Migration Restrictions: Implications on Human Capital, Output, and Welfare*

Jingchao Li†, Byoung Hoon Seok‡, and Hye Mi You§

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Abstract

This paper quantifies the effect of eliminating internal migration restrictions on Chinese output and welfare in the presence of endogenous human capital. Removing restrictions on rural-to-urban migration reallocates capital and labor more efficiently, yet it increases the opportunity cost of schooling. This discourages rural agents from acquiring more education. Using a general equilibrium model with migration decisions and endogenous human capital, eliminating these restrictions increases total output by 5.6%, and consumer welfare by 41%. The role of endogenous human capital is found to be crucial in this result.

Keywords: Migration, Human Capital, Welfare Analysis, China
JEL Classifications: I2, O1, R1

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† School of Business, East China University of Science and Technology, Email: jingchaoli@ecust.edu.cn

‡ Corresponding Author: Department of Economics, Ewha Womans University, Email: bhseok@ewha.ac.kr

§ Corresponding Author: College of Economics and Finance, Hanyang University, Email: hyemiyou@hanyang.ac.kr

1 Introduction

Recent literature shows that low productivity in developing countries can be largely attributed to resource misallocation (Banerjee and Duflo (2005); Restuccia and Rogerson (2008); Bartelsman, Haltiwanger, and Scarpetta (2013); Restuccia and Rogerson (2013))—China is not an exception. Hsieh and Klenow (2009) and Song, Storesletten, and Zilibotti (2011) show that reallocating capital from low- to high-productivity production units substantially increases efficiency in China.[1] We revisit China's allocation issues, but focus on its unique migration policy, which restricts rural-to-urban migration. China has a household registration system called the *hukou system*. The hukou system classifies residents as rural or urban to regulate changes in their permanent residences. Under this system, rural individuals require an entry permit to migrate to a city. Once rural agents move to a city, they have limited access to public services such as health insurance, public education, and housing that are otherwise available to urban hukou owners. In this study, we explore the effect of eliminating these hukou restrictions on China's output, earnings inequality, and welfare.

A novel feature of this study is that we quantify the distortionary effect of hukou restrictions by allowing for endogenous human capital accumulation through schooling. We expect the elimination of hukou restrictions to increase the allocation efficiency of capital and labor between rural and urban areas, thus leading to potentially large efficiency gains. Extant literature has largely ignored the established effect of hukou restrictions on incentives to invest in human capital. If such restrictions are eliminated, rural agents will face larger long-term gains from migration. This increases the opportunity cost of schooling for rural

[1] Hsieh and Klenow (2009) claim that a hypothetical reallocation of capital and labor that is comparable to the U.S. economy increases the manufacturing total factor productivity (TFP) of China by more than one-third its value. According to Song, Storesletten, and Zilibotti (2011), about 70% of China's recent TFP growth is attributable to the reallocation of factor inputs along with financial development. Song, Storesletten, and Zilibotti (2011) focus on financial imperfections in China, where less efficient state-owned firms have better access to credit markets than more efficient entrepreneurial firms.

agents, causing them to leave school and migrate to urban areas earlier, which, in turn, depresses the aggregate human capital, and hence the aggregate output eventually. Any research that neglect this endogenous human capital channel may overstate the efficiency gain from eliminating hukou restrictions

To separately identify these two effects, we build a two-sector general equilibrium model of rural-to-urban migration with endogenous human capital. We incorporate hukou restrictions in this model in the form of the migration flow cost, which captures migrants' limited access to social services that are otherwise available to urban hukou owners. Our model economy is calibrated to the 2008 Chinese economy. We then implement a counterfactual exercise by removing the migration flow cost and quantify its impact on output, inequality, and welfare. We further conduct a decomposition analysis by shutting down endogenous human capital to quantitatively understand its importance in the main result.

Our results show that eliminating hukou restrictions increases the aggregate output by 5.58%. If we shut down endogenous human capital, the output gain from more efficient allocation of capital and labor increases to 18.34%. If consumers adjust their educational choices without hukou restrictions, rural hukou owners leave school earlier to enter rural or urban labor markets. Contrariwise, urban hukou owners obtain more education. As capital and labor move from rural to urban areas, the supply of rural goods declines, which increases their relative price. Without accumulating more human capital through schooling, urban hukou owners cannot afford enough rural goods consumption. This endogenous response of human capital to the removal of hukou restrictions reduces the output gain down to 5.58%.

We also find that eliminating hukou restrictions increases consumer welfare by 41.06% in the presence of endogenous human capital. The lifetime consumption of rural hukou owners increases by 53.88%, since rural residents benefit from the increased price of rural goods, and hence the rural wage, while migrants enjoy the full cut of the flow cost. However, urban hukou owners suffer from a 1.97% decline in their lifetime consumption because of more expensive rural goods. If we shut down endogenous human capital, the total welfare gain drops to 27.42% despite the larger output gain. About one-fifth of the gain in the welfare of

rural hukou owners is attributable to endogenous human capital. Endogenous educational choice is even more important for urban hukou owners' welfare. If urban hukou owners cannot adjust their educational choices, their welfare declines by 22.81%. Lastly, allowing migrants full access to social benefits in urban areas helps achieve a more equal distribution of earnings. Removing hukou restrictions reduces the wage gap between rural and urban areas, decreasing the Gini coefficient of earnings by 10% to 13%.

This study is a part of the literature on the hukou system's macroeconomic implications. Dollar and Jones (2013) explain China's high saving and investment rates using the hukou system. They argue that the hukou system weakens workers' bargaining power over wages, thus lowering the labor share while increasing firm savings, as we too observe in China. Garriga, Tang, and Wang (2017) study the impact of this system on China's housing market. They claim that increased rural-to-urban migration caused by relaxed hukou restrictions also increased the demand for urban housing, and hence contributed to the recent housing boom in China. Tombe and Zhu (2019) quantify the effect of declines in trade and migration costs on the recent growth in China's aggregate labor productivity. Bond, Riezman, and Wang (2015) measure the importance of trade liberalization and migration cost reduction to China's growth and urbanization over the past few decades. Our study also enriches the literature by quantifying the efficiency and welfare gains from eliminating these restrictions in the presence of endogenous human capital. Similarly, Whalley and Zhang (2007) measure the efficiency gains from removing these restrictions, although they focus on its effect on income and wealth inequality in China. On the other hand, we endogenize human capital accumulation and migration decisions of agents in the presence of an explicit channel through which labor mobility is restricted. In our study, the removed hukou restrictions have important effects on the human capital accumulation of all types of agents. This significantly reduces the output gain from reallocation of labor and capital.

Many empirical micro-studies have examined the hukou system's effect on the educational attainment of rural youth and migrants' economic outcomes in China. Zhao (1997) shows that schooling increases the possibility of migration to urban areas, claiming that this

positive relationship can explain why schooling rates are high in rural areas, although returns to schooling are low. Contrariwise, de Brauw and Giles (2008) show that migration opportunities discourage middle school graduates from enrolling in high school in rural China. Démurger, Gurgand, Li, and Yue (2009) and Liu (2005) find that the hukou system lowers rural migrants' educational attainments by restricting their access to quality education. This relationship creates an earnings difference between urban hukou owners and migrants. Our study is motivated by the research outlined so far—it explores the effect of removing migration restrictions on output and welfare through endogenous education decisions.

The remaining paper is organized as follows. We provide a brief overview of the hukou system in China in section 2. We introduce our model in section 3 and calibrate the model in section 4. In section 5, we present the main quantitative results, and then discuss the implication of eliminating hukou restrictions on welfare and earnings inequality in section 6. We conclude the study in section 7.

2 The hukou system

The hukou system in China was introduced as a registration system in the early 1950s. However, from the late 1950s onward, the Chinese government exploited this system to restrict migration from rural to urban areas in response to burgeoning rural-to-urban migrantion. Under this system, there are two types of hukou: agricultural (rural) and non-agricultural (urban). A citizen's hukou type determines her/his eligibility for public services. For instance, non-agricultural hukou owners are entitled to state benefits that include employment opportunities, subsidized housing, health care, pension, and public education, whereas agricultural hukou owners are not, because they are expected to be self-reliant. In addition, Chinese citizens are classified as local or non-local hukou according to their place of registration. Given the structure of the hukou system, rural-to-urban migration usually involves both converting an agricultural hukou to a non-agricultural one and acquiring a local hukou in the receiving cities. Before the 1980s, the most critical step in rural-to-urban migration

was changing the hukou from agricultural to non-agricultural, a process severely restricted by the central government.

Then, in 1978, Deng Xiaoping led the policies of the reform and opening-up of China, and with this, the hukou system began to change. Responding to the increased demand for labor in urban areas owing to economic development, the Chinese government reformed the hukou system to provide cheap labor for urban firms. In 1984, agricultural hukou owners were legitimately allowed to live in cities if they had employment and housing in the receiving cities. In the 1990s, agricultural versus non-agricultural hukou classification was eliminated in many cities. These reforms accompanied the localization of hukou management. During this time, the central government mostly delegated the power of hukou policies to local governments. Such reforms in the hukou system continued until the early 2000s, which relaxed limitations on rural-to-urban migration further and removed discriminatory practices against migrants in employment opportunities.

However, Chan and Buckingham (2008) argue that the reforms had little effect on ordinary rural migrants. Rather, they largely involved a power transfer from the central government to local authorities. Further, these reforms selectively benefited wealthy and high-skilled migrants. Afridia, Li, and Ren (2015) also state that most migrants still have very limited access to local social benefits and that occupational segregation still exists between migrants and urban workers, which has resulted in most migrants being forced into low-skill and low-paying occupations.

On December 2, 2014, the State Council announced new reforms in the hukou system; these reforms include abolition of the hukou system in small cities and towns, and eased restrictions in medium-sized cities. However, the reforms do not relax migration to megacities with more than five million residents; Instead, authorities will strictly control inflow of migrants to these megacities. Thus, the hukou system is still a prevailing barrier to rural-to-urban migration.

We incorporate the hukou system into our model by considering the migration flow cost. When rural agents move to a city, they bear the costs of obtaining residence or work permits

under the hukou system. These costs cannot be clearly identified from usual moving costs, such as costs of finding employment opportunities through agencies, friends, and relatives, or initial deposits for housing rental. Since the major difficulty of a non-local hukou owner in an urban area comes from limited access to urban social benefits, we model out-of-pocket expenses to cover these benefits as flow costs associated with hukou restrictions. The empirical literature reveals mixed results on whether the observed occupational segregation and wage gap between migrants and urban workers are due to their skill differences or discrimination against migrants.[2] Thus, we do not model migrants' disadvantages in the urban labor market as another type of hukou restriction.

3 Model

This section introduces our general equilibrium model of migration from rural to urban areas. We incorporate the hukou restrictions described in the previous section into our model and elaborate the problems solved by rural agents, migrants, and urban agents. We then describe the technology in this model and define the stationary competitive equilibrium.

3.1 Environment

Our model consists of two spatially separated regions: rural and urban. Capital is mobile between the two regions, yet labor mobility is restricted by the hukou system. In this economy, there are two goods: an urban firm produces urban goods and a rural firm produces rural goods. The urban good is the *numéraire*. We assume that urban goods production is more capital-intensive than rural goods production and that agents' expenditure share of urban goods is greater than that of rural goods. Given that rural residents form more than half the total population, these assumptions imply that the urban firm offers a higher

[2]Song (2014) surveys many studies and concludes that severe discrimination in wages and employment opportunities exists against migrants. However, Pakrashi and Frijters (2016) find a smaller effect of discrimination against migrants on the wage gap between urban natives and migrants compared with estimates from extant studies. Moreover, Kuhn and Shen (2015) find evidence to show that urban employers prefer migrants to urban hukou owners for certain types of jobs.

wage per unit of human capital. Since the urban wage is higher than the rural wage, rural residents seek migration to urban areas, whereas urban agents have no incentives to migrate to rural areas in our model.

We consider five agent types: rural workers (rw), rural students (rs), migrant workers (rm), urban workers (uw), and urban students (us). Rural workers, rural students, and migrant workers own the rural hukou. Whether in rural or urban area, students attend school in the current period and accumulate human capital. While in school, students incur a utility cost x_i , drawn from an area-specific distribution $N(\mu_i, \sigma_i^2)$, where $i \in \{r, u\}$. For the next period, students choose between continued education and labor market entry. Urban students attend an urban school and enter the urban labor market after completing education. On the other hand, rural students attend a rural school in the current period, and for the next period, choose between continued schooling in a rural school, entering the rural labor market, and entering the urban labor market as a migrant. If a rural student chooses to migrate to an urban area in the next period, she/he pays a one-time moving cost, τ. Regardless of type, once agents leave school, they never return to school for more education.

Rural workers earn labor income by supplying labor to the rural firm; they choose between staying in the rural area and migrating to the urban area for the next period. A rural worker's labor income is the product of wage per efficiency unit of labor offered by the rural firm and her/his human capital stock. A migrant worker pays a migration flow cost of ψ (representing hukou restrictions) in every period and stays in the urban area indefinitely because return migration is not allowed.[3] Urban workers also stay in urban areas for as long as they survive. The human capital stocks of migrant and urban workers are perfectly substitutable for the urban firm's production, and hence the urban wage applies to both human capital stocks.

The initial period in an agent's life in the model corresponds to age 13 with 7 years of

[3]Return migration had received scarce attention in the literature until recently, mainly because good Chinese data on return migration were unavailable. As more data on rural migrants have become available, the effects of returnees on their origin communities and rural-to-urban migration patterns have also become worthy of more exploration.

education in real life. In each period, agents face a survival probability of $\lambda \in (0,1)$, which implies that a fixed fraction, $1-\lambda$, of the population is replaced by newborn agents. Agents are endowed with one unit of time in each period, and leisure is not valued. Agents enjoy utility flows from consumption of rural and urban goods, and they discount future utility with a discount factor $\beta \in (0,1)$. Agents trade a risk-free asset and are allowed to borrow up to ϕ. Finally, unclaimed assets of dying agents are collected and redistributed equally to all agents in a lump-sum transfer, T.

3.2 Urban agents

An urban agent who works in the urban labor market supplies one unit of time and earns $w_u h$ as her/his labor income, where w_u is the real wage per efficiency unit of the labor offered by the urban firm. Urban workers continue to stay in the urban area and work for the urban firm. We write an urban worker's problem as follows—

$$V(uw, x_u, a, h) = \max_{\{c_r, c_u, a'\}} \left[u(c_r, c_u) + \beta\lambda V(uw, x_u, a', h)\right]$$

subject to

$$\begin{aligned} p_r c_r + c_u + a' &= (1+r)a + w_u h + T; \\ a' &\geqslant -\phi, \end{aligned}$$

where c_r and c_u are rural and urban goods consumption, respectively; p_r is the relative price of rural goods; a is a risk-free asset; and r is the real interest rate on the risk-free asset.

Before entering the urban labor market, an urban student accumulates human capital, h, by attending school. The law of motion for human capital is given by $h' = \exp(\theta) \cdot h$ based on Caselli (2005). There is no tuition for schooling, and yet urban students incur x_u utility cost of schooling per period while in school. An urban student decides whether to continue schooling or enter the urban labor market in the next period. Thus, we write an urban student's problem as follows—

$$V(us, x_u, a, h) = \max_{\{c_r, c_u, a', h'\}} \{u(c_r, c_u) - \exp(x_u) + \beta\lambda \max\left[V(us, x_u, a', h'), V(uw, x_u, a', h')\right]\}$$

subject to

$$\begin{aligned} p_r c_r + c_u + a' &= (1+r)a + T; \\ h' &= \exp(\theta) \cdot h; \\ a' &\geqslant -\phi. \end{aligned}$$

3.3 Migrants

Since migrants incur additional expenditures due to limited access to urban social services for as long as they live in urban areas, we introduce the migration flow cost, ψ. We then write a migrant's value function as follows—

$$V(rm, x_r, a, h) = \max_{c_r, c_u, a'} \{u(c_r, c_u) + \beta\lambda V(rm, x_r, a', h)\}$$

subject to

$$\begin{aligned} p c_r + c_u + a' + \psi &= (1+r)a + w_u h + T; \\ a' &\geqslant -\phi, \end{aligned}$$

where w_u is the real wage per efficiency unit of labor for migrants offered by the urban firm.

3.4 Rural agents

A rural worker supplies one unit of time and receive $w_r h$ as her/his labor income, where w_r is the real wage per efficiency unit of labor offered by the rural firm. For the next period, a rural worker chooses either to stay in the rural labor market or migrate to an urban area. We can write a rural worker's value function as follows—

$$V(rw, x_r, a, h) = \max_{\{I, c_r, c_u, a'\}} \{u(c_r, c_u) + \beta\lambda \max\left[V(rw, x_r, a', h), V(rm, x_r, a', h)\right]\}$$

subject to

$$\begin{aligned} p_r c_r + c_u + a' + \tau I &= (1+r)a + w_r h + T; \\ a' &\geqslant -\phi, \end{aligned}$$

where $I = 1$ if $V(rm, x_r, a', h) > V(rw, x_r, a', h)$ or $I = 0$ otherwise.

A rural student accumulates human capital, h, by attending school. The law of motion for human capital for rural students is the same as that for urban students. Rural students also bear a utility cost of x_r for each year in school. A rural student has three options available for the next period: she/he chooses to continue schooling in the rural area; she/he enters the rural labor market; or she/he migrates to the urban to enter the urban labor market. We write a rural student's problem as follows—

$$\begin{aligned} V(rs, x_r, a, h) = \max_{\{I, c_r, c_u, a', h'\}} &\{u(c_r, c_u) - \exp(x_r) \\ &+ \beta\lambda \max\left[V(rs, x_r, a', h'), V(rw, x_r, a', h'), V(rm, x_r, a', h')\right]\} \end{aligned}$$

subject to

$$\begin{aligned} p_r c_r + c_u + a' + \tau I &= (1+r)a + T; \\ h' &= \exp(\theta) \cdot h; \\ a' &\geqslant -\phi, \end{aligned}$$

where $I = 1$ if $V(rm, x_r, a', h') > \max[V(rs, x_r, a', h'), V(rw, x_r, a', h')]$ or $I = 0$ otherwise.

3.5 Firms

In this economy, the rural firm produces rural goods and the urban firm produces urban goods. The former represents agricultural goods, while the latter, manufactured goods. Given market prices r, w, and p_r,[4] the rural firm employs capital, K_r, and rural labor, H_r, in

[4] As per the model, if more rural agents move to urban areas, agricultural production reduces, and the relative price of rural goods increases. This price change also represents a variety of costs that urban residents should bear with an increase in rural-to-urban migration, such as, congestion and housing bubbles in the urban area.

competitive markets to produce rural goods. We write the rural firm's profit maximization problem as follows—

$$\max_{\{K_r,H_r\}} \left[p_r Y_r - w_r H_r - (r+\delta)K_r\right],$$

where $Y_r \equiv z_r K_r^{\kappa} H_r^{1-\kappa}$, z_r is the total factor productivity (TFP) of the rural firm, and $H_r = \int h dG(rw, x_r, a, h)$. The optimal choice of factor inputs by the rural firm implies that

$$r + \delta = p_r z_r \kappa (K_r/H_r)^{\kappa-1},$$

$$w_r = p_r z_r (1-\kappa)(K_r/H_r)^{\kappa}.$$

The urban firm uses capital, K_u, and two types of labor, H_u and H_m, supplied by urban workers and migrant workers, respectively. These two types of labor are perfectly substitutable when producing urban goods. We write the urban firm's problem as follows—

$$\max_{\{K_u,H\}} \left[Y_u - w_u H - (r+\delta)K_u\right],$$

where $Y_u \equiv z_u K_u^{\alpha} H^{1-\alpha}$, z_u is the TFP of the urban firm, $H \equiv H_u + H_m$, $H_u = \int h dG(uw, x_u, a, h)$, and $H_m = \int h dG(rm, x_r, a, h)$. Since the agricultural sector is more labor-intensive than the manufacturing sector, we assume $\kappa < \alpha$. The urban firm's profit maximization implies that

$$r + \delta = z_u \alpha (K_u/H)^{\alpha-1},$$

$$w_u = z_u (1-\alpha)(K_u/H)^{\alpha},$$

3.6 Stationary equilibrium

A recursive stationary equilibrium consists of a set of value functions, $\{V(ij, x_i, a, h)\}$; a set of agents' optimal policies, $\{c(ij, x_i, a, h), a'(ij, x_i, a, h), h'(ij, x_i, a, h)\}$; a set of aggregate inputs, $\{K_r, H_r, K_u, H\}$; a set of prices, $\{p_r, r, w_r, w_u\}$; and a distribution of agents, $G(ij, x_i, a, h)$, where $ij \in \{rs, rw, rm, us, uw\}$ and $i \in \{r, u\}$, such that:

1. Given p_r, r, w_r, and w_u, agents optimally choose $c(ij, x_i, a, h)$, $a'(ij, x_i, a, h)$, and $h'(ij, x_i, a, h)$ that are consistent with agents' problems;

2. Given $p_{r,}$ r, w_r, and w_u, firms choose K_r, H_r, K_u, and H to maximize profits;

3. The rural goods market clears:

$$\sum_{ij} \int c_r(ij, x_i, a, h) dG(ij, x_i, a, h) = Y_r;$$

4. The urban goods market clears:

$$\sum_{ij} \int \{c_u(ij, x_i, a, h) + a'(ij, x_i, a, h)\} \, dG(ij, x_i, a, h)$$
$$+ \int \tau I(rw, x_r, a, h) dG(rw, x_r, a, h) + \int \tau I(rs, x_r, a, h) dG(rs, x_r, a, h)$$
$$+ \int \psi dG(rm, x_r, a, h) = Y_u + (1 - \delta)(K_r + K_u);$$

5. Factor markets clear:

$$H_r = \int h dG(rw, x_r, a, h),$$
$$H = \int h dG(uw, x_u, a, h) + \int h dG(rm, x_r, a, h),$$
$$K_r + K_u = \sum_{ij} \int a dG(ij, x_i, a, h);$$

6. The government budget constraint is satisfied:

$$\sum_{ij} \int T dG(ij, x_i, a, h) = (1 - \lambda) \sum_{ij} \int a dG(ij, x_i, a, h);$$

7. The distribution of agents, G, is stationary.

4 Calibration

We select a set of parameters based on the literature. One period in our model is one year. The utility function is a standard constant-relative-risk-aversion function, with the unit elasticity of substitution between rural and urban goods consumption: $u(c_r, c_u) =$

$\frac{[(c_r-\chi)^{\eta}c_u^{1-\eta}]^{1-\gamma}}{1-\gamma}$.[5] The coefficient of relative risk aversion, γ, is set to 1.5, based on common estimates between 1 and 2 in the literature. The parameter of η that governs the expenditure share of agricultural goods is set to its long run value of 0.15, which is consistent with Cao and Birchenall (2013) and Cheremukhin, Golosov, Guriev, and Tsyvinski (2015). In the benchmark model, agents are not allowed to borrow, which sets the borrowing limit, ϕ, to zero. As in Cao and Birchenall (2013), we set the capital share in urban and rural goods production function, α and κ, to 0.54 and 0.25, respectively. The capital depreciation rate, δ, is set to 0.10 as Song, Storesletten, and Zilibotti (2011) do.

Another set of model parameters is calibrated by targeting relevant data moments. Our primary data sources include a household-level survey conducted by China Household Income Project at the end of 2008 (CHIP 2008), China Statistical Yearbook 2014, and China Rural Household Survey Statistical Yearbook 2010. CHIP 2008 contains three subsamples: urban households, rural households, and rural-to-urban migrants. We restrict our attention to men between the ages of 16 and 60 years, who are not self-employed and have non-missing information about educational attainment, income, and hours. The resulting samples are used to compute the distribution of educational attainments, the Mincer return to schooling, and relative earnings of each worker group. We use the remaining data sources to obtain the population shares of five agent groups. The parameter of θ, that governs the marginal return to schooling, is set to 0.0894, which is the urban Mincer return to schooling in our CHIP 2008 sample.[6] The one-time moving cost, τ, is chosen to match the ratio of the average years of schooling of migrants to those of rural workers in our sample—that is, 1.2052. The migration flow cost, ψ, is selected to match the ratio of migrants to the sum of migrants and urban hukou owners—that is, 0.4263. We choose χ, which represents the subsistence level of consumption of rural goods, by matching the ratio of agricultural output to gross domestic product (GDP) in China in 2008, which is 0.1034. Following Song, Storesletten,

[5] We assume the unit elasticity of substitution between rural and urban goods consumption as per Brandt, Hsieh, and Zhu (2008).

[6] In the 2008 CHIP rural sample, only a subset of agents is asked about their earnings. Thus, we estimate the Mincer return to schooling for the urban sample and use the estimate for calibration.

and Zilibotti (2011), the time discount factor, β, is chosen to match the annual real interest rate of 0.0175. The survival probability, λ, is chosen to match the average work life of 47 years. We normalize the TFP of the urban firm and the rural firm to 1. We then choose the mean (μ_r and μ_u) and the variance (σ_r and σ_u) of the utility cost of schooling of rural and urban agents by targeting the distribution of educational attainment in each group. Specifically, we target the share of those with up to nine years of education and of those with 10 to 12 years of education in each group. The share of the last education window is then automatically matched. Table 1 summarizes these parameter values.

5 Results

This section begins by presenting the benchmark results of our model. We then implement a counterfactual exercise in which the flow cost of migration is eliminated, and thus examine how this affects human capital and output.

5.1 Benchmark results

Our benchmark economy satisfactorily replicates the 2008 Chinese economy (Table 2). The share of urban hukou owners from the model is, by construction, the same as that in the data. The population shares of rural residents and migrants are endogenously determined in the model owing to the migration decisions of rural hukou owners. The share of rural residents and migrants from the model is 43.02% and 30.03%, respectively, which is broadly consistent with their data counterparts. The average years of schooling for rural, migrant, and urban workers also qualitatively reflect the data. In the model, migrants are positively selected from rural hukou owners—that is, migrants, on average, acquire more education than rural workers do, which is consistent with the data observations.[7] In addition, the average years of schooling of urban workers are longer than those of rural and migrant workers both in the model and in the data. Since there is no difference in the quality of education between rural

[7] However, education is not the only determinant of migration. Some of the more educated rural residents stay in rural areas because they cannot afford to pay the one-time moving cost.

and urban areas, any difference in earnings between the migrant and urban worker groups is due to differences in their human capital stocks accumulated through schooling. In the benchmark economy, migrant workers earn labor income five times more than rural workers do, while urban workers earn slightly more than migrant workers do. The sizable earnings gap between rural workers and migrants can be attributed to the higher wage rate per efficiency unit of labor in the urban area compared with the rural wage. The urban wage is 2.7562, which is 4.7 times the rural wage of 0.5906 (Table 3). The remaining difference in earnings between rural workers and migrants is due to the difference in their human capital stocks. In contrast, the earnings gap between migrants and urban workers is solely attributable to their human capital differences. In the benchmark economy, the relative price of rural goods is 0.6922 and the real interest rate is 0.0172.

Moreover, the mobile capital input is concentrated in the urban firm (Table 4). The urban firm employs 96.4% of the aggregate capital stock, while the remaining 3.6% is adopted by the rural firm. In contrast, labor input is more equally distributed between the rural and the urban firm. The urban firm employs 61.93% of the aggregate labor input measured in efficiency unit. Based on this allocation of capital and labor, the value of rural goods produced by the rural firm forms 7.47% of the aggregate output, while the urban firm is responsible for the remaining 92.53%.

5.2 Eliminating hukou restrictions

This subsection discusses the effect of the removed hukou restrictions on the economy. The major cost of migration in the real world is associated with migrants' limited access to social benefits in a city, which is captured by the migration flow cost in our model. In the benchmark model, the flow cost (ψ) is almost one-third the average migrant earnings. What if the government removes this migration flow cost? Table 5 summarizes how this policy affects the model economy.

If migrants do not have to pay the flow cost, their life becomes more beneficial, which facilitates rural-to-urban migration. The population share of migrants increases from 30.03%

in the benchmark economy to 37.26%, which reduces the rural population share by the same amount. Since the long term gain from migration increases with the removed flow cost, the opportunity cost of schooling increases. Consequently, rural agents leave school and migrate to urban areas earlier than they do in the benchmark model. The average years of schooling for migrants decline from 10.99 years in the benchmark model to 10.13 years in this experiment. The large inflow of migrants into the urban area increases the marginal product of capital, bringing more capital to the urban firm.

On the other hand, as more labor moves from rural to urban areas, the relative price of more labor-intensive rural goods increases by 45.27%. This accompanies a 64.67% increase in the rural wage, compared with the benchmark model. In response to the increased rural wages, rural students also shorten their years of schooling and enter the rural labor market earlier than in the benchmark model. Thus, the average years of schooling for rural workers are reduced to 9.29 years. Meanwhile, the hike in the relative price of rural goods causes urban workers to obtain more education. Without accumulating more human capital through schooling, urban workers cannot afford enough rural goods consumption. Consequently, the average years of schooling for urban workers increase from 11.42 years in the benchmark model to 12.15 years in this experiment. This increases the education gap between migrants and urban workers. Hence, the average earnings of urban workers, relative to those of migrants, increase by 16.55%, compared with the benchmark model.

Eliminating hukou restrictions facilitates more efficient allocation of labor between rural and urban firms, leading to more active capital accumulation. Since rural goods production is more labor intensive, the lost rural labor is replaced by a larger increase in the rural capital, although the rural output still declines by 11.14%. The urban firm's labor input increases by 10.82% because of more migrants and increased human capital stocks from urban workers. This, combined with the same increase in the urban capital, marginally changes the urban wage. The urban firm, using the increased capital and labor, produces 11.15% more output, compared with the benchmark economy. The aggregate capital increases by 12.08%, which reduces the real interest rate marginally. Contrariwise, the aggregate labor input reduces

because the decline in human capital stocks supplied by both rural workers and migrants is larger than the increase in human capital stock supplied by urban workers. However, the effect of more efficient allocation of resources and increased capital stocks on the aggregate output is dominant—that is, the aggregate output increases by 5.58% if hukou restrictions are removed.[8]

5.3 The role of endogenous human capital

The counterfactual experiment shows that, if the migration flow cost is eliminated, the level and the distribution of human capital stocks across worker groups change significantly. If this endogenous human capital channel is shut down, how would the result change? To answer this question, we consider a model economy where hukou restrictions are eliminated, but no agents can adjust their educational attainments. More specifically, the students leave school as hukou restrictions are eliminated, and both workers and students are distributed according to the human capital distribution in the benchmark model. We compare this economy with what we obtained from the previous counterfactual experiment so as to identify the role of endogenous human capital in the effect of eliminating hukou restrictions.

Table 6 indicates that eliminating hukou restrictions with exogenous human capital facilitates rural-to-urban migration even more than in the endogenous human capital case. The population share of migrants increases to 43.27%. Note that migrants are positively selected from the education distribution of rural hukou owners. Given the education distribution, more migration implies that the average years of schooling for migrants declines.

[8] In this model, the urban goods are the *numéraire*, and the relative price of rural goods is denoted by p_r. When we conduct counterfactual experiments, the price level of the model economies varies. To compare the real output of different model economies correctly, we calculate the GDP deflator and divide the total output of each model economy by the deflator. By solving the following problem, we obtain the GDP deflator of the model economy:

$$P = \min_{c_u, c_r} \{c_u + p_r c_r\}$$
$$\text{s.t.} \quad (c_r - \chi)^{\eta} c_u^{1-\eta} = 1.$$

Thus, the GDP deflator is $P = \frac{p_r^{\eta}}{\eta^{\eta}(1-\eta)^{1-\eta}} + \chi p_r$.

The average years of schooling for migrants declines to 10.67 years with exogenous human capital, relative to the benchmark model. The average years of schooling for rural workers also decline marginally. The exodus of rural residents to urban areas challenges rural goods production, which then increases the relative price of rural goods by 46.72%. This causes the rural wage to soar up by 83.05%, more than in the presence of endogenous human capital. This large increase in the rural wage is attributable to the lack of an endogenous human capital channel. If human capital is endogenous, rural agents would have left school earlier to pursue higher rural wages. Thus, the rural wage would not have increased this much.

Without hukou restrictions, more efficient allocation of capital and labor follows. With an even larger inflow of migrants to the urban area, the labor input employed by the urban firm increases by 25.67%, more than in the endogenous human capital case. This attracts more capital to the urban firm, which increases the urban capital by 27.29%. In the rural area, the larger increase in the rural wage causes the rural firm to substitute capital for labor more, adopting 44.64% more capital, compared with the benchmark model. Thus, the drop in the rural output is slightly less compared with the endogenous human capital case. In sum, aggregate capital and labor inputs increase by 27.91% and 7.73%, respectively. This leads to a 18.34% increase in the aggregate output in the exogenous human capital case relative to the benchmark economy. We find that the endogenous human capital channel is quantitatively important, which reduces the efficiency gain down to 5.58%. Without considering this channel, one may overstate the output gain from eliminating hukou restrictions.

6 Implications on welfare and inequality

In this section, we discuss the implications of eliminating hukou restrictions on welfare and inequality.

6.1 Welfare analysis

This section proceeds by reporting welfare gains or losses from the removed hukou restrictions. The welfare changes are calculated as percentage changes in per-period consumption that we should give to agents in the benchmark model such that agents are indifferent between the benchmark model and counterfactual experiments. As Table 7 reports, eliminating hukou restrictions generates welfare gains with and without endogenous human capital. If the migration flow cost is removed from the benchmark economy, the welfare gain amounts to 41.06%. Rural hukou owners are better off, as their lifetime consumption increases by 53.88%. Rural residents enjoy higher rural wages and migrants benefit from the full cut of the flow cost. In contrast, urban hukou owners bear a small welfare loss due to the increase in the relative price of rural goods. To examine how much of these welfare changes are due to endogenous human capital, we compute the welfare changes with exogenous human capital.

About one-quarter of the welfare gain among rural hukou owners is attributable to endogenous human capital. Both migrants and rural workers enjoy more welfare gain by leaving school and entering rural or urban labor markets earlier if hukou restrictions are eliminated. The endogenous human capital is even more important for urban hukou owners. If urban workers were not able to obtain more education, they would have received far lesser earnings despite the large increase in the cost of living. This would have been a decline in their lifetime consumption by more than 20%. By limiting the degree of freedom of consumers by shutting down the endogenous human capital channel, the average welfare gain from eliminating hukou restrictions is reduced to 27.42%, compared with 41.06% in the presence of endogenous human capital. Thus, more output gains do not necessarily guarantee larger welfare gains.

6.2 Implications on inequality

Our model has important implications on earnings inequality. Restrictions on internal migration lead to a large income gap across regions. If these restrictions are removed, agents

will move to a region with better income prospects, which eliminates variations in income across regions unless there are moving costs. In our model, the hukou system functions as an obstacle for rural agents migrating to the urban area, and contributes to the rural-urban divide in wages and earnings. If the migration flow cost is eliminated, the inequality in cross-sectional earnings reduces substantially. In Table 8, we present the earnings Gini coefficients for the counterfactual experiments in this study.

Eliminating the migration flow cost reduces earnings inequality significantly, and the Gini coefficient drops by 13.17%, compared with the benchmark result. This large drop is mainly attributable to a reduction in the gap between the rural and the urban wage. After the flow cost is removed, the education gap between urban and rural hukou owners increases significantly. The reduced wage gap between these workers dominates the difference in their educational attainments, which improves the earnings inequality. If we shut down the endogenous human capital channel, the earnings inequality still improves, although the change only marginally. Without endogenous human capital, eliminating hukou restrictions barely changes the education gap between urban and rural hukou owners, while reducing the rural and urban wage gap. Consequently, the earnings Gini coefficient declines by 10.02%, compared with the benchmark model.

7 Conclusion

In this paper, we study the distortional effect of China's unique migration policy under the hukou system. We view the hukou system as a barrier to migration between rural and urban areas in China, and thus attempt to quantify the effect of eliminating them on China's output, inequality, and welfare. If migrations restrictions are removed, potentially large efficiency gains are expected owing to the more efficient allocation of capital and labor. However, these restrictions also affect incentives to invest in human capital through schooling. Removing migration restrictions may encourage rural agents to leave school and move to urban areas earlier. This may depress aggregate human capital and output. To address these two effects,

we explore the effect of eliminating hukou restrictions in the presence of endogenous human capital.

We build a two-sector general equilibrium model with migration decisions and endogenous human capital accumulation through schooling. Our model incorporates hukou restrictions in the form of migration flow costs incurred as long as a migrant resides in the urban area. We calibrate this economy to the 2008 Chinese economy, and then conduct a counterfactual exercise by eliminating the flow cost in this model. Using the result, we examine how eliminating hukou restrictions affect migration patterns, educational attainments, aggregate output, and consumers' welfare with and without endogenous human capital.

We find that removing the flow cost increases the aggregate output by 5.58% and consumers' welfare by 41.06%. Abolishing hukou restrictions allow us to allocate capital and labor across regions more efficiently, while encouraging rural hukou owners to leave school earlier. The latter effect is large: without endogenous human capital, the aggregate output increases by 18.34%, while consumer welfare increases by 27.42%. Removing the hukou restrictions also helps achieve a more equal distribution of earnings. Cutting the flow cost of migration reduces the earnings Gini coefficient by 13.17% and 10.02% with and without endogenous human capital, respectively.

In this study, we focus on hukou restrictions as a main barrier to rural-to-urban migration and thus quantify the effect of abolishing the restrictions on output, inequality, and welfare. Exploring other issues related to the hukou system, such as migration decisions with family members left behind in the home village, migration with school-age children, and various factors affecting return migration, would have important policy implications too. We leave these issues for future research.

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Table 1: Parameterization

Parameter	Target or Source
$\gamma = 1.5$	Intertemporal elasticity of substitution of 0.67
$\eta = 0.15$	Cao and Birchenall (2013); Cheremukhin, Golosov, Guriev, and Tsyvinski (2015)
$\phi = 0$	No borrowing is allowed
$\alpha = 0.54$	Cao and Birchenall (2013)
$\kappa = 0.25$	Cao and Birchenall (2013)
$\delta = 0.1$	Song, Storesletten, and Zilibotti (2011)
$\theta = 0.0894$	Urban Mincer return to schooling
$\tau = 22.4492$	The average years of schooling of migrants relative to rural workers of 1.2052
$\psi = 1.3011$	The share of migrants out of urban residents of 0.4263
$\chi = 0.0425$	Agricultural output to GDP ratio of 0.1034
$\beta = 1.0051$	Annual real interest rate: 0.0175
$\lambda = 0.9787$	Average length of work life: 47 years
$z_u = z_r = 1$	Normalization
$\mu_r = 2.7626$	Share of rural hukou owners with up to 9 years of education: 0.8135
$\sigma_r = 1.8384$	Share of rural hukou owners with 10 to 12 years of education: 0.1596
$\mu_u = -11.2599$	Share of urban hukou owners with up to 9 years of education: 0.2442
$\sigma_u = 10.9156$	Share of urban hukou owners with 10 to 12 years of education: 0.3577

Table 2: Benchmark Results

	Population Share (%)		Avg. Yrs. of Schooling		Earnings ($w\overline{h}$)	
	Data	Model	Data	Model	Data	Model
Rural	53.01	43.02	7.74	9.86	..	0.88
Migrant	20.03	30.03	9.33	10.99	20,408	4.57
Urban	26.96	26.96	12.10	11.42	31,148	4.67

Note: Earnings in the data is denominated in 2008 Chinese Yuan. In the CHIP2008, only a subset of rural workers were asked about their earnings, so we do not present them here as the average earnings of rural workers.

Table 3: Prices in the Benchmark Economy

	w_r	w_u	p_r	r
Value	0.5906	2.7562	0.6922	0.0172

Table 4: Inputs and Outputs in the Benchmark Economy

	Capital Input K (Share)		Labor Input H (Share)		Output (Share)	
Rural	0.94	(3.61%)	0.56	(38.07%)	0.44	(7.47%)
Urban	25.07	(96.39%)	0.91	(61.93%)	5.46	(92.53%)
Total	26.01	(100.00%)	1.47	(100.00%)	5.90	(100.00%)

Table 5: The Effects of Eliminating Hukou Restrictions

Panel (a) Population Share and Schooling

	Population Share (%)		Avg. Years of Schooling	
	BM	No Flow Cost	BM	No Flow Cost
Rural	43.02	35.78	9.86	9.29
Migrant	30.03	37.26	10.99	10.13
Urban	26.96	26.96	11.42	12.15

Panel (b) Wages, Earnings, and Price

	BM	No Flow Cost (Change, %)
w_r	0.59	0.97 (64.67)
w_u	2.76	2.76 (0.30)
$\frac{w_u\overline{h_u}}{w_u\overline{h_m}}$	1.02	1.19 (16.55)
p_r	0.69	1.01 (45.27)
r	0.0172	0.0172 (−0.06)

Panel (c) Input and Output Change Relative to BM (%)

	No Flow Cost		
	Capital	Labor	Output
Rural	29.41	−21.61	−11.14
Urban	11.43	10.82	11.15
Total	12.08	−1.52	5.58

Table 6: The Role of Human Capital in the No Flow Cost Case

Panel(a) Population Share and Schooling

	Population Share (%)			Avg. Years of Schooling		
	BM	End. HC	Exo. HC	BM	End. HC	Exo. HC
Rural	43.02	35.78	29.77	9.86	9.29	9.82
Migrant	30.03	37.26	43.27	10.99	10.13	10.67
Urban	26.96	26.96	26.96	11.42	12.15	11.42

Panel (b) Earnings and Price

	BM	Endogenous HC (Change, %)	Exogenous HC (Change, %)
w_r	0.59	0.97 (64.67)	1.08(83.05)
w_u	2.76	2.76 (0.30)	2.78(0.69)
$\frac{w_u\overline{h_u}}{w_u\overline{h_m}}$	1.02	1.19 (16.55)	1.03(1.10)
p_r	0.69	1.01 (45.27)	1.01(46.72)
r	0.0172	0.0172 (-0.06)	0.0170(-0.99)

Panel (c) Input and Output Change Relative to BM (%)

	Endogenous HC			Exogenous HC		
	Capital	Labor	Output	Capital	Labor	Output
Rural	29.41	-21.61	-11.14	44.64	-21.44	-8.49
Urban	11.43	10.82	11.15	27.29	25.67	26.54
Total	12.08	-1.52	5.58	27.91	7.73	18.34

Table 7: Welfare Change (Unit: % Change in Per-Period Consumption)

	End. HC	Exo. HC
Rural Hukou	53.88	41.87
Urban Hukou	−1.97	−22.81
Total	41.06	27.42

Table 8: Earnings Inequality

	BM	End. HC (Change)	Exo. HC (Change)
Gini Coef.	0.2791	0.2423 (−13.17%)	0.2511 (−10.02%)