents their preference to remain in the birth location. If the child chooses *not* to migrate, they realize $\xi_r^{'}$ in the next period. Then, children in both provinces make a migration decision to maximize expected continuation utility.

Children who relocate from the rich region to the poor region receive a Hukou and migrate costlessly ($m' = 0$). However, children who migrate from the poor to the rich province receive a Hukou only if they attended the elite college. Otherwise, while they live and work in the rich region, they face Hukou costs ($m' = 1$). The asymmetry between poor-to-rich and rich-to-poor migration is intentional: it is difficult obtain a Hukou in rich cities, where higher wages and better quality of public resources drive competition for living space, but not in poorer areas.

After the migration decision, the child realizes a lognormal wage shock $\xi_{y,r'} \sim logN(0, \sigma_{y,r'})$, becomes an adult, and has his own child. The next state begins with state variables $r^{'}$, $H_2^{'}$, $\xi_{y,r'}$, $\xi_{r'}$, and $m^{'}$.

Below is a timeline of the events in the model.

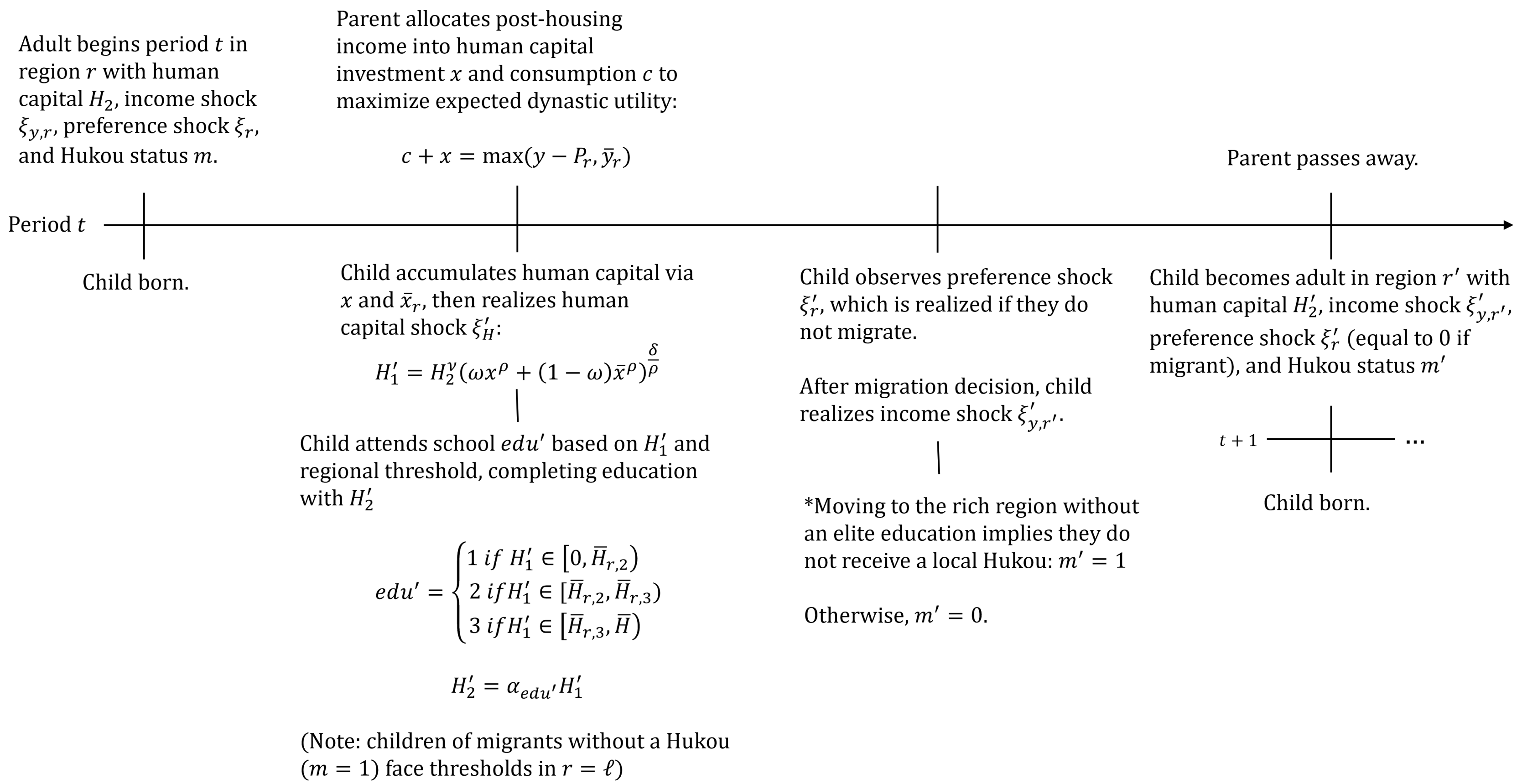


Figure 3: Timeline of Model Events and Decisions

3.4 Housing Prices

Regional housing prices are given by $P_r = A_r N_r^{\sigma_P}$, where A_r is a province-specific constant that captures housing demand, N_r is population size of province r, and σ_P is the inverse price elasticity of housing supply.

3.5 Steady State Equilibrium

Our baseline results study both differences in steady state equilibria across counterfactuals and transition paths between steady states. In this subsection I define a steady state equilibrium.[10] There are several values that households take parametrically: regional housing prices P_r, regional tax rates τ_r, regional public spending levels $\bar{x}_r$, and college admission thresholds $\bar{H}_{r,e}$. These values are constant in equilibrium so I suppress them as arguments.

Let $V_r(H, \xi_y, \xi_r, m)$ represent the value function for an adult living and working in region r with human capital H, income shock ξ_y, home-province preference shock ξ_r, and Hukou status m. Adults allocate income less taxes and housing costs into current-period consumption and investment to maximize dynastic utility. Investment increases future utility by improving children's human capital and subsequent education and migration outcomes. These tradeoffs are made explicit in the Bellman equations that follow. The Bellman equation for a household in the poor province is given by:

[10]We discuss transition dynamics in a later section.

$$V_\ell(H_2,\xi_{y,\ell},\xi_\ell,0) = \max_{c,x}\ u(c,\xi_\ell) + \beta\ max\ E \begin{cases} V_\ell(H_2^{'},\xi_{y,\ell}^{'},\xi_\ell^{'},0), \\ \mathbb{1}[e^{'} \leq 2]V_h(H^{'},\xi_{y,h}^{'},0,1), \\ \mathbb{1}[e^{'} = 3]V_h(H^{'},\xi_{y,h}^{'},0,0) \end{cases}$$

$$\text{s.t. } c + x = max((1-\tau_\ell)\bar{w}H_2\xi_{y,\ell} - P_\ell, \bar{y}_\ell)$$

$$H_1^{'} = H_2^{\nu}(\omega x^{\rho} + (1-\omega)\bar{x}_\ell^{\rho})^{\frac{\mu}{\rho}}\xi_H^{'}$$

$$e^{'} = \begin{cases} 1, & \text{if } H_1^{'} \in [0,\bar{H}_{\ell,1}) \\ 2, & \text{if } H_1^{'} \in [\bar{H}_{\ell,1},\bar{H}_{\ell,2}) \\ 3, & \text{if } H_1^{'} \in [\bar{H}_{\ell,2},\bar{H}) \end{cases}$$

$$H_2^{'} = \alpha_{e^{'}}H_1^{'}$$

$$r' = \underset{r^*\in\{\ell,h\}}{argmax} E(V_{r^*}(H_2^{'},\xi_{y,r^*}^{'},\mathbb{1}[r^*=\ell]\xi_\ell^{'},\mathbb{1}[r^*=h]\mathbb{1}[e^{'}<3])$$

$$log\xi_{y,r'}^{'} \sim N(0,\sigma_{y,r'}^2)$$

$$log\xi_H^{'} \sim N(0,\sigma_H^2)$$

$$\xi_\ell^{'} \sim N(\mu_{M,\ell},\sigma_M^2)$$

Note that because the children are born in the poor province, they realize preference shock $\xi_\ell^{'}$ as an adult if they decide to not migrate, and they face one period of migration costs if they do not obtain an elite college education.

The Bellman equation for a household with a Hukou in the rich province is given by:

$$V_h(H_2, \xi_{y,h}, \xi_h, 0) = \underset{c,x}{max}\ u(c, \xi_h) + \beta\ max\ E \begin{cases} V_\ell(H_2^{'}, \xi_{y,\ell}^{'}, 0, 0), \\ V_h(H_2^{'}, \xi_{y,h}^{'}, \xi_h^{'}, 0) \end{cases}$$

$$\begin{aligned}
\text{s.t. } c + x &= max((1-\tau_h)\alpha_h \bar{w} H_2 \xi_{y,h} - P_h, \bar{y}_h) \\
H_1^{'} &= H_2^{\nu}(\omega x^{\rho} + (1-\omega)\bar{x}_h^{\rho})^{\frac{\mu}{\rho}} \xi_H^{'} \\
e^{'} &= \begin{cases} 1, & \text{if } H_1^{'} \in [0, \bar{H}_{h,2}) \\ 2, & \text{if } H_1^{'} \in [\bar{H}_{h,2}, \bar{H}_{h,3}) \\ 3, & \text{if } H_1^{'} \in [\bar{H}_{h,3}, \bar{H}) \end{cases} \\
H_2^{'} &= H_1^{'} \alpha_{e'} \\
r' &= \underset{r^* \in \{\ell, h\}}{argmax} E(V_{r^*}(H_2^{'}, e^{'}, \xi_{y,r^*}^{'}, 0, 0)) \\
log \xi_{y,r'}^{'} &\sim N(0, \sigma_{y,r'}^2) \\
log \xi_H^{'} &\sim N(0, \sigma_H^2) \\
\xi_h^{'} &\sim N(\mu_{M,h}, \sigma_M^2)
\end{aligned}$$

Finally, the Bellman equation for a household without a Hukou in the rich province is given by:

$$
\begin{aligned}
V_h(H_2, \xi_{y,h}, 0, 1) &= \underset{c,x}{max}\ u(c, 0) + \beta\ max\ E \begin{cases} V_\ell(H_2^{'}, \xi_{y,\ell}^{'}, 0, 0), \\ V_h(H_2^{'}, \xi_{y,h}^{'}, \xi_h^{'}, 0) \end{cases} \\
\text{s.t. } c + (1 + \tau_{m,x})x &= max((1 - \tau_h)(1 - \tau_{m,y})\alpha_h \bar{w} H_2 \xi_{y,h} - (1 + \tau_{m,P})P_h, \bar{y}_\ell) \\
H_1^{'} &= H_2^{\nu}(\omega x^{\rho} + (1 - \omega)\bar{x}_\ell^{\rho})^{\frac{\mu}{\rho}} \xi_H^{'} \\
e^{'} &= \begin{cases} 1, & \text{if } H_1^{'} \in [0, \bar{H}_{\ell,2}) \\ 2, & \text{if } H_1^{'} \in [\bar{H}_{\ell,2}, \bar{H}_{\ell,3}) \\ 3, & \text{if } H_1^{'} \in [\bar{H}_{\ell,3}, \bar{H}) \end{cases} \\
H_2^{'} &= H_1^{'} \alpha_{e'} \\
r' &= \underset{r^* \in \{\ell, h\}}{argmax} E(V_{r^*}(H_2^{'}, \xi_{y,r^*}^{'}, 0, 0)) \\
log \xi_{y,r'}^{'} &\sim N(0, \sigma_{y,r'}^2) \\
log \xi_H^{'} &\sim N(0, \sigma_H^2) \\
\xi_h^{'} &\sim N(\mu_{M,h}, \sigma_M^2)
\end{aligned}
$$

Note the differences in costs of investment ($\tau_{m,x}$), income ($\tau_{m,y}$), housing ($\tau_{m,P}$), human capital accumulation ($\bar{x}_\ell$ instead of $\bar{x}_h$), and thresholds for college attendance ($\bar{H}_{\ell,e}$ instead of $\bar{H}_{h,e}$) from the previous specification for a rich province Hukou holder.

We proceed to define the steady state. Let $\mu_r(H_2, \xi_{y,r}, \xi_r, m)$ represent the measure over effective human capital H_2, income shocks human capital $\xi_{y,r}$, location preference shock ξ_r, and Hukou status m in province r. Let $T(\mu_\ell, \mu_h) = (\mu_\ell^{'}, \mu_h^{'})$ be the mapping from the measures in period t to the measures in period $t + 1$. We define a steady state equilibrium as follows: given housing prices $\{P_\ell^*, P_h^*\}$, regional human capital thresholds $\{H_{\ell,2}^*, H_{\ell,3}^*, H_{h,2}^*, H_{h,3}^*\}$, and public spending levels $\{\bar{x}_\ell, \bar{x}_h\}$, a steady state in our model is a pair (μ_ℓ^*, μ_h^*) such that:

1. Households maximize utility.

2. (μ_ℓ^*, μ_h^*) is a fixed point of the mapping T, i.e. $T(\mu_\ell^*, \mu_h^*) = (\mu_\ell^*, \mu_h^*)$.

3. Housing and labor markets clear.

4 Model Calibration

In this section, we discuss our model calibration. We first describe our sources of data. We then outline the steps we take to aggregate province-level data into moments that discipline the representative poor province and rich province in our model. Finally, we detail the calibration process, in which we choose parameters to calibrate the steady state of the model to match important features of China such as educational attainment, intergenerational mobility, and the income distribution. For the remainder of the paper, we refer to the model calibrated to current Chinese data the "baseline" model.[11]

4.1 Data Sources

We combine data from multiple sources to calculate key moments that guide our calibration. We use administrative province-level college enrollment data in 2011, which informs the number of applicants and admitted students for each tier of college (tier 1, tier 2, 4-year, Project 211, Project 985, and Peking or Tsinghua University) from each province.[12] We combine this with provincial age-7 population counts from the 2000 Chinese Census (as these children applied for college in 2011) to calculate admissions rates for each province and tier of schooling. Our primary source for other province-level data is the National Bureau of Statistics of China (NBS), which provides information on regional GDP, population size, government social insurance (or *dibao*), and enrollment and per-student public spending by K-12 schooling level (primary, middle, and high school).

Individual- and family-level data comes from the China Family Panel Survey (CFPS), a household survey with waves every two years from 2010-2018. It features data on location, Hukou status, family- and individual-level income, education, and other characteristics such as spending on education and housing. We use this data to estimate Hukou cost parameters and migration flows. Survey questions asking directly about migration appear to severely undercount the number of migrants based on the number of people changing location from their birthplace, so we approximate migration flows by comparing an individual's province at age 12 to their province as an adult. We are particularly interested in whether an individual moves from a poor province during childhood to a rich province during adulthood or vice-versa.

[11] A detailed explanation of the steady-state solution process can be found in the Appendix.

[12] Project 211 (less prestigious) and Project 985 (more prestigious) are two projects created by the Ministry of Education to raise education and research quality and expand college access. The Project 211 tier has 116 schools, while Project 985 includes 39 of those 116. Peking and Tsinghua University are the two most prestigious colleges in China.

4.2 Aggregating the Data to Two Regions

First, we must categorize provinces as low-income or high-income to generate the representative regions in the model. We use 40,000 yuan/year in 2011 GDP per capita as an income cutoff to distinguish between "poor" and "rich" provinces in the data, and we aggregate the provinces within each group into the representative poor and rich province, respectively. The resulting categorization is consistent with that used in previous literature (Whalley and Zhang (2007)). The calibration targets for the two provinces in our model are based on population-weighted data from provinces within each group.so

Table 1 summarizes the results of this exercise. Our aggregate poor province contains 63.9% of the population, has an average income of 28,588 yuan, and spends 4,693 yuan per student on public education. 16.2% of children with a poor-province Hukou attend a four-year college, and 3.9% of these children attend an elite college. Our aggregate rich province holds 36.1% of the population, has an average income of 56,319 yuan, and spends 7,439 yuan per student on funding public education. 24.8% of children with a rich-province Hukou attend a four-year college, and 6.7% of these children attend an elite college. The list of provinces in each aggregate province can be found in the Appendix.

Table 1: Results of Province Aggregation

	Population (%)	GDP per capita (RMB)	K-12 spending (RMB/student)	4-year (%)	Tier 1 (%)
Poor	63.9	28,588	4,693	16.2	3.9
Rich	36.1	56,319	7,439	24.8	6.7

4.3 Calibration Procedure

The only unspecified functional form is the period utility function; we assume that $u(c, \xi_r)$ is given by $log(c + \xi_r)$. The model has 31 parameters to be calibrated: discount factor β; human capital accumulation parameters $\nu, \omega, \rho, \delta$, and σ_H^2; income parameters $\bar{w}, \alpha_h, \sigma_{y,\ell}^2$, and $\sigma_{y,h}^2$; returns to education α_1, α_2, and α_3; housing parameters A_ℓ, A_h, and ϕ; public social insurance levels $\bar{y}_\ell$ and $\bar{y}_h$; public investment levels $\bar{x}_\ell$ and $\bar{x}_h$ and tax rates τ_ℓ and τ_h; migration cost parameters $\tau_{m,x}, \tau_{m,p}$, and $\tau_{m,y}$; college thresholds $\bar{H}_{2,\ell}, \bar{H}_{3,\ell}, \bar{H}_{2,h}$, and $\bar{H}_{3,h}$; and preference shock means $\mu_{M,\ell}, \mu_{M,h}$ and variance σ_M^2. We proceed to calibrate the model in two steps. First, we set 17 parameters outside of the model using estimates from data and previous literature. Then, we jointly identify the remaining 14 parameters by targeting 14 moments in the steady-state equilibrium of our model to 14 equivalent moments in the data. We describe each step in the following subsections.

4.3.1 External Calibration

Table 2 lists externally-calibrated parameters. Many of these estimates are based on previous literature using similar models or producing values relevant to our model. The discount factor β is calibrated at .55 based on an annual discount rate of .98 for a period length of 30 years. The weight on private investment $\omega = .324$, return to total investment $\mu = .334$, and elasticity of substitution between public and private investment $\rho = .589$ come from Kotera and Seshadri (2017), who incorporate public and private investment in a similar specification for human capital accumulation. Education premia relative to high school for the four-year college ($\alpha_2 = 1.44$) and elite college ($\alpha_3 = 2.02$) are derived from the return to an average 4-year college in Zhong (2011) and the return to elite education in Jia and Li (2021), respectively. The estimate of inverse price elasticity of housing supply $\sigma_P = 2$ comes from Chow and Niu (2015). The income penalty for migrants without a Hukou is set at $\tau_{m,y} = .08$, which is consistent with recent work estimating the urban Hukou wage premium at 6-10%. (Boffy-Ramirez and Moon (2018), Dreger and Zhang (2017)).

The remaining parameters in Table 2 come from data from the CFPS and the National Bureau of Statistics of China (NBS). Provincial education spending tax rates τ_ℓ and τ_h are calculated from public education expenditure as a share of provincial GDP within each aggregate province. Social insurance payments and per-student public spending levels for the representative poor and rich provinces are informed by NBS data on social security and K - 12 public spending. We calculate $\bar{y}_\ell$ and $\bar{y}_h$ by aggregating over province-level data on unemployment insurance expenses and the number of beneficiaries. Similarly, we compute per-student public spending levels by combining NBS provincial data on schooling expenditures with the number of K-12 students. We identify the non-Hukou migrant expenditure taxes on private investment ($\tau_{m,x}$) and housing ($\tau_{m,p}$) using CFPS data with the following regression:

$$log(spend_{f,t}) = \alpha_0 + \alpha_1 log(y_f) + \gamma_r + \tau_{m,t} richprov_f (1 - hukou_f) + \varepsilon_f$$

where $\tau_{m,t}$ is the coefficient of interest. $t = x$ or $t = p$ denotes education or housing, respectively, $spend_{f,t}$ is family spending, y_f is family income, $richprov_f$ is an indicator for whether the individual lives in a rich province, and $hukou_f$ is an indicator for whether the family's household head holds a local Hukou. Since spending on housing and education are family-level decisions, we use f to denote the use of family-level variables. Our regressions

Table 2: **Externally-Calibrated Parameter Values**

Parameter	Value	Source	Description
β	0.55	Standard	Discount factor
ω	0.37	Kotera and Seshadri (2017)	Weight on private investment
ρ	0.589	Kotera and Seshadri (2017)	Elast. of subs. b/t investment types
μ	0.36	Kotera and Seshadri (2017)	Return to total investment
α_1	1	Normalization	Return to high school education
α_2	1.44	Zhong (2011)	Return to four-year college
α_3	2.02	Jia and Li (2021)	Return to elite college
σ_P	2	Chow and Niu (2015)	Inverse price elasticity of housing supply
$\tau_{m,y}$	.08	Boffy-Ramirez and Moon (2018), Dreger and Zhang (2017)	Income penalty w/o Hukou
$\bar{y}_\ell$	1,716	NBS	Province ℓ social insurance
$\bar{y}_h$	3,456	NBS	Province h social insurance
$\bar{x}_\ell$	4,693	NBS	Province ℓ public investment
$\bar{x}_h$	7,439	NBS	Province h public investment
τ_ℓ	.023	NBS	Province ℓ public education tax
τ_h	.014	NBS	Province h public education tax
$\tau_{m,x}$	.55	CFPS	Investment cost w/o Hukou
$\tau_{m,p}$	.40	CFPS	Migrant housing cost w/o Hukou

yield $\tau_{m,x} = .55$ and $\tau_{m,p} = .4$, implying that migrant families living in a rich province without a local Hukou spend 55% more on education and 40% more on housing than families with one, controlling for income.

4.3.2 Internal Calibration

We calibrate the remaining 14 parameters using a Nelder-Mead simplex algorithm to choose 14 parameters to minimize a loss function based on the weighted sum of squared errors between 14 model-based moments and analogous moments in the data. While all internally-calibrated parameters are jointly identified by the moments of the model, each of these parameters is intuitively directly related to one particular moment. Table 3 lists the internally-calibrated parameters alongside their associated moments in the data and the model. In this section, we explain each parameter-moment relationship.

We use provincial enrollment rates in the administrative data to construct the four human capital thresholds $H_{2,\ell}$, $H_{3,\ell}$, $H_{2,h}$, and $H_{3,h}$, choosing thresholds to send the correct proportions of students from each province to the four-year and elite college in the baseline steady state.

Housing constants A_ℓ and A_h are pinned down by mean provincial housing expenditures as a share of earnings in the NBS. We find that households in poor provinces spend 12.5% on housing while households in rich provinces spend 10.5%. We incorporate these expenditure shares with targeted average earnings in each province to calculate housing prices P_r, which we combine with targeted provincial population sizes N_r to back out housing constants $A_\ell = \frac{P_\ell}{(N_\ell)^{\sigma_P}}$ and $A_h = \frac{P_h}{(N_r)^{\sigma_P}}$.

$\bar{w}$, α_r, $\sigma^2_{y,\ell}$, and $\sigma^2_{y,h}$ relate to the income distribution. Wage per effective human capital $\bar{w}$ is chosen to match average earnings in the poor province, while $\alpha_r > 1$ sets the rich-province wage premium to match average earnings in the rich province. The variance of the regional income shocks $\sigma^2_{y,r}$ are informed by the standard deviation of the regional log earnings distributions.

An individual's migration decision depends on his preference across locations, which depends on the realization of location preference shock $\xi_r \sim N(\mu_{M,r}, \sigma^2_M)$. We calibrate the mean of preference shock $\mu_{M,ell}$ to match the proportion of the population living in poor provinces in China. Increasing $\mu_{M,\ell}$ implies an increased preference for children born in the poor region to stay and work close to their family, which increases steady-state poor province population size. Preference shock variance σ^2_M determines the likelihood that an individual receives a shock large enough to migrate. Thus, σ^2_M is informed by matching excess migration flows; in our model with two provinces, this amounts to migration volume from the rich province to the poor province. [13]

The final parameters in Table 3 are used to match measures of social and intergenerational mobility. Since human capital shock ξ_H affects pre-college human capital, it greatly influences children's capacity to receive a college education, especially for children of low-income parents who receive relatively little private investment in human capital. We thus calibrate σ^2_H to match the proportion of children from the bottom parent income quintile attending at least a 4-year college, which serves as a measure of access to opportunity. ν is the elasticity of children's human capital with respect to parent's human capital absent investment. The

[13] We recognize a caveat in interpreting our model: empirical poor-to-rich migration volume exceeds rich-to-poor migration volume in the CFPS. This suggests that provincial population sizes have not yet reached steady state in China, whereas our calibration treats the economy as if they have. However, analysis in our model requires a definitive target for the steady state, which is difficult to project in the future.

parameter characterizes the hereditary aspect of human capital and subsequently income transmission. We estimate the intergenerational elasticity (IGE) in the model by taking the slope coefficient in a regression of child's log earnings on parent's log earnings in the steady state, and we choose ν to match it to the estimate for China produced in Yan and Deng (2022) (IGE = .410).

Table 3: Internally-Calibrated Parameters and Model Fit

Parameter	Description	Value	Moment (Source)	Value	
				Target	Model
$\bar{H}_{2,\ell}$	Four-year college threshold, province ℓ	176	% province ℓ attending 4-year college (admin data + Census)	16.2	16.2
$\bar{H}_{3,\ell}$	Elite college threshold, province ℓ	299	% province ℓ attending elite college (admin data + Census)	3.9	3.9
$\bar{H}_{2,h}$	Four-year college threshold, province h	217	% province h attending 4-year college (admin data)	24.8	24.7
$\bar{H}_{3,h}$	Elite college threshold, province h	402	% province h attending elite college (admin data)	6.7	6.7
$\mu_{M,\ell}$	Mean of poor province pref shock ξ_ℓ	181	Location size in poor province (%) (NBS)	63.9	64.1
A_ℓ	Housing constant, province ℓ	8,773	Housing expenditure share, province ℓ (%) (NBS)	12.5	13.0
A_h	Housing constant, province h	45,592	Housing expenditure share, province h (%) (NBS)	10.5	10.3
$\bar{w}$	Wage per effective human capital	188	Average yearly earnings in poor province (NBS)	28,588	27,543
α_h	Rich-province premium in earnings	1.033	Average yearly earnings in in rich province (NBS)	56,318	57,809
$\sigma^2_{y,\ell}$	Variance of income shock ξ_y, poor province	1.03	Std. dev. of log earnings, poor province (CFPS)	1.16	1.12
$\sigma^2_{y,h}$	Variance of income shock ξ_y, rich province	.28	Std. dev. of log earnings, rich province (CFPS)	1.07	1.06
σ^2_H	Variance of human capital shock ξ_H	.58	% from first quintile attending college from poor province (CFPS)	6.1	7.0
σ^2_M	Variance of preference shocks $\xi_{M,r}$	636	Migration volume from rich to poor (%) (CFPS)	4.9	6.4
ν	Elasticity of child's HC wrt parent's HC	.411	Intergenerational elasticity (Fan et al. (2019))	.410	.400

Our calibrated model matches key characteristics of income and regional mobility, educational attainment, and the income distribution well. We also verify the performance of our model in matching non-targeted moments in the Appendix.

5 Policy Evaluation

We study the effects of policy changes on aggregate outcomes such as intergenerational mobility, earnings, inequality, and welfare. Moreover, we are interested in how the effects of policy are distributed across the parent income distribution—in particular, whether policy can provide better opportunities or outcomes for vulnerable subsets of the population, such as poor households with little capacity to invest in children's human capital and without the option to freely migrate.

The current policies in China either determine the quality of opportunity available within a region or access to opportunity available elsewhere. Thus, our policy experiments modify specific features of the Chinese institutional context along one of these dimensions. We evaluate four counterfactual policies, which we call Hukou, Public Spending, Merit, and Equity. We choose these policies because each one's implementation can be justified through equity or efficiency concerns. The Hukou counterfactual lifts Hukou restrictions, eliminating a longstanding policy that continues to distort human capital investment and migration decisions. In the model, we remove the five migration costs for poor-to-rich migrants without an elite education, allowing all individuals to efficiently sort across locations. The Public Spending counterfactual equates per-student public education spending across the two regions (as if the central government equally allocated all educational spending), holding the national public spending-earnings ratio fixed. This eliminates differences in human capital accumulation caused by differences in public school quality and removes one major source of regional inequality during childhood, promoting more equitable outcomes.

The latter two policies directly affect the allocation of college seats between the two regions. In the Merit counterfactual, we lift the provincial element of college seat allocation by equating human capital thresholds across provinces. This allocates children with the highest levels of pre-college human capital to the best college seat available regardless of location, improving the aggregate efficiency of the allocation in terms of total earnings. Each college's human capital thresholds are higher in the rich province than the poor province at baseline, implying that the Merit counterfactual allocates more seats to the rich province and is thus a *regressive* intervention. In the Equity counterfactual, we set provincial quotas such that equal proportions of children from both regions attend each tier of college. This effectively mitigates equity concerns over the "regional fairness" of the college policy by providing children born in each region equal opportunity to attend college. Note that a higher proportion of children from the rich province attend both levels of college in the baseline model, making the Equity counterfactual a *progressive* intervention by improving access to college for children in the poor province.

Each counterfactual creates incentives to live in a region and could thus change equilibrium location sizes. This induces corresponding changes in regional quotas, per-student public spending levels, and housing prices. In changing regional quotas, we hold each college's *total* capacity constant from baseline. The Hukou and Public Spending college allocations adjust to location size changes by reallocating provincial seats at each college equal to the baseline overall attendance rate at that college multiplied by the net migration flow relative to baseline in each respective region.[14] In the Equity and Merit counterfactuals, the new college allocation rules dictate how to set the quotas. We adjust provincial per-student public education spending by fixing from baseline the ratio of spending to average earnings in each province (except the Public Spending counterfactual, in which both provinces receive the same ratio of spending to average earnings across the country as in baseline). Finally, housing prices adjust to population sizes according to the previously-defined relationship $P_r = A_r N_r^{\sigma_P}$.

[14]For example, if 25% of the population attends the 4-year college in the baseline steady state and a province grows (shrinks) by 1,000 individuals in the Hukou or Public Spending counterfactual, that province also gains (loses) 250 seats at the four-year college.

Steady state results allow for comparisons in aggregate outcomes such as total income and welfare, population size, intergenerational mobility, and inequality. However, comparing steady state outcomes for different subgroups becomes difficult to interpret because the steady-state compositions of subgroups could differ across counterfactuals. For this reason, it is more natural to study policy effects on a *fixed* population. We accomplish this by solving for the transition path between baseline and counterfactual steady states.[15] We then apply the decision rules from the first period along the transition path after the policy has been enacted to the baseline steady state and simulate one generation for each policy, comparing each outcome to another generation of the baseline steady state. These results allow us to better study policy effects effects on specific fixed individuals or groups relative to baseline.

As we are interested in examining regional effects of policy on the poor, we study outcomes for children born in different regions and to different quartiles of the parental income distribution. These exercises help us understand how each policy affects the regional allocation of opportunities and how effectively the policy targets children whose parents lack sufficient private resources. In particular, we are able to better comprehend the *mechanisms* underlying changes in mobility and welfare driven by policy in isolation–by comparing differences in *individual* outcomes, we can discern both *which* individuals are affected and *why* they are affected.

In what follows, we define household welfare as the household's dynastic utility. In tables that include comparisons of average welfare between baseline and counterfactual populations or subgroups, we report differences in welfare as the compensating equivalent consumption for each counterfactual as a percentage of baseline consumption in each group. In other words, we calculate the percentage increase in consumption from baseline for all individuals within each group that is required to match mean welfare in the counterfactual for that group.

5.1 Steady State Effects

We begin by focusing on differences in aggregate outcomes across counterfactual steady-state equilibria listed in Table 4. We are interested in changes in income, spatial population distribution, intergenerational mobility (measured by the intergenerational elasticity), inequality (measured by the Gini), and welfare.

The Hukou counterfactual lifts migration costs in moving from the poor to the rich province without an elite education, effectively treating poor-to-rich migrants the same as residents of the rich province. This has important implications for decision-making, partic-

[15]Details for the solution process of solving for the transition path can be found in the Appendix.

Table 4: Steady State Differences across Policies

	Baseline	Hukou	Public Spending	Merit	Equity
Average Income	37,988	36,966	38,369	37,955	37,491
Population size (%), province ℓ	63.9	59.0	67.3	62.8	64.3
IGE	0.401	0.384	0.374	0.411	0.390
Gini	0.564	0.543	0.563	0.565	0.557
Welfare	21.743	21.820	21.779	21.748	21.766
Δ Welfare in % Consumption (CE %)	-	8.0	3.7	.4	1.3

ularly in the human capital investment and migration decisions. We find that lifting Hukou restrictions also has relatively significant effects in the steady state. Removing migration costs encourages individuals to move from the poor to the rich region, increasing the rich province's population size by about 5% of the population. Intergenerational persistence decreases by .017 (about 4.2% or .11 expected generations required to regress to the mean), driven by improved labor mobility and access to better K-12 education for the children of migrants from the poor province. The Gini coefficient decreases by about 3.7%. Interestingly, while average national earnings *decreases* by about 2.7%, welfare increases by about 8.0% of baseline consumption.

In the Public Spending counterfactual, we equalize per-student public spending levels $\bar{x}_\ell$ and $\bar{x}_h$, holding fixed the total spending. This is equivalent to the government collecting all education tax revenue and allocating it equally across the population rather than each province distributing its own revenue. This eliminates one substantial, policy-relevant source of inequity in human capital development for children born in rich and poor provinces by improving the opportunities available in the poor province. Equalizing per-student public spending across regions has sizable effects on steady state outcomes. The average income increases by about 1%, driven by providing higher-quality education to a larger population in the poor province. Equating public spending makes province ℓ a more attractive location, resulting in a larger steady-state population. Higher public spending in the poor region reduces the correlation between parent's income and public schooling quality, reducing intergenerational income persistence by 6.7% from baseline or .18 expected generations to regress to the mean. Overall inequality remains roughly the same. Average welfare increases by 3.7% of average baseline consumption.

The latter two policies, Merit and Equity, affect regional opportunity by reallocating college seats across provinces. The Merit counterfactual maximizes efficiency in allocating individuals to college by sending the highest-human capital individuals to the best college seat available regardless of birth province, maximizing the expected returns to college in terms of total earnings. The Equity counterfactual equalizes the proportion of applicants from each province who attend each college. We again note that relative to the baseline model, the Merit counterfactual reallocates seats from the poor province to the rich province, and vice versa in the Equity counterfactual.

In the Merit counterfactual, individuals no longer face higher human capital thresholds in the rich province, attracting individuals to the rich province. Moreover, it increases the association between parent's income and children's education by providing children in the rich province with more college seats, resulting in a 2.5% increase in the IGE. The Equity counterfactual generates changes in the opposite direction: more college seats makes the poor province slightly more attractive and decreases the association between income and college attendance, decreasing IGE by 2.7%. Neither policy substantially changes aggregate inequality, welfare, or income.

These findings suggest that despite public controversy regarding the fairness of the college allocation mechanism in China, revising the mechanism with an efficient or equitable allocation does not appear to produce large aggregate effects, with modest effects on intergenerational persistence. The reasoning for this likely stems from the fact that in 2011, only about 20% of age-18 children across the country attended a four-year college, so that reallocating college seats does not shift the education outcomes of many individuals relative to the general population. However, China's recent educational expansion beyond 2011 gives scope for these policies to have greater effects with more college seats available.

5.2 Distributional Effects and Mechanisms

We are also interested in studying heterogeneity in household effects across the income distribution as well as the mechanisms of these effects. To study this, we enact each policy in the baseline steady state and compute the transition path between baseline and counterfactual steady states. This allows us to fix one generation of households (namely, the baseline steady state) and directly compare outcomes from enacting the policy for each individual household (or groups of households, e.g. birth locations and/or parent income quartiles) between one additional generation of baseline policy and the first period of the transition path after the policy.[16].

In order to isolate the effects of policy in this exercise, we fix the child's idiosyncratic human capital shock $\xi_H^{'}$ and location preference shock $\xi_r^{'}$. Policy welfare effects are calculated using *expected* welfare with respect to location preference shock ξ_r and income shock $\xi_{y,r}$, as these shocks affect welfare and decision making in the *subsequent* period.

In the following subsections, we examine effects from each policy by first studying effects

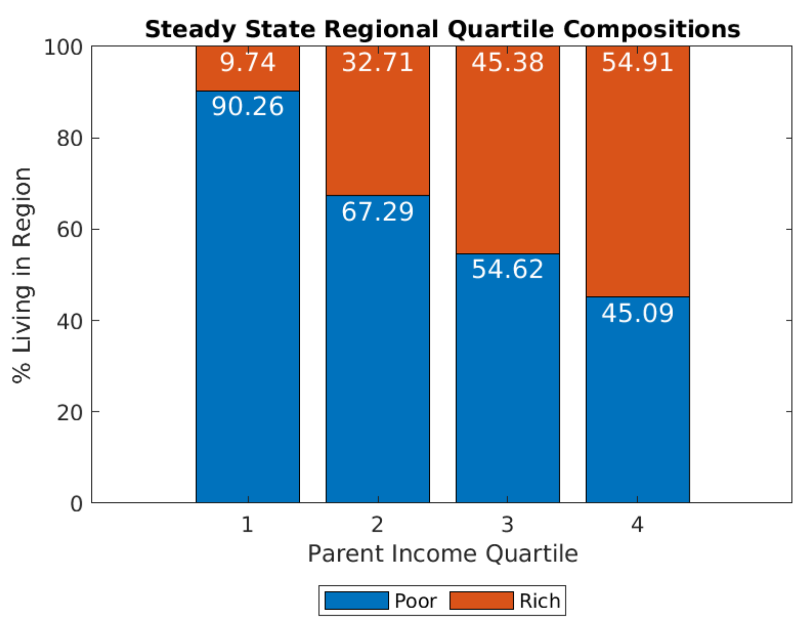
[16]Details regarding the computation of transition paths can be found in the Appendix

on average welfare, human capital, college attendance, and income for children born to each quartile of the parental income distribution in each province. Then, we directly study the mechanisms of improved welfare outcomes by comparing the "winners" and "losers" of each policy: our heterogeneous agent model allows us to compare children who are better off in expectation under the policy relative to baseline ("winners") to those who are worse off ("losers"). In other words, we attribute gains in expected welfare to differences in characteristics between the winners and losers from the policy. We examine four quantities that could change expected welfare: (i) higher counterfactual human capital (and thus income), (ii) higher counterfactual education, (iii) differential migration, and (iv) elite migration (defined as migration to the rich region with an elite college education) for children born in the poor province, and parent's Hukou status for children born in the rich province.

Note that in the Hukou and Public Spending counterfactuals, since the policies apply at the beginning of the period when population sizes and regional college seat allocations are fixed and the college allocation mechanism has not changed (as it does in Equity and Merit), provincial college attendance rates should not change for children born in both provinces. However, we can still observe whether college seats are distributed differently across quartiles *within* each province due to policy.

Figure 4 provides a regional decomposition of parent income quartiles in the baseline steady state, which helps to contextualize the scale of effects on parent income quartiles within a region and better understand the overall impacts of policy.

Figure 4: Steady State Regional Quartile Compositions



Hukou

Table 5: Hukou: Effects on Child's Expected Welfare

	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	14.1	84.5	-2.2	31.5
Q1	16.3	89.3	10.0	69.8
Q2	14.4	87.0	0.5	45.5
Q3	13.3	84.6	-3.0	33.0
Q4	10.5	71.1	-5.3	14.8

Table 5 lists the welfare effects of lifting the Hukou policy on children born in different parent income quartiles in each region. We again report welfare effects as the consumption equivalent relative to baseline consumption within the subgroup. Most individuals in the poor province and the poorest quartile in the rich province are better off at the cost of the top two quartiles in the rich province, with children born in the poor province benefiting in the range of 10.5 to 16.3% with the greatest gains at the bottom of the parental income distribution.

Table 6: Hukou: Effects on Migration %

	Province ℓ		Province h	
	Baseline	Hukou	Baseline	Hukou
Overall	5.7	33.2	10.7	45.3
Q1	3.1	27.3	26.9	72.7
Q2	4.2	29.3	17.9	62.9
Q3	5.0	33.0	11.5	51.8
Q4	13.8	50.9	2.9	24.6

Next, we study the mechanisms of these changes. Table 6 shows that eliminating Hukou costs induces substantial changes in migration flows in both directions; poor-to-rich migration increases from 5.7 to 33.2% while rich-to-poor migration increases from 10.7 to 45.3%. The fact that poor-to-rich migration increases and drives welfare gains is unsurprising, as the primary channel affected by lifting the Hukou policy is migration, and individuals can now migrate and realize the benefits of living in the richer region. The Hukou policy also allows for efficient sorting, encouraging certain individuals to move to the poor region for lower housing prices without fear of facing migration costs to move back in a later generation. This option value lessens the welfare gap between rich and poor provinces, leading to higher rich-to-poor migration flows as well.

Next, we examine effects on average human capital, college attendance, and income across quartiles in Table 7. Human capital and college attendance outcomes do not substantially change except perhaps slightly for children in the bottom quartile in the rich province, driven by migrants without a Hukou newly accessing the rich province's higher social insurance and public schooling. Similarly, college attendance rates do not change substantially for any quartile. Incomes in the poor province increase in the range of 2 to 4%, while incomes in the rich province decrease between 1 to 6%. These results suggest that welfare gains and losses are largely driven by migration and not other outcomes.

Table 7: Hukou: Effects on Human Capital, College Attendance %, and Log(Income)

	Province ℓ		Province h	
	Baseline	Hukou	Baseline	Hukou
Human Capital				
Overall	106.2	105.9	174.5	174.8
Q1	81.5	81.4	72.0	74.1
Q2	96.0	95.9	113.1	113.5
Q3	111.3	111.1	147.0	146.9
Q4	165.0	164.2	253.1	253.3
College Attendance %				
Overall	16.1	16.3	24.0	24.6
Q1	7.8	8.0	2.5	2.5
Q2	11.8	12.0	7.5	7.8
Q3	17.4	17.6	14.7	15.4
Q4	37.6	37.8	45.3	46.1
Log(Income)				
Overall	9.72	9.74	10.30	10.27
Q1	9.46	9.48	9.38	9.37
Q2	9.62	9.64	9.86	9.84
Q3	9.80	9.83	10.16	10.10
Q4	10.29	10.32	10.85	10.83

Finally, we study differences in observables between winners and losers from the Hukou policy. Each cell in Table 8 represents the proportion of individuals realizing each outcome for the winners ("W") and losers ("L") from the policy. For example, in the "Higher HC" column under province ℓ, we calculate the percentage of children who have higher human capital in the counterfactual among those who are better off (winners) and compare it to the percentage of children who have higher human capital in the counterfactual among those who are worse off (losers). Results from this table help us understand what characteristics drive welfare gains compared to welfare losses.

Table 8: Hukou: Differences Between Winners vs. Losers from Policy

Province ℓ	Higher HC			Higher Edu			Migration			Elite Migration		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	0.0	0.0	0.0	0.1	0.0	0.1	27.2	99.0	-71.8	0.1	56.9	-56.8
Q1	0.0	0.2	-0.2	0.1	0.0	0.1	22.8	100.0	-77.2	0.0	24.7	-24.7
Q2	0.0	0.0	0.0	0.1	0.0	0.1	24.4	99.1	-74.8	0.1	41.9	-41.8
Q3	0.0	0.0	0.0	0.1	0.0	0.1	27.4	98.8	-71.4	0.1	56.1	-56.0
Q4	0.0	0.0	0.0	0.1	0.0	0.1	41.3	98.5	-57.1	0.1	87.4	-87.3

Province h	Higher HC			Higher Edu			Migration			Non-Hukou Parent		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	12.9	3.9	9.0	1.9	0.0	1.9	86.0	30.1	55.8	12.6	0.2	12.3
Q1	29.0	1.1	27.8	0.1	0.0	0.1	77.8	57.5	20.3	29.0	1.1	27.8
Q2	8.3	0.1	8.1	0.5	0.0	0.5	88.3	44.8	43.5	8.3	0.1	8.1
Q3	7.9	0.2	7.7	1.7	0.0	1.7	89.5	37.9	51.6	7.9	0.2	7.7
Q4	14.5	8.0	6.5	8.5	0.0	8.5	83.0	17.6	65.4	12.3	0.3	12.0

We find that better short-term outcomes for children born in the poor province are not driven by increases in human capital accumulation or educational attainment, and they are much less likely to migrate to the rich province than those who are worse off. This happens for two main reasons. First, lifting the Hukou policy on adds the option value of freely migrating to province h for later generations of residents in province ℓ, indirectly increasing welfare from living in the poor province. Second, children who migrate to the rich province, including those with an elite education, under the baseline and Hukou policy settings are relatively worse off without migration restrictions because the influx of migrants requires them to pay higher housing prices in the next period. This explains why migrants lose from a policy that lifts migration costs–migration is always the best option for these individuals under both baseline and counterfactual, but it does not provide the same return as before.

Winners born in the rich province typically migrate to the poor province for lower housing costs, especially for children born to higher-income parents. Human capital outcomes improve as well; observing the similarity between the "Higher HC" and "Non-Hukou Parent columns," we find that children who enjoy better human capital outcomes are almost exactly the ones whose parents receive a Hukou due to the policy, with the only difference in the highest parent income quartile. These children and their parents benefit from no longer facing Hukou costs in earnings, education, housing, and investment.

Taken together, results suggest that lifting Hukou restrictions produces positive welfare effects through two main mechanisms. First, it improves human capital outcomes for children whose parents previously faced Hukou restrictions. Second, it lessens the welfare gap between the rich and poor province by allowing individuals to efficiently sort without facing migration costs in a later period. Both of these channels emphasize the welfare improvement from better access to the rich province.

Public Spending

Table 9 decomposes the welfare effects by parent income quartile and birth location in the Public Spending counterfactual. As expected, all quartiles in the poor province are better off, gaining 8 to 17.4% in welfare and 14.5% overall. Lower-income parents in the poor province gain the most from the policy because they are relatively more dependent on public rather than private investment in children's human capital accumulation. The opposite holds in the rich province: most children are worse off, losing 9.3 to 14.5% of income in consumption equivalent and 12.9% overall. The bottom quartile of the rich province appears to suffer the lowest welfare loss on average, but this is due to this group largely consisting of non-Hukou holders; we expand on this in a later table.

Table 9: Public Spending: Effects on Child's Expected Welfare

	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	14.5	96.4	-12.9	6.2
Q1	17.4	99.0	-9.3	18.2
Q2	15.9	98.9	-14.5	8.1
Q3	13.4	97.3	-14.3	5.5
Q4	8.0	86.1	-11.5	3.4

We next examine effects on migration in Table 10. Equalization in public spending unsurprisingly makes the poor province more attractive, inducing migration into the region particularly by children born to lower-income parents in the rich province. The justification for the small increase in migration rates in the opposite direction is less obvious; however, equating per-student public spending across regions also incentivizes poor-to-rich migration by lessening the cost of moving from without receiving a Hukou, as children of migrants no longer face a difference in schooling quality upon migration.

Table 10: Public Spending: Effects on Children's Migration %

	Province ℓ		Province h	
	Baseline	Public Spending	Baseline	Public Spending
Overall	5.7	6.7	9.8	17.9
Q1	3.4	4.3	25.5	40.7
Q2	4.1	5.2	16.4	29.5
Q3	5.1	6.3	10.1	19.4
Q4	13.5	14.4	2.7	5.6

We report effects on children's human capital, college attendance, and logged income in Table 11. As expected, average child human capital increases for children across all quartiles in the poor province and decreases across all quartiles in the rich province, with larger percentage gains and losses in lower quartiles of the poor and rich province, respectively. This is met with slight increases in college attendance (about 3 - 5% of baseline) in the bottom two quartiles and slight decreases in the upper two quartiles for children born in the poor province, as children with poorer parents benefit relatively more from increases in public relative to private investment. However, this comes at a cost–children of poorer parents in the rich province suffer the largest relative decreases in human capital and college-going, with attendance increasing for the top quartile. The richest individuals can most readily compensate losses in public funding with private investment, allowing them to maintain their children's status at the top of the human capital and education distribution. These factors lead to the largest income gains for children of the poorest in the poor province and the largest income reductions for the children of the poorest in the rich province.

Table 11: Public Spending: Effects on Children's Human Capital, College Attendance %, and Log(Income)

	Province ℓ		Province h	
	Baseline	Public Spending	Baseline	Public Spending
Human Capital				
Overall	105.5	110.2	173.2	164.9
Q1	80.8	85.8	73.3	68.7
Q2	95.1	100.3	112.0	103.8
Q3	111.0	115.6	143.5	134.5
Q4	164.1	167.8	252.9	244.6
College Attendance %				
Overall	16.1	16.1	24.0	23.8
Q1	7.8	8.2	2.5	1.9
Q2	11.8	12.2	7.5	6.9
Q3	17.4	17.2	14.7	14.0
Q4	37.6	36.5	45.3	46.0
Log(Income)				
Overall	9.71	9.76	10.30	10.24
Q1	9.46	9.52	9.41	9.35
Q2	9.62	9.67	9.86	9.78
Q3	9.80	9.84	10.14	10.07
Q4	10.26	10.28	10.85	10.81

Table 12 reveals the mechanisms of welfare gains and losses. We first note that from Table 9, almost all children born in the poor province are winners while almost all children born in the rich province are losers from the policy, as would be expected from reallocating public schooling funds from rich to poor regions. Welfare losers born in the poor province are migrants who receive an elite education and obtain a Hukou for the rich province in both the baseline and the counterfactual, whose children then do not receive higher quality schooling as before. The children born in the rich province who gain from the policy consists of those born to migrants without a Hukou who do not have access to the rich province's public education or those who migrate to the poor province under both the baseline and policy counterfactual settings (or both). As with the Hukou policy, the children with better human capital outcomes in the rich province are mostly the same as the children of parents without a Hukou. However, under this policy, rather than children of migrants benefiting from access to public schools in the rich region, they benefit from improved schooling quality in the poor region.

Table 12: Public Spending: Differences Between Winners vs. Losers from Policy

Province ℓ	Higher HC			Higher Edu			Migration			Elite Migration		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	99.9	97.2	2.7	0.4	0.0	0.4	3.5	92.1	-88.7	1.4	71.7	-70.3
Q1	99.8	91.3	8.5	0.5	0.0	0.5	3.6	97.5	-93.9	1.2	6.3	-5.1
Q2	100.0	95.8	4.2	0.5	0.0	0.5	4.1	94.7	-90.6	2.1	31.6	-29.4
Q3	100.0	99.0	1.0	0.3	0.0	0.3	3.6	97.9	-94.4	1.6	72.0	-70.4
Q4	100.0	97.5	2.5	0.0	0.0	0.0	1.8	89.9	-88.1	0.2	82.9	-82.8

Province h	Higher HC			Higher Edu			Migration			Non-Hukou Parent		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	62.2	0.9	61.3	8.8	0.0	8.8	47.4	16.7	30.6	62.2	0.9	61.3
Q1	91.6	7.3	84.2	0.5	0.0	0.5	48.0	39.7	8.4	91.6	7.3	84.2
Q2	69.6	0.3	69.3	0.5	0.0	0.5	45.0	29.0	16.0	69.6	0.3	69.3
Q3	60.0	0.3	59.7	0.5	0.0	0.5	53.0	18.4	34.6	60.0	0.3	59.7
Q4	26.9	0.7	26.2	33.0	0.0	33.0	43.7	4.5	39.2	26.9	0.7	26.2

In summary, the Public Spending counterfactual accomplishes similar welfare outcomes to the Hukou counterfactual, particularly improving outcomes for low-income populations in the poor province. However, whereas the Hukou counterfactual lessens the poor-rich gap by allowing access to the rich province's resources, the Public Spending counterfactual accomplishes its outcome by improving resources in the poor province, lifting individuals who are born or attend public school in the region.

Merit and Equity

The Merit and Equity policies may impact outcomes within subgroups if college seats are differentially allocated across the groups or they generate differential incentives for child investment. The effect of these policies on child investment is unclear–on one hand, lower human capital thresholds in a region implies that parents need not invest as much to guarantee the same probability of admission (prior to the human capital shock) as in baseline. On the other hand, further marginal investments into children could increase admission probability and produce much better future outcomes by attaining a higher tier of education.

Table 13: Merit: Effects on Child's Expected Welfare

Merit	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	-4.2	31.4	9.4	94.9
Q1	-1.7	46.1	1.8	85.3
Q2	-3.4	33.4	5.1	90.3
Q3	-5.2	20.3	8.5	95.3
Q4	-9.2	12.5	14.5	99.0

We begin by analyzing the welfare effects of the Merit counterfactual in Table 13. In the baseline counterfactual, the marginal student from the rich province has higher human capital, meaning that lifting provincial quotas with this policy reallocates seats from the poor province to the rich province. On average, children born in the poor province are worse off by 4.2% and children born in the rich province are better off by 9.4%, where losses and gains are concentrated at the top end of the parental income distribution in both the poor and rich provinces, respectively.

Examining human capital, college attendance, and earnings outcomes in Table 14 helps to explain these changes in welfare. The policy slightly reduces human capital and greatly reduces college attendance for children in the poor province, with a corresponding 2% overall decrease in income. In the rich province, average human capital stays roughly the same; combined with increases in college attendance, this drives a 4% increase in earnings. The largest percentage point losses and gains in earnings and college attendance are again concentrated among children of high-income parents in both regions. This trend is explained by the fact that children of high-income parents are most likely to be on the margin of college attendance and thus have college attainment affected by the reallocation.

Table 14: Merit: Effects on Children's Human Capital, College Attendance %, and Log(Income)

	Province ℓ		Province h	
Human Capital	Baseline	Merit	Baseline	Merit
Overall	106.3	105.9	174.5	175.2
Q1	81.5	81.4	71.8	71.9
Q2	96.1	95.9	113.0	113.2
Q3	111.4	110.7	146.9	147.6
Q4	165.2	164.0	253.1	254.3
College Attendance (%)				
Overall	16.3	11.9	24.9	32.1
Q1	7.6	5.0	1.7	2.6
Q2	12.3	8.6	8.3	13.0
Q3	17.3	12.2	16.6	24.0
Q4	38.3	30.0	45.9	55.6
Log(Income)	9.46	9.45	9.38	9.38
Overall	9.72	9.70	10.30	10.34
Q1	9.46	9.45	9.38	9.38
Q2	9.62	9.60	9.86	9.88
Q3	9.80	9.77	10.16	10.20
Q4	10.29	10.24	10.85	10.91

Table 15 shows that welfare improvements in the poor province through the Merit reallocation are not driven by improved human capital accumulation or educational outcomes, but rather by migration to the rich province with a Hukou, particularly for children of the richest parents. The subsequent generation of these households then access a better college allocation relative to the baseline allocation in the rich province. Winners born in the rich province are more likely than losers to have higher human capital and better educational outcomes, migrate toward the worse college allocation much less often, and tend to have parents who hold the local Hukou so that they are able to access the rich province's allocation upon birth.

Table 15: Merit: Differences Between Winners vs. Losers from Policy

Province ℓ	Higher HC			Higher Edu			Migration			Elite Migration		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	0.0	0.0	0.0	0.0	0.0	0.0	8.6	3.7	4.9	6.6	0.0	6.6
Q1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.0	0.8	1.3	0.0	1.3
Q2	0.0	0.0	0.0	0.0	0.0	0.0	5.0	3.0	1.9	3.3	0.0	3.3
Q3	0.0	0.0	0.0	0.0	0.0	0.0	9.1	3.7	5.4	8.0	0.0	8.0
Q4	0.3	0.2	0.1	0.0	0.0	0.0	57.0	5.2	51.8	56.3	0.0	56.3

Province h	Higher HC			Higher Edu			Migration			Non-Hukou Parent		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	55.0	13.4	41.6	11.3	0.0	11.3	4.8	93.8	-89.1	3.2	10.2	-7.0
Q1	7.0	1.6	5.4	1.3	0.0	1.3	12.2	95.7	-83.5	21.6	16.8	4.8
Q2	20.9	5.7	15.2	6.1	0.0	6.1	7.1	98.5	-91.4	3.5	3.0	0.6
Q3	53.6	24.7	28.9	10.1	0.0	10.1	5.5	93.7	-88.3	1.9	8.9	-6.9
Q4	82.4	45.6	36.8	16.7	0.0	16.7	1.8	61.8	-59.9	1.0	39.7	-38.7

Given that reallocating college seats to the rich province tends to increase welfare in the rich province and decrease welfare across all quartiles of the poor province, one might surmise that the Equity counterfactual would have the reverse effects. Table 16 shows that this holds true in the poor province as children improve welfare by 3.7% on average, with effects concentrated at the top of the income distribution. However, while overall welfare does slightly decrease in the rich province, this is driven by a decrease in average welfare only for children of the highest-income parents; in fact, most children born in all subgroups are better off under the Equity allocation than baseline, a perhaps surprising result.

Table 16: Equity: Effects on Child's Expected Welfare

Equity	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	3.7	79.8	-0.3	79.9
Q1	2.1	72.4	3.7	95.1
Q2	3.2	80.0	3.8	94.7
Q3	4.4	87.8	1.7	89.8
Q4	6.6	84.6	-4.4	59.9

Table 17 sheds light on the effects on human capital, college attendance, and earnings. With lower human capital thresholds in the poor province, parental incentive to invest decreases, resulting in lower human capital but increases college attendance across children in the poor province. These offset to generate only small income gains overall (1%, up to 3% in the top quartile). Higher human capital thresholds in the rich province induce greater investment and higher human capital outcomes for children in the rich province. This offsets the decrease in college attendance so that incomes only decrease by 1% (4% in the top quartile). Again, effects are magnified in the top quartiles, where children are most likely to be at the margin of college attendance and thus affected by the policy.

Table 17: Equity: Effects on Children's Human Capital, College Attendance %, and Log(Income)

	Province ℓ		Province h	
Human Capital	Baseline	Merit	Baseline	Merit
Overall	106.3	105.5	174.5	176.4
Q1	81.5	80.5	71.8	72.8
Q2	96.1	95.3	113.0	115.4
Q3	111.4	110.8	146.9	149.2
Q4	165.2	164.6	253.1	254.5
College Attendance (%)				
Overall	16.3	19.3	24.9	19.1
Q1	7.6	9.3	1.7	1.6
Q2	12.3	15.1	8.3	5.4
Q3	17.3	21.0	16.6	11.6
Q4	38.3	43.4	45.9	36.8
Log(Income)				
Overall	9.72	9.73	10.30	10.29
Q1	9.46	9.45	9.38	9.39
Q2	9.62	9.62	9.86	9.87
Q3	9.80	9.81	10.16	10.16
Q4	10.29	10.32	10.85	10.81

Finally, we study the characteristics of winners and losers from the Equity policy in Table 18. Welfare improvements for children born in province ℓ are driven by higher college attendance from the improved allocation, while welfare losses are driven by migrants who attend the elite college and then face the rich province's lower college allocation in future generations. As before, education and migration differentials are concentrated in the top quartile. In the rich province, higher welfare indeed appears to be driven by a greater proportion of improved human capital outcomes relative to losers as well as migration to the poor province or children of non-Hukou parents, who now access the improved college quota in province ℓ.

Table 18: Equity: Differences Between Winners vs. Losers from Policy

Province ℓ	Higher HC			Higher Edu			Migration			Elite Migration		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	0.0	0.0	0.0	5.1	0.0	5.1	2.0	23.1	-21.1	1.3	19.3	-18.0
Q1	0.0	0.0	0.0	2.8	0.0	2.8	1.6	7.5	-5.9	0.4	4.1	-3.7
Q2	0.0	0.0	0.0	4.2	0.0	4.2	1.5	15.7	-14.2	0.8	11.8	-11.0
Q3	0.0	0.0	0.0	5.6	0.0	5.6	1.7	34.1	-32.4	1.4	27.9	-26.5
Q4	0.0	0.0	0.0	9.4	0.0	9.4	3.7	82.9	-79.3	3.4	80.0	-76.7

Province h	Higher HC			Higher Edu			Migration			Non-Hukou Parent		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	92.4	80.4	12.0	0.2	0.0	0.2	12.3	1.2	11.1	5.9	2.9	3.0
Q1	50.1	6.6	43.5	0.2	0.0	0.2	26.1	23.0	3.2	80.3	17.9	62.4
Q2	97.5	73.4	24.1	0.1	0.0	0.1	17.2	3.6	13.6	25.7	2.2	23.4
Q3	98.6	88.0	10.6	0.2	0.0	0.2	11.3	2.6	8.7	10.1	1.4	8.7
Q4	92.1	81.0	11.1	0.2	0.0	0.2	4.9	0.2	4.7	1.8	1.2	0.6

One curious result is that both counterfactual allocations alter incentives such that the rich province invests more into children and the poor province invests less. This suggests that parents in the high-income province are able to more readily increase private investment in children's human capital in response to both upward or downward movements in human capital thresholds. We also observe that both allocations have the greatest effects on children of high-income parents in both regions; the largest impacts are concentrated among children who are on the margin of college attendance, and thus positive (or negative) effects from changing college allocation mechanisms born to the lowest-income parents are limited.

6 Discussion and Conclusion

China's regional education and migration policies have generated lasting unrest over fairness in treatment by the government. In this paper, we explore the effects of these policies on intergenerational mobility, inequality, welfare, and the income distribution, with particular attention on the effects of policy on different subgroups. Our counterfactual policy exercises each address one dimension of regional inequity, affecting either the quality of existing opportunities in the poor province or access to better opportunities in the rich province.

The Hukou and Public Spending policies generate positive aggregate and distributional effects for children born to the poorest parents in the low-income province, decreasing intergenerational persistence and increasing overall welfare by 8.0% and 3.7%, respectively. Notably, they achieve this with different end results for the spatial distribution of individuals. Eliminating Hukou migration costs allows individuals to freely access opportunities in the rich province by migrating from the poor province, inducing net migration into the rich province. Equalizing provincial per-student public spending improves existing K-12 education quality in the poor province, attracting individuals to the poor province. We find that lifting Hukou migration costs and equating public spending across provinces reduces intergenerational income persistence, but at the cost of worsening outcomes in the rich province.

One common thread between these policies is that both improve the value of living in the poor province. Lifting Hukou restrictions decreases the welfare gap between the two locations through the increased option value of free migration to the rich province as well as decreased housing prices in the poor province and increased housing prices in the rich province; children who migrate with or without a Hukou under both the baseline and Hukou settings actually tend to be worse off from the policy due to higher housing prices. Setting public schooling quality equal increases the value of growing up in the poor relative to the rich province. However, the distribution of these effects differs–the Hukou policy improves welfare for most individuals (children who do not obtain an elite education and non-migrants) in the poor province and some (children of migrant parents without a Hukou) in the rich province. The Public Spending policy improves welfare for almost all individuals in the poor province and very few (children of migrants without a Hukou) in the rich province.

Despite debate regarding the provincial college allocation mechanism, modifying the allocation to be more equitable or efficient across regions does not produce significant aggregate effects. Welfare effects both overall and within each region are much smaller from these policies than Hukou or Public Spending policies, with the most significant impact on children born to rich parents whose educational outcomes are most likely to change due to policy. Notably, allocating college seats away from the rich province, where parents have resources to smooth over losses in college opportunities through childhood investments, may produce small positive welfare effects for most children born in the region by incentivizing parental investments in children's human capital.

There are additional empirical and theoretical extensions to consider that would improve our work. We could employ longer panel data sets in China to estimate the returns to child investment. Currently, our human capital accumulation equation relies on the specification and parameter values from Kotera-Seshadri, who estimate the parameters for the United States. While this is a useful approximation, there is reason to believe China may differ in these parameters. If peer effects matter, this could change our results because outcomes would be affected by regional human capital distributions, intensifying "brain drain" effects as living in the rich province would produce positive spillovers. Finally, we acknowledge the possibility of general equilibrium effects in labor markets, public spending, and social insurance that are not in the model. For example, changes in the educational composition of the regional labor force due to changing college quotas or reducing migration restrictions could affect wage premia for college-educated workers. Lifting Hukou restrictions could impose a substantial cost to the government if individuals at the bottom of the income distribution move into the richer cities to benefit from the region's social insurance, or it could cause schooling quality to decrease by diffusing public K - 12 educational resources across too many children if educational tax revenues cannot sustain current levels of per-student spending. It could also be interpreted as unfair to individuals in rich provinces, who would be effectively subsidizing the education of those in poor provinces.

Still, our model produces a number of interesting results for policymakers to consider, and the richness of the model enables us to consider a wide range of other interesting interventions such as affirmative action policies that allocate college seats to individuals from different parts of the income distribution rather than the human capital distribution. One could also consider combining multiple policies discussed in the paper to study the marginal contributions of each policy. For example, combining Merit and Public Spending or Merit and Hukou and observing changes in human capital thresholds relative to Merit alone could help identify to what extent public spending or Hukou restrictions cause a divergence in human capital distributions across provinces. Combining Public Spending and Hukou both equates public schooling quality across provinces and provides free access to the rich province, which could lead to interesting sorting effects in equilibrium. Lastly, there is the consideration of optimal policy; for example, what is the welfare-optimizing allocation of college seats and public education spending across regions? How would results change if weights in a social welfare function depend on parent's income quartile? We leave these extensions to future work.

A Appendix

A.1 Rich vs. Poor Provinces

Table A1: Rich vs. Poor Provinces

Poor	Population (10,000s)	GDP per Capita	Public K-12 spending	4-year (%)	Tier 1 (%)
Guizhou	3,469	16,438	3,785	11.4	2.4
Yunnan	4,631	19,204	4,187	13.4	3.3
Gansu	2,564	19,579	4,492	17.4	3.3
Guangxi	4,645	25,233	4,464	11.8	2.6
Anhui	5,968	25,638	4,866	16.4	4.8
Jiangxi	4,488	26,073	4,190	17.2	3.7
Sichuan	8,050	26,120	4,468	11.4	2.5
Henan	9,388	28,687	3,365	15.4	3.3
Hainan	877	28,754	6,963	15.2	4.8
Qinghai	568	29,400	7,365	16.2	5.6
Hunan	6,596	29,822	4,307	17.1	3.3
Xinjiang	2,209	29,927	8,656	13.8	4.6
Shanxi	3,593	31,276	5,363	18.1	3.8
Heilongjiang	3,834	32,817	6,199	25.8	5.8
Ningxia	639	32,875	5,396	20.4	5.6
Shaanxi	3,743	33,432	6,456	22.3	6.7
Hebei	7,241	33,859	4,821	20.8	5.4
Hubei	5,758	34,099	4,138	16.8	3.8
Chongqing	2,919	34,297	5,141	13.6	4.1
Jilin	2,749	38,440	7,314	23.5	5.0
Aggregate	63.9%	28,588	4,693	16.2	3.9
Rich	Population (10,000s)	GDP per Capita	Public K-12 spending	4-year (%)	Tier 1 (%)
Shandong	9,637	47,071	6,162	26.8	8.9
Fujian	3,720	47,205	6,281	21.3	6.4
Guangdong	10,505	50,653	5,031	13.6	2.4
Liaoning	4,383	50,711	7,669	48.9	16.9
Zhejiang	5,463	59,160	8,174	61.0	13.3
Jiangsu	7,899	62,174	8,807	45.0	8.4
Beijing	2,019	80,511	22,039	32.4	16.7
Shanghai	2,347	81,772	19,685	26.4	9.7
Tianjin	1,355	83,449	15,058	42.7	15.3
Aggregate	36.1%	56,319	7,439	24.8	6.7

Income and public spending data from NBS 2011; provincial admissions rates from 2011 administrative data

Table A.1 categorizes provinces in China into "rich" and "poor" based on GDP per capita data from the 2011 Chinese Census, along with their per-student public spending levels and college allocations. [17] As noted, students applying from rich provinces enjoy higher public spending and better 4-year and elite college prospects than students in poor provinces.

[17] We define "rich" as greater than 40,000 in GDP per capita, which is a natural cutoff given the large gap between Jilin and Shandong as well as consistent with previous literature classifying rich and poor provinces by Whalley and Zhang (2007).

A.2 College Seat Allocation

Access to higher education in China is highly regulated by the Ministry of Education. The Ministry organizes a hierarchy of college education ranked by school quality, starting with first-tier colleges at the top, then provincial and local four-year colleges, and finally vocational colleges. A school's ranking determines its level of public funding and subsequently the quality of students who apply to each college. The MoE assigns quotas that govern the number of students enrolling in each tier from each province, thereby controlling each province's access to college education.

Within each province's allocation, college applicants are assigned to schools based on their preferences and their scores on the National College Entrance Examination (NCEE), or *Gaokao*. Applicants choose one of two tracks, social science or natural science. The exam consists of six sections, which depend on the chosen track, worth a total of 750 points. All students must take Chinese (150 points), mathematics (150), and a foreign language (150; most commonly English). Social science students then also take history (100), geography (100), and political science (100), while natural science students take physics (110), chemistry (100), and biology (90). All exams are written and graded within province so that scores are comparable *within-province*, but not *between provinces*.

Students receive scores around two weeks after the exam. The Ministry determines and announces a cutoff total score for each province, college tier, and track based on the score distribution and desired provincial quotas.[18] Students' scores must exceed the cutoff within their track in order to apply for schools within the tier, though this does not guarantee admission. Students then apply to at most 5 colleges (and 3-5 majors within each college) by ranking them on a preference form. If a student is not admitted to any schools on their list, they can indicate on the application that they would be willing to matriculate at other schools with openings.

Once students have supplied their preferences, colleges begin admitting students based on highest NCEE scores during mid-July –August.[19] The top tier admits students first, and the second tier does not begin admitting students until the first tier is complete. Students are admitted to at most one college; they may either accept the offer and matriculate, or decline the offer and not enroll in any college that year.

[18] Cutoff scores are set well below the applicable admissions quotas to ensure that colleges receive enough applications to fill vacant seats.

[19] There are also additional considerations for special talents or for ethnic minorities similar to Affirmative Action in the United States, but admission is solely based on test score for most of the population.

A.3 Steady-State Solution Process

First, to obtain the baseline steady state, we set housing prices P_ℓ and P_h based on empirical housing expenditure shares across provinces and set regional public spending levels $\bar{x}_\ell$ and $\bar{x}_h$ equal to per-student K - 12 spending in the data for each province. Then, we guess equilibrium provincial college human capital thresholds $\bar{H}_{2,\ell}, \bar{H}_{3,\ell}, \bar{H}_{2,h}$, and $\bar{H}_{3,h}$ and poor province location preference mean $\mu_{M,\ell}$. Given these values, we solve for value functions $V_r(H_2, \xi_y, \xi_r, m)$ across all possible combinations of state variables on a grid. We initialize the economy with a large number of individuals and an arbitrary distribution across state variables, then we use the value functions to interpolate each individual's decision rule in each period. Once we obtain the steady state from these value functions, we adjust the guess for the human capital thresholds in each province toward the implied human capital thresholds from the new steady state, and we increase or decrease $\mu_{M,\ell}$ depending on whether province ℓ is too small or too large, respectively, in the attained steady state. Finally, we re-calculate the value functions given these new human capital thresholds and location preference mean and repeat the process. We continue iterating until provincial enrollment and province size match 2011 with negligible tolerance.

To obtain counterfactual steady states, the process is largely the same. However, $\mu_{M,\ell}$ and housing constants A_r are held fixed from baseline, and we guess location size and human capital thresholds in each iteration. We achieve steady state when housing prices, public spending levels, and schooling enrollments (which adjust with location size as described in the paper) are consistent with the location size and human capital threshold guesses.

A.4 Solving for the Transition Path

We use the transition path between baseline and counterfactual steady state to compute the effects of counterfactual policy on a fixed initial distribution (namely, the baseline steady state) in Section 5.2 by comparing outcomes in the first period of the counterfactual transition path relative to another generation of the baseline policy. To solve for the transition path, we begin by setting the baseline and counterfactual steady states as the start and endpoints of the path, respectively, and assuming the transition path takes at most T generations to reach the counterfactual steady state. This pins down housing prices and human capital thresholds from period T onward. Then, we guess housing prices and human capital thresholds for each college and province in each period along the transition path. Starting from period $T-1$, we use backward induction to solve for value functions in each preceding period, using guessed prices and thresholds in the current period and value functions in the next period to solve for current-period value functions. Finally, we use these value functions to simulate the transition path and check that equilibrium conditions on housing and college attainment are consistent with the optimal decision rules, i.e. population sizes and college capacities are consistent with the guesses for housing prices and human capital thresholds. If they are not, we adjust the guesses accordingly and repeat the process until equilibrium is achieved.

We show transition paths for average income and location size for each counterfactual in the figures below. For the purposes of this exercise, the policy is enacted at the *beginning* of period 2 so that the starting point in period 1 is the baseline steady state. This implies that location sizes in period 1 and period 2 (which are measured at the beginning of the period) will be identical since individuals affected by the policy do not migrate until the end of the period in which the policy changes. We find that the transitions are relatively smooth and monotone. Location size in the Equity counterfactual appears to fluctuate, but the magnitude of these fluctuations is small, so we attribute them to noise.

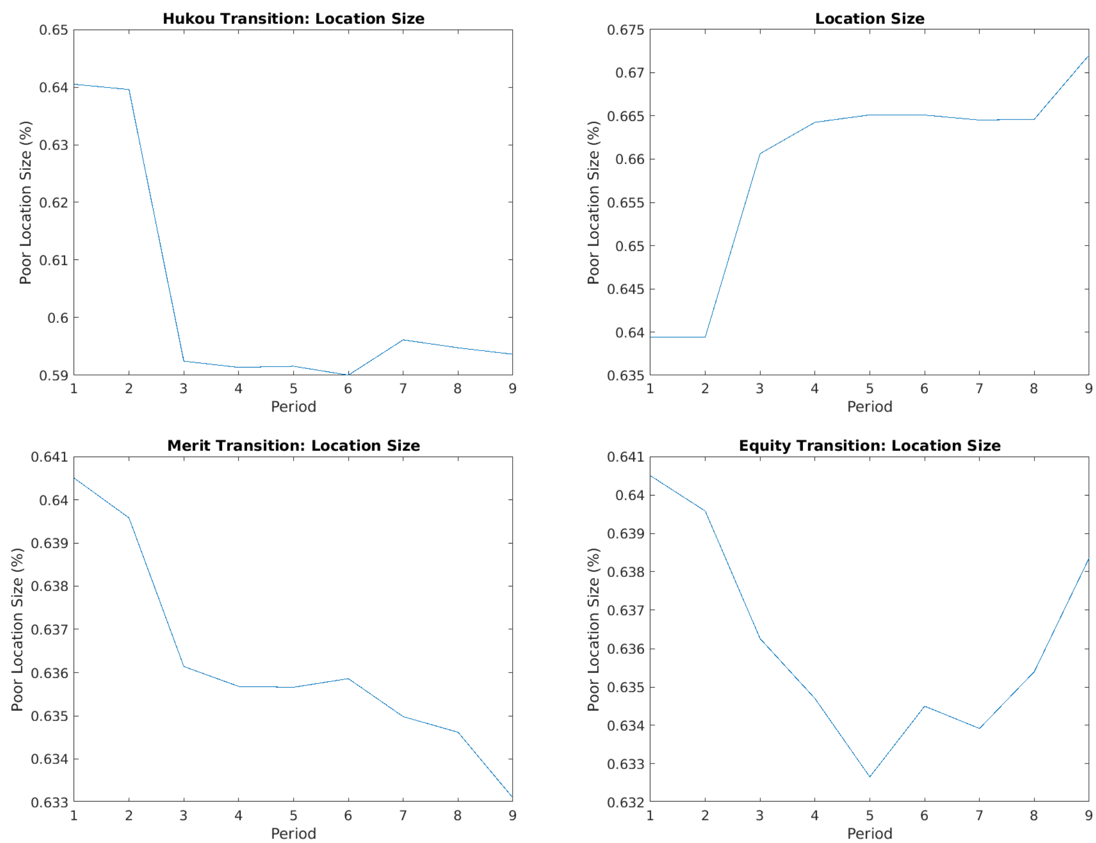


Figure A1: Transition Paths: Location Size

From Figures A1 and A2, it appears that the economy takes only a few generations to roughly converge from the baseline to the counterfactual steady state in most cases. We choose $n = 9$ as an upper bound, and convergence appears to occur well before then.

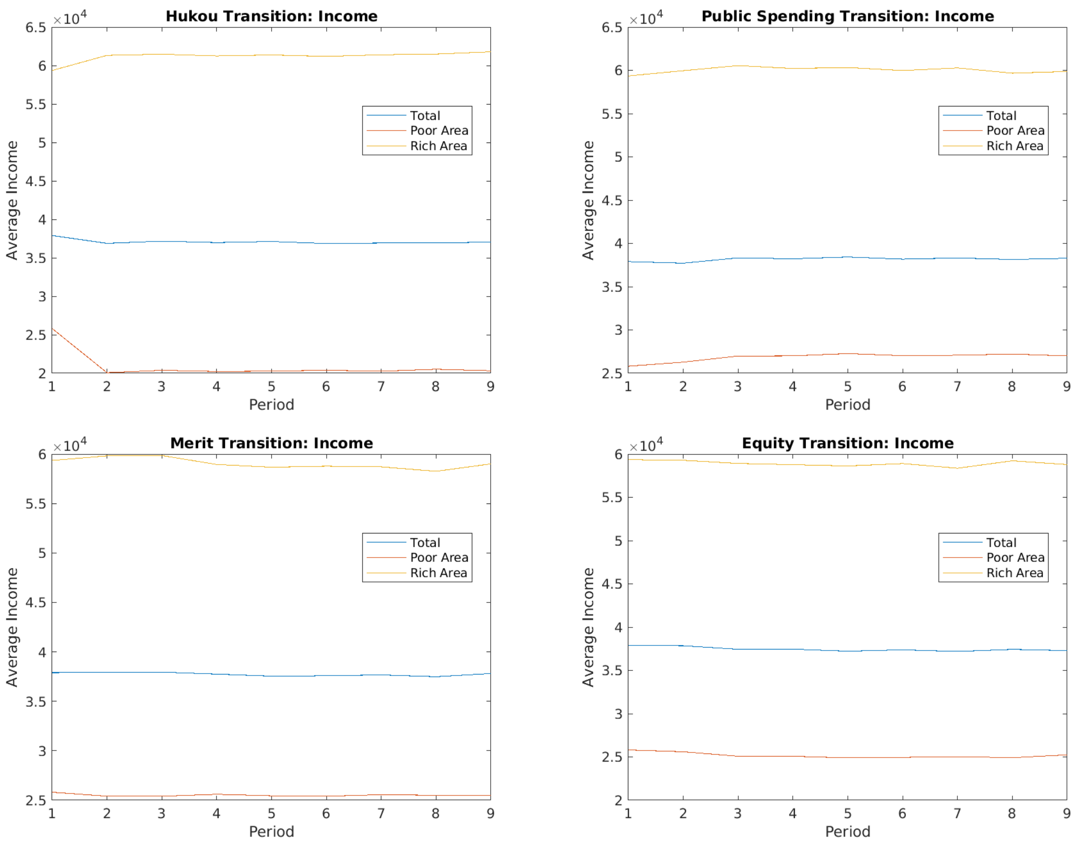


Figure A2: Transition Paths: Income

A.5 Calibration: Non-Targeted Moments

We verify the performance of our model in matching intergenerational quartile transition matrices for the entire population and each province, moments which are not directly targeted by the calibration. Our model suggests slightly higher income persistence for children born to either end of the parental income distribution, particularly at the upper end, but otherwise matches well.

A.6 Combining Hukou and Public Spending Policies

The Hukou and Public Spending counterfactuals address two different sources of regional inequality: access to regional amenities through migration and the level of an important regional amenity, respectively. What, then, would happen if both occurred at the same time? Not only are individuals able to sort efficiently

Interactive effects on mobility

Table A2: Quartile-Quartile Transition Matrix

		Child Quartile			
	CFPS Data	1	2	3	4
Parent Quartile	1	35.7%	28.5%	19.9%	16.0%
	2	28.4%	27.2%	25.3%	19.1%
	3	19.3%	27.2%	28.7%	24.8%
	4	16.7%	17.6%	25.5%	40.1%
	Model	1	2	3	4
Parent Quartile	1	41.1%	26.0%	19.5%	13.4%
	2	34.8%	26.6%	19.9%	18.7%
	3	30.0%	24.6%	22.1%	23.3%
	4	18.9%	20.2%	20.6%	40.3%

Table A3: Steady State Differences across Policies

	Baseline	Hukou	Public Spending	H + PS
Average Income	37,988	36,966	38,369	37,672
Population size (%), province ℓ	63.9	59.0	67.3	63.1
IGE	0.401	0.384	0.374	0.364
Gini	0.564	0.543	0.563	0.552
Welfare	21.743	21.820	21.779	21.845
Δ Welfare in % Consumption (CE %)	-	8.0	3.7	10.7

Table A4: Hukou + Public Spending: Effects on Child's Expected Welfare

H + PS	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	19.5	95.3	-13.8	12.9
Q1	22.7	98.6	-7.4	28.4
Q2	21.5	97.6	-14.1	14.6
Q3	18.2	95.1	-15.1	15.0
Q4	12.0	85.5	-13.6	7.2

Table A5: Hukou + Public Spending: Effects on Children's Human Capital, College Attendance %, and Log(Income)

	Province ℓ		Province h	
Human Capital	Baseline	H + PS	Baseline	H + PS
Overall	106.3	111.1	173.0	164.7
Q1	80.9	86.0	73.4	68.7
Q2	95.8	101.0	113.6	105.1
Q3	111.8	116.4	144.8	135.5
Q4	166.7	170.2	250.8	242.5
College Attendance (%)				
Overall	16.4	16.4	24.6	24.8
Q1	7.8	8.2	1.9	1.8
Q2	12.6	12.9	8.5	7.9
Q3	17.5	17.4	15.9	15.8
Q4	38.3	37.0	45.6	46.6
Log(Income)				
Overall	9.72	9.79	10.30	10.21
Q1	9.44	9.52	9.39	9.33
Q2	9.64	9.71	9.88	9.76
Q3	9.80	9.86	10.15	10.04
Q4	10.30	10.35	10.84	10.78

Table A6: Hukou + Public Spending: Differences Between Winners vs. Losers from Policy

Province ℓ	Higher HC			Higher Edu			Migration			Elite Migration		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	99.8	98.1	1.7	0.4	0.0	0.4	25.1	79.1	-54.0	0.5	55.9	-55.4
Q1	99.7	97.5	2.2	0.5	0.0	0.5	19.6	89.4	-69.8	0.6	17.4	-16.7
Q2	100.0	98.5	1.5	0.5	0.0	0.5	24.1	78.5	-54.4	0.8	40.5	-39.7
Q3	100.0	99.4	0.6	0.2	0.0	0.2	28.0	81.9	-54.0	0.3	58.1	-57.9
Q4	99.6	97.5	2.0	0.0	0.0	0.0	35.8	76.1	-40.3	0.0	66.3	-66.3

Province h	Higher HC			Higher Edu			Migration			Non-Hukou Parent		
	W	L	Diff	W	L	Diff	W	L	Diff	W	L	Diff
Overall	23.7	0.6	23.1	5.0	0.0	5.0	85.6	41.4	44.2	86.0	14.0	72.0
Q1	52.1	8.4	43.7	0.0	0.0	0.0	89.9	58.8	31.1	71.0	29.0	42.0
Q2	22.3	0.3	22.1	0.8	0.0	0.8	90.9	58.4	32.5	93.2	6.8	86.4
Q3	15.0	0.1	14.9	0.7	0.0	0.7	91.1	46.5	44.6	97.0	3.0	94.0
Q4	20.0	0.0	20.0	21.0	0.0	21.0	66.6	25.6	41.0	100.0	0.0	100.0

A.7 Scaling College Allocation Counterfactuals

Overall college attendance rates in China have drastically increased in recent years. However, we are unable to obtain admissions data to different levels of college at the province level past 2011. In this section, we adjust for changes in college attendance by scaling the overall baseline college attendance rates in the model to match those in the United States.[20]

Effects are similar to the non-scaled case, with small changes in steady-state welfare and income. One deviation is that the low-income province shrinks in the scaled Equity counterfactual, as significantly more people from the low-income province attend the elite college and can move without facing Hukou costs. The short-run welfare effects are similarly distributed as well, with the largest improvements for the children of high-income parents in the high-income province in the Merit counterfactual.

[20]Since college attendance in China continues to grow currently, we use the United States as a benchmark for the long-run steady state of college attendance.

	Baseline	Merit	Equity
Average Income	45,561	46,183	45,260
Population size (%), province ℓ	63.3	63.4	60.7
IGE	0.435	0.459	0.431
Gini	0.560	0.570	0.556
Δ Welfare in % Consumption (CE %)		0	1.3

Table A7: Steady State Differences across College Allocation Policies (Scaled)

Table A8: Merit: Effects on Child's Expected Welfare (Scaled)

Merit	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	-14.7	31.4	30.8	94.9
Q1	-14.0	46.1	13.1	85.3
Q2	-14.9	33.4	28.0	90.3
Q3	-15.7	20.3	32.4	95.3
Q4	-15.0	12.5	31.7	99.0

Table A9: Equity: Effects on Child's Expected Welfare (Scaled)

Equity	Province ℓ		Province h	
	CE%	% Better Off	CE%	% Better Off
Overall	2.1	31.4	–3.0	94.9
Q1	.3	46.1	4.8	85.3
Q2	2.1	33.4	3.1	90.3
Q3	4.0	20.3	-1.7	95.3
Q4	4.3	12.5	-5.9	99.0

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