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

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Preliminary

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Abstract

This paper studies the effects of rural-to-urban migration restrictions on human capital, output and welfare in China. We build a general equilibrium model with an explicit migration decision of rural residents, where urban firms are more productive than rural firms. The migration restrictions are incorporated into our model in the form of both a migrant-hiring fee imposed on urban firms and fixed costs of migration. Reducing either type of restrictions promotes both rural-to-urban migration and human capital accumulation of migrants. This also causes capital to move from rural to urban firms, contributing to efficiency gains in production. We find that a decline in the migrant-hiring fee by half accompanied by an equivalent reduction in the fixed cost of migration for work increases total output and welfare by 4.69% and 6.20%, respectively. This policy also reduces rural-urban inequality, decreasing the Gini coefficient of earnings by 9.26%.

Keywords: Migration Restrictions, Resource Misallocation, Welfare Analysis, China
JEL Classifications: I2, O1, R1

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1 Introduction

A recent literature argues that resource misallocation contributes largely to low productivity in developing countries (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) claim that a hypothetical reallocation of capital and labor comparable to the U.S. economy increases the manufacturing total factor productivity (TFP) of China by more than one third. Song, Storesletten, and Zilibotti (2011) point out financial imperfections in favor of state-owned enterprises with low productivity in China, suggesting large efficiency gains from a reduction in the financial frictions. In this paper, we explore restrictions on rural-to-urban migration in China as another source of economic inefficiency and quantify their effects on human capital, output, and welfare.

To this aim, we build a general equilibrium model with an explicit rural-to-urban migration decision, where urban firms are more productive than rural firms. The restrictions on rural-to-urban migration in China, so-called the Hukou restrictions, are incorporated into our model in the form of both a migrant-hiring fee imposed on urban firms and fixed costs of migration paid by migrants. The migrant-hiring fee lowers wages of migrant workers relative to otherwise the same urban workers, as we observe in the data. The fixed costs of migration capture costs incurred by migrants due to the Hukou restrictions such as limited access to social insurance and discriminatory practices against migrants, as well as usual moving costs. By reducing either type of restrictions, we study how incentives to invest in human capital change, how resources are reallocated between rural and urban firms, and how aggregate output and welfare are affected.

The migration restrictions keep labor from being efficiently allocated across regions while distorting agents' incentives to invest in human capital. A reduction in the migrant-hiring fee raises migrant wages, increasing the expected return to migration above relevant costs.

This results in more rural agents to move to urban area. In addition, potential rural-to-urban migrants have an incentive to spend more time in school because the expected rate of return to human capital conditional on migration rises. The labor reallocation combined with the increased human capital accumulation by migrants lead to capital reallocation from rural to urban firms (or low productivity to high productivity firms), ultimately increasing the aggregate output. On the other hand, a decline in the fixed costs of migration affects the cost side of migration, holding the benefits. A lower fixed cost of migration makes migration affordable to more rural agents, promoting rural-to-urban migration. It also raises the expected rate of return to migrants' human capital net migration cost, encouraging human capital accumulation of potential migrants.

Our model implies that these channels are quantitatively important for future development of China. We find that cutting the migrant-hiring fee by half accompanied by an equivalent reduction in the fixed cost of migration for work increases total output and welfare by 4.69% and 6.20%, respectively. Relaxed Hukou restrictions also help achieve a more equal distribution of earnings across regions, decreasing the Gini coefficient of earnings by about 10%.

This paper is a part of a literature on macroeconomic implications of the Hukou system. Dollar and Jones (2013) attempt to explore the Hukou system as a potential explanation for China's high saving and investment rates. They argue that the Hukou system makes migrant workers' bargaining power over wages weak, which lowers the labor share and increases firms' savings in China. According to them, this mechanism can ultimately generates high saving and investment rates observed in China. Garriga, Tang, and Wang (2014) study the impact of the Hukou system on China's housing market. They claim that increasing rural-to-urban migration caused by relaxed Hukou restrictions raised demands for urban housing and hence contributed to a recent housing boom in China. Tombe and Zhu (2015) attempt to quantify the effects of reductions in international and internal trade costs and in migrations costs on recent growth in China's aggregate labor productivity. Bond, Riezman, and Wang (2015) measure how important trade liberalization and migration cost reduction

have been in China's growth and urbanization for the past few decades. Our study adds to the literature by examining specific frictions that restrict rural-to-urban migration in China and providing a measure of efficiency and welfare gains from a reduction in these frictions. Whalley and Zhang (2007) also measure efficiency gains from eliminating the Hukou restrictions, although their main goal is to explore the Hukou restrictions as a source of income and wealth inequality in China. Our contribution relative to their work is that we endogenize human capital accumulation and migration decision of agents in the presence of two explicit channels through which labor mobility is restricted. The Hukou restrictions have important effects on human capital accumulation of migrants, which amplifies the efficiency gain from labor reallocation. We further explore the welfare implications of the policy change unlike other studies.

There are also many empirical micro studies on the impacts of the Hukou system on educational attainment of youth in rural area and migrants' economic outcomes in China. Zhao (1997) shows that schooling raises the possibility of migration to urban areas and claims that this positive relationship between schooling and migration can explain why the schooling rates are high in rural areas although returns to schooling are low. Démurger, Gurgand, Li, and Yue (2009) and Liu (2005) find that the Hukou system lowers rural migrants' educational attainment by restricting their access to quality education and this generates earnings differences between urban residents and rural migrants. Our paper is motivated by these studies and explores the impact of various policies mitigating migration restrictions on output and welfare through human capital accumulation and resource reallocation.

The remainder of the paper is organized as follows. Section 2 provides a brief overview of the Hukou system in China. We introduce our model in section 3 and present how we calibrate the model in section 4. Section 5 presents the main quantitative results and section 6 discusses implications of the mitigation of Hukou restrictions on welfare and earnings inequality. Section 7 concludes the paper.

2 The Hukou System

The Hukou system in China records the citizens' identifying information such as name, residence, and date of birth. When the system was first enacted, it was mainly used for registration purpose and did not interfere with the flow of population. However, as migrants flooded into cities for better opportunities in the late 1950s, the government implemented strict controls over rural-to-urban migration by stratifying its citizens into urban Hukou and rural Hukou in 1958. Citizens with a rural Hukou must hold an entry permit in order to migrate to cities. The Hukou system is a major barrier to rural-urban migration, causing a significant divide between rural and urban areas.

With the launch of the reform and opening-up policies initiated by Deng Xiaoping in 1978, the Hukou policy has been somewhat relaxed. In 1984, citizens with a rural Hukou were legitimately allowed to live in cities, providing cheap labor to urban firms. Since then, the Chinese government has carried out a series of Hukou system reform, aiming to improve the welfare of rural Hukou holders.

Nonetheless, migrants still have limited access to housing, medical insurance, etc. and suffer from discriminatory practices in work and education opportunities. For instance, some local governments stipulate recruiting policies that give privileges to unemployed urban Hukou owners over migrants; others set quotas on the number of migrants. Migrant workers typically receive much lower hourly wages than urban workers, and their work environment tends to be worse than urban counterparts.

3 Model

The 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. We consider three agent types, where agent type $i \in \{r, m, u\}$. An agent registered in rural area (rural Hukou owner) may fall in either a rural resident (r) or a migrant (m), depending on where they currently live. An urban agent (urban Hukou owner) is represented by u. The initial

period in agent's life in the model corresponds to age 16 in real life. Each agent draws her utility cost of attending school $x \sim N(\mu, \sigma)$, when she is born. Each type of agent may be either a student (s) or a worker (w). A student can choose between continued education and labor market entry in each period. An urban student goes to an urban school and enters urban labor market once she leaves school. A rural student also chooses between continued education and labor market entry, yet her choice is not restricted in rural area. A rural student has an option to continue education or enter labor market in urban area as well, in which case, she becomes a migrant. A rural worker is also allowed to migrate to urban area by finding a job in urban area. Regardless of agent type, once an agent leaves school, she never comes back to school. Urban and rural areas differ mainly in two dimensions: i) urban firms are more productive, offering a higher wage per unit of human capital than rural firms do; ii) the quality of education in urban schools are better than in rural schools. These two are main reasons why rural residents wish to migrate to urban areas and urban agents have no incentives to migrate to rural areas in our model.

3.1 Rural Residents

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

A rural student accumulates human capital h by attending school. The law of motion for human capital in rural area is given by $h' = h + \rho_r h^\theta$. There is no tuition for schooling, yet a rural student bears a utility cost x for each year in school. A rural student has four options available for the next period. She can continue schooling in rural area ($I_s^m = I_w^m = 0$) or enters rural labor market ($I_s^m = I_w^m = 0$). She also has an option to migrate to urban area to continue schooling ($I_s^m = 1$ and $I_w^m = 0$) or enter urban labor market ($I_s^m = 0$ and $I_w^m = 1$).

Migration is costly in that agents should pay a fixed cost of migration, which reflects not only usual costs of moving, but also other costs caused by the Hukou restrictions such as a limited access to public services in urban area. We allow the fixed cost of migration to vary by the purpose of migration. Let ψ_w and ψ_s denote a fixed cost of migration for work and schooling, respectively. A rural student's problem is then given by

$$\begin{aligned} V(r,s,x,a,h) &= \max_{I_w^m, I_s^m, c, a', h'} \{u(c) - x \\ &\quad + \beta\lambda \max\left[V(r,s,x,a',h'), V(r,w,x,a',h'), V(m,s,x,a',h'), V(m,w,x,a',h')\right]\} \end{aligned}$$

subject to

$$\begin{aligned} c + a' + I_w^m \psi_w + I_s^m \psi_s &= (1+r)a + T; \\ h' &= h + \rho_r h^\theta; \\ a' &\geqslant -\phi, \end{aligned}$$

where r is real interest rate on the risk-free asset.

A rural resident who works in rural labor market supplies one unit of time and earns $w_r h$, where w_r is the real wage per efficiency unit of labor in the rural area. In the next period, a rural worker chooses either to continue to stay in rural labor market ($I_w^m = 0$) or migrate to the urban area ($I_w^m = 1$). A rural worker's value function can be written as

$$V(r,w,x,a,h) = \max_{I_w^m, c, a'} \{u(c) + \beta\lambda \max\left[V(r,w,x,a',h), V(m,w,x,a',h)\right]\}$$

subject to

$$\begin{aligned} c + a' + I_w^m \psi_w &= (1+r)a + w_r h + T; \\ a' &\geqslant -\phi. \end{aligned}$$

3.2 Migrants

A migrant student who attends school in urban area benefits from the better quality of education, while incurring the same utility cost as in rural schools. Human capital in urban

schools accumulates through $h' = h + \rho_u h^\theta$, where $\rho_r < \rho_u$. In order to be consistent with empirical evidence on return migration in China, we assume that migrants stay in urban region with probability $\kappa \in (0,1)$. This implies that migrants return to rural region with probability $1-\kappa$ and this return migration is assumed to be costless. A migrant student's value function is defined as

$$\begin{aligned} V(m,s,x,a,h) &= \max_{c,a',h'}\{u(c) - x \\ &\quad +\beta\lambda\kappa \max\left[V(m,s,x,a',h'), V(m,w,x,a',h')\right] \\ &\quad +\beta\lambda\left(1-\kappa\right)\max\left[V(r,s,x,a',h'), V(r,w,x,a',h')\right]\} \end{aligned}$$

subject to

$$\begin{aligned} c + a' &= (1+r)a + T; \\ h' &= h + \rho_u h^\theta; \\ a' &\geqslant -\phi. \end{aligned}$$

A migrant worker continues to work as a migrant unless she returns to rural area in the next period. A migrant worker's value function is then written as

$$V(m,w,x,a,h) = \max_{c,a'}\left\{u(c) + \beta\lambda\kappa V(m,w,x,a',h) + \beta\lambda\left(1-\kappa\right)V(r,w,x,a',h)\right\}$$

subject to

$$\begin{aligned} c + a' &= (1+r)a + w_m h + T; \\ a' &\geqslant -\phi, \end{aligned}$$

where w_m is real wage per efficiency unit of labor for migrants in the urban area.

3.3 Urban Agents

An urban agent accumulates her human capital following $h' = h + \rho_u h^\theta$ as migrant students do. She incurs an utility cost of schooling x per period while in school and decides whether to continue schooling or enter urban labor market in the next period. Urban students are in

a better position to finance their education, compared to rural agents, because they have an additional source of income from the local government. The urban government imposes a fee on urban firms if they hire migrant workers. The fee introduces a friction, which lowers migrant wages relative to urban wages, and ultimately restricts the rural-to-urban migration. The fees collected by the urban government are redistributed to urban agents in the form of a lump-sum transfer T_u. An urban student's problem is given by

$$V(u,s,x,a,h) = \max_{c,a',h'} \{u(c) - x + \beta\lambda \max\left[V(u,s,x,a',h'), V(u,w,x,a',h')\right]\}$$

subject to

$$\begin{aligned} c + a' &= (1+r)a + T + T_u; \\ h' &= h + \rho_u h^{\theta}; \\ a' &\geqslant -\phi. \end{aligned}$$

Once an urban student enters urban labor market, she continues to work for an urban firm. An urban worker's problem is written as :

$$V(u,w,x,a,h) = \max_{c,a'} \{u(c) + \beta\lambda V(u,w,x,a',h)\}$$

subject to

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

where w_u is real wage per efficiency unit of labor for urban agents.

3.4 Firms

In each region, a firm's technology is given by a Cobb-Douglas production function. A rural firm hires capital K_r and labor H_r in competitive markets to produce consumption goods. The rural firm's profit maximization problem is then written as

$$\max_{K_r,H_r} z_r K_r^{\alpha} H_r^{1-\alpha} - w_r H_r - (r+\delta)K_r.$$

The optimal choice of factor inputs by a rural firm implies that

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

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

In contrast with the rural firm, an urban firm hires capital K_u and two types of workers, urban workers H_u and migrants H_m. These two types of workers are imperfectly substitutable in producing output. A typical urban firm's problem is given by

$$\max_{K_u, H_u, H_m} z_u K_u^{\alpha} H^{1-\alpha} - w_u H_u - (w_m + \upsilon) H_m - (r + \delta) K_u,$$

where $H \equiv [\chi H_u^{\eta} + (1 - \chi) H_m^{\eta}]^{\frac{1}{\eta}}$ and the elasticity of substitution is $\frac{1}{1-\eta}$. We assume that urban firms are required to pay a fee υ per efficiency unit of migrant labor. Using a survey of 118 enterprises in four cities in China, Huaibin, Knight, and Song (1999) report that 77% of enterprises paid fees to employ migrant workers and that the average recruitment fee per migrant employee equals 44% of the their average monthly wages. This fee creates a wedge between the marginal product of migrant workers' labor input and their wages, causing migrant wages to earn lower wages than otherwise the same urban workers, consistent with the data. An increase in the fee υ implies strengthened Hukou restrictions in favor of urban workers. An urban firm's profit maximization implies

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

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

$$w_m = z_u (1 - \alpha)(1 - \chi)(K_u / H)^{\alpha} H^{1-\eta} H_m^{\eta - 1} - \upsilon.$$

3.5 Stationary Equilibrium

A recursive stationary equilibrium consists of a set of value functions $\{V(i, e, x, a, h)\}$, a set of agents' optimal policies $\{c(i, e, x, a, h), a'(i, e, x, a, h),\ h'(i, e, x, a, h), I_w^m(r, e, x, a, h), I_s^m(r, s, x, a, h)\}$, a set of aggregate inputs $\{K_r, H_r, K_u, H_u, H_m\}$, a set of prices $\{r, w_r, w_m, w_u\}$,

a set of taxes $\{\upsilon, T_u, T\}$, and a distribution of agents $G(i, e, x, a, h)$, where $i \in \{r, m, u\}$ and $e \in \{s, w\}$, such that:

1. Given r, w_r, w_m, w_u, T_u, T, and G, agents optimally choose $c(i, e, x, a, h)$, $a'(i, e, x, a, h)$, $h'(i, e, x, a, h)$, $I_w^m(r, e, x, a, h)$, and $I_s^m(r, s, x, a, h)$ that are consistent with agents' problems,

2. Given υ, firms chooses K_r, H_r, K_u, H_u, and H_m to maximize profits,

3. The goods market clears:

$$\sum_i \sum_e \int \{c(i, e, x, a, h) + a'(i, e, x, a, h)\} \, dG(i, e, x, a, h)$$
$$+ \sum_e \int \{I_w^m(r, e, x, a, h)\psi_w\} \, dG(r, e, x, a, h) + \int \{I_s^m(r, s, x, a, h)\psi_s\} \, dG(r, s, x, a, h)$$
$$= z_r K_r^\alpha H_r^{1-\alpha} + z_u K_u^\alpha \left\{ [\chi H_u^\eta + (1-\chi) H_m^\eta]^{\frac{1}{\eta}} \right\}^{1-\alpha} + (1-\delta)(K_r + K_u),$$

4. Factor markets clear:

$$H_i = \int h dG(i, w, x, a, h), \text{ where } i \in \{r, m, u\},$$
$$K_r + K_u = \sum_i \sum_e \int a dG(i, e, x, a, h),$$

5. Urban government budget constraint is satisfied:

$$\upsilon H_m = \sum_e \int T_u dG(u, e, x, a, h),$$

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

4 Calibration

We select a set of parameters based on the related literature. The utility function is a standard CRRA function: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. The relative risk aversion γ is set to 1.5, based on common estimates between 1 and 2 in the literature. One period in our model is one year.

Following Song, Storesletten, and Zilibotti (2011), time discount factor β is chosen to match the annual real interest rate of 0.0175 and capital depreciation rate δ is set to 0.10. For the capital share α in the production function, we assign 0.5, consistent with the empirical labor share of 0.5 in China. We choose the survival probability λ to match the average work life of 44 years. The parameter κ, which governs the probability of return migration $1-\kappa$, is chosen to match the average migrant life of 6.46 years in Démurger and Xu (2011). We set the parameter χ at 0.5, assuming that there is no home bias in the demand for labor of urban firms. It is hard to find a counterpart for the elasticity of substitution $\frac{1}{1-\eta}$ between migrants and urban workers in the literature. Since urban workers tend to obtain much longer years of schooling than migrants, we use an estimate for the substitution elasticity between skilled and unskilled workers in the literature as an alternative. We select 0.5 for η so that the elasticity is 1.5 as in Card and Lemieux (2001).

Another set of model parameters are calibrated by targeting relevant data moments. Our primary data source is the household-level survey conducted by China Household Income Project at the end of 2002 (CHIP 2002). The CHIP 2002 contains three subsamples: urban households, rural households, and rural-to-urban migrants. We first select males ages between 16 and 60 to compute the fraction of students in each sample. The samples are further restricted to those who are not self-employed and have non-missing information about educational attainment, income, and hours. The resulting samples are used to compute the return to schooling and wages. The borrowing limit $-\phi$ of agents is set to -36.1156 so that the model matches the fraction of students in our sample. The fixed costs of migration for work, ψ_w, and schooling, ψ_s, are selected to match the ratio of migrant to urban workers of 0.1936 and that of migrant to urban students of 0.0733 in the data. The fee υ imposed on urban firms hiring migrant workers, which generates a wage gap between migrant and urban workers, is set by matching the relative wages of urban workers to migrants in our sample. We normalize the TFP of rural firms to 1 and choose urban firms' TFP by targeting the relative wages of urban workers to rural workers. Normalizing the efficiency ρ_r of rural education system to 1, other two parameters θ and ρ_u governing the human capital

production technology are set to replicate the Mincerian returns to schooling in our rural and urban samples. We then select the mean and the variance of the utility cost of schooling by matching the fractions of those with some college education (13 years or more years of schooling) and those with 10 to 12 years of education in our urban sample of the CHIP 2002. Table 1 summarizes these parameters.

5 Results

This section begins by presenting benchmark results of our model, followed by counterfactual exercises in which either migrant-hiring fee or the fixed costs of migration is reduced. We examine how such changes in the Hukou restrictions affect human capital and output through labor and capital reallocations.

5.1 Benchmark Results

Our benchmark economy replicates the 2002 Chinese economy fairly well as shown in Table 2. The population shares of rural residents, migrants and urban Hukou owners are 15.94%, 13.34% and 70.71%, respectively, as are their data counterparts. Our model also replicates hourly wages of each group of workers in the data. Under this calibration, migrant workers on average earn about 10% more per efficiency unit of labor than rural workers, while the real wage of urban workers is almost twice that of rural workers. The average years of schooling of the three different worker groups are also in line with the data. Urban workers on average acquire three more years of education, compared to rural workers. Migrants are positively selected from the rural area's education distribution, completing 0.5 years of education more than rural workers.

In the benchmark economy, factor inputs are concentrated in urban firms as Table 3 indicates. About 98% of the aggregate capital stock and 92% of the labor input are adopted by urban firms, producing 98% of the aggregate output.

5.2 Relaxing the Hukou Restrictions

This subsection discusses the effect of the relaxed Hukou restrictions on human capital and quantify the efficiency gains from capital and labor reallocation following the policy changes. We first consider a reduction in each type of the Hukou restrictions separately and examine their interactions.

5.2.1 Migrant-Hiring Fee

Consider a 50% reduction in the migrant-hiring fee v imposed on urban firms. See Table 4 for a specific value for the fee v adopted in this experiment. Table 5 summarizes how the policy changes affects the economy. The reduction in the migrant-hiring fee leads to a one-to-one increase in the migrants' real wage, providing rural workers a stronger incentive to move to urban area. The increased wage for migrants also makes it more attractive to migrate as a workers than as a student. Consequently, the share of migrant workers increases by 0.54%, while that of migrant students declines by 3.76% relative to the benchmark results. Since migrant students form a small fraction of total migrants, the overall share of migrants rises by 0.47%, which reduces rural population by 0.37%.

Given the education distribution in the rural area, a rise in the migrant wage increases the expected rate of return to migration. This lowers the threshold level of human capital (or education) above which agents choose to migrate, reducing the mean levels of education of both migrants and rural agents. However, the mean years of schooling of migrant actually rise with the halved migrant-hiring fee because rural agents who intend to migrate now face stronger incentives to invest in human capital as the rate of return to schooling conditional on migration increases. Table 5 reports that the average schooling of migrants rises by 0.16% and that of rural population drops by 0.08%.

The increase in migrant workers accompanied by a greater human capital accumulation raises the productivity of physical capital in urban firms, attracting more capital to urban firms, compared to the benchmark results. We find that physical capital adopted by urban firms increases by 0.07%, which benefits urban workers through a slight increase in their

wages. To the contrary, rural firms lose physical capital by 6.00% and thus rural wage declines by 2.55%. The reallocation of capital and labor inputs from rural to urban firms leads to an efficiency gain to the economy, equivalent to a 2.57% increase in the aggregate output, compared to the benchmark results.

5.2.2 Fixed Migration Cost for Work

In order to make a fair comparison of the effects of different types of the Hukou restrictions, we consider a change in the fixed cost of migration equivalent to the 50% reduction in the migrant-hiring fee. Note that rural agents benefit from the halved migrant-hiring fee as long as they survive in urban firms. This implies that the present value of the 50% reduction in the migrant-hiring fee can be written as

$$\Omega = \frac{\lambda \cdot \left(\frac{1}{1+r}\right)}{1 - \lambda\kappa \cdot \left(\frac{1}{1+r}\right)} \cdot \frac{\upsilon}{2}.$$

Thus, we consider a decline in the fixed cost of migrant for work by Ω, financed by lump-sum taxes on urban residents. Table 4 presents the value of the fixed cost of migration used as an input to this experiment.

This reduction in the migration cost for work facilitates migration of rural agents to urban area without affecting the migration for education much. The population share of migrants rises by 0.46%, mostly attributable to the increased migration for work. As does the decline in the migrant hiring fee, this policy change also provides potential migrants a stronger incentive to invest in human capital, raising the average years of schooling of migrants, compared to the benchmark result.

This increased migration to urban firms attracts physical capital from rural area. In addition, both rural and migrant workers can afford more savings because rural agents spend less time in school, entering labor market earlier and migrants pays a smaller cost of migration for work. Therefore, urban firms' capital rises more than rural firms' capital declines, increasing the aggregate capital stock. The concentration of capital stock in urban firms raises wages of both migrant and urban workers. Following the adjustments in both human

and physical capital investments, urban firms' output and the aggregate output rise by 1.04% and 0.99%, respectively.

5.2.3 Migrant-Hiring Fee and Migration Cost for Work

Assume that the migrant-hiring fee is reduced by half and the fixed cost of migration for work declines by Ω, simultaneously. This policy change raises the expected return to migration for work, while reducing its cost, induce more rural agents to migrate to urban area. Therefore, the population share of migrants rises by 0.67%. In line with the previous results, the average level of education of migrants rises with this policy change, whereas that of rural workers declines.

This comprehensive relaxation of the Hukou restrictions reallocates both capital and labor from rural to urban area. Moreover, physical capital investment rises, compared to the benchmark model, because a rise in savings by both migrants and rural workers dominates a decline in savings by urban residents. The increased capital stock in urban firms makes labor adopted by urban firms more productive, while reducing the productivity of rural labor. As a result, urban real wage rises by 1.39% and rural wage drops by 1.94%.

The more efficient allocation of factor inputs reduces rural output by 3.12% and increases urban output by 4.83%. Since most of the aggregate output is produced by urban firms, the aggregate output increases by 4.69%, almost as much as urban output.

5.2.4 Fixed Migration Cost for Education

In this section, we consider another policy experiment where the fixed cost of migration for education declines. Suppose that the migration cost of students declines by Ω, equivalent to the reductions in the other two types of the Hukou restrictions described above. In our calibration, Ω is greater than the fixed cost of migration for education. Thus, reducing the fixed cost of migration for education by Ω means that the urban government provides migrant students with a subsidy by collecting lump-sum taxes on urban residents. The value of the subsidy is reported in Table 4.

Table 6 implies that this policy change has significant effects on migration decisions of rural agents. The population share of migrant students and workers increase by 2.57% and 9.48%, respectively. More intriguing is that the average years of schooling of rural workers as well as migrants increase with a subsidy on migrant students. More rural agents who would have entered the labor market in either rural or urban areas are now tempted to migrate as students to urban area in this experiment. Thus, the average years of schooling completed by migrant workers increase by 0.85%. With return migration incorporated, a constant fraction of these migrant students and workers return to rural area in every period, which dominates the negative selection of rural workers in the education distribution and raises the average years of schooling in rural area.

This channel benefits rural firms rather than urban firms because labor input from migrant workers do not increase as much as the human capital of rural workers in this case. This causes capital to reallocate from urban to rural firms, increasing the output of rural firms by 3.70%, whereas decreasing urban firms' output by 2.07%. The capital reallocation towards rural firms with a lower TFP reduces the aggregate output by 1.97%, compared to the benchmark results.

6 Discussion

In this section, we discuss implications of the relaxed Hukou restrictions on welfare and inequality. It follows that we study the role of return migration in explaining the effects of the relaxed Hukou restrictions.

6.1 Welfare Analysis

This section proceeds by reporting welfare gains or losses from the relaxation of the Hukou restrictions. As Table 7 reports, reducing the Hukou restrictions benefits migrants at the expense of rural and urban residents. With a reduction in migrant-hiring fee, migrants gain substantially from higher wages, enjoying a 70.71% rise in their per-period consumption.

However, rural agents lose 2.29% of their consumption in every period because they should bear less wage income. Urban residents also experiences a welfare loss equivalent to 1.87% of their per-period consumption, mostly because their transfer income from the urban government based on the migrant hiring fee declines. Despite the welfare losses of both rural and urban residents, the total population's consumption increases by 4.50% with this policy change.

If the fixed cost of migration is reduced instead, migrants still receive welfare gains, whereas both rural and urban agents lose their consumption. Migrants not only gain from increased wages, but also receive more capital income because they can afford savings even after paying the cost of migration. However, the welfare gain of migrants is not as dramatic as that with the reduced migrant-hiring fee and thus rural and urban residents' consumption does not decline as much. The total population's welfare then increases by 1.32%, compared to the benchmark result.

If both types of the Hukou restrictions are relaxed simultaneously, migrants' welfare gain amounts to a 83.11% increase in their consumption in every period. This policy change hurts urban residents much more than in the previous two experiments because both the increased wages and reduced migration cost for migrants are financed by additional taxes on urban residents. Urban residents' consumption drops by 3.20%, close to the sum of welfare losses in the previous two experiments. Rural agents's consumption also declines further, but their welfare loss is not as much as the sum of the previous two welfare losses. With this policy change, the welfare gain for the total population is equivalent to 6.20% of their per-period consumption.

6.2 Implications on Inequality

Our model has implications on earnings inequality. Agents are heterogeneous in the utility cost of education, which induce them to make a different choice of education and hence human capital among themselves. In addition, depending on where they are registered and where they work, they face different real wage per efficiency unit of labor. Because of these two

factors, earnings vary across agents. We compute the earnings Gini coefficients for various experiments implemented in this study to examine how earnings distribution is affected by the relaxed Hukou restrictions.

Table 8 presents the earnings Gini coefficients. Since the Hukou system reinforces the rural-urban divide by restricting rural agents from accessing higher wages in urban areas, relaxing the Hukou system generally reduces earnings inequality. If the fee is reduced by half, the earnings Gini declines from 0.2561 to 0.2376, by about 7.20%. The fixed cost of migration also reduces earnings inequality, yet its quantitative impact is about half that with the reduced migrant-hiring fee. If both the migrant hiring fee and fixed cost of migration are reduced simultaneously, it is more effective in achieving more equal distribution of earnings. The earnings Gini declines to 0.2323 by 9.26%.

6.3 The Role of Return Migration

[to be added]

7 Conclusion

The Hukou restrictions in China is regarded as a barrier to efficient allocation of labor and hence development of China. This paper examines the impacts of relaxed Hukou restrictions on human capital, output, and welfare using a general equilibrium model with endogenous migration and human capital accumulation.

Our model incorporates the Hukou restrictions in the form of a migrant-hiring fee imposed on urban firms and fixed costs of migration. Reducing the migrant-hiring fee increases migrant wage and thus the expected rate of return to migration, while a decline in the fixed cost of migration affects the cost side of migration. Both policy changes cause rural-to-urban migration to increase and encourage migrants' human capital accumulation. They enable factor inputs to be more efficiently allocated across regions and firms.

We find that a decline in the migrant-hiring fee by half accompanied by an equivalent

reduction in the fixed cost of migration for work increases total output and welfare by 4.69% and 6.20%, respectively. Relaxing the Hukou restrictions also helps achieve a more equal distribution of earnings.

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Table 1: Parameterization

Parameter	Target (Source)
$\gamma = 1.5$	Intertemporal elasticity of substitution: 0.67
$\beta = 0.9849$	Annual real interest rate: 0.0175
$\delta = 0.1$	Song, Storesletten, and Zilibotti (2011)
$\alpha = 0.5$	Labor share in China: 0.5
$\lambda = 0.9773$	Average length of work life: 44 years
$\kappa = 0.8452$	Average length of migrant life: 6.46 years
$\chi = 0.5$	
$\eta = 0.5$	Elasticity of substitution of 1.5 in Card and Lemieux (2001)
$\phi = 36.1156$	The fraction of students in CHIP 2002: 0.0806
$\psi_w = 213.7613$	Migrant to urban workers ratio in CHIP 2002: 0.1936
$\psi_s = 5.8633$	Migrant to urban students ratio in CHIP 2002: 0.0733
$\upsilon = 4.5980$	$w_u\overline{h_u}/w_m\overline{h_m}$ in CHIP 2002: 1.7126
$z_u = 2.1951$	$w_u\overline{h_u}/w_r\overline{h_r}$ in CHIP 2002: 1.8755
$\theta = 0.1849$	Mincer return to schooling in rural area in CHIP 2002: 0.0561
$\rho_u = 2.8669$	Mincer return to schooling in urban area in CHIP 2002: 0.0794
$\mu = 18.3415$	Fraction of urban agents who have attended colleges in CHIP 2002: 0.3541
$\sigma = 12.7324$	Fraction of urban agents with 10 to 12 years of educ. in CHIP 2002: 0.3610

Table 2: Benchmark Results: Population Share, Wage, and Schooling

	Population Share		Hourly Wage ($w\overline{h}$)		Wage (w)		Years of Schooling	
	Date	Model	Data	Model	Data	Model	Data	Model
Rural	15.94	15.94	1.0000	1.0000	..	1.0000	8.1371	7.9785
Migrant	13.34	13.34	1.0951	1.0951	..	1.0969	8.6756	8.4579
Students	0.21	0.21	..	..	..	..	..	..
Workers	13.13	13.13	1.0951	1.0951	..	1.0969	8.6756	8.4579
Urban	70.71	70.71	1.8755	1.8755	..	1.9113	11.6382	11.0279

Table 3: Inputs and Outputs in the Benchmark Economy

	Capital Input K (Share)		Labor Input H (Share)		Output (Share)	
Rural	10.95	(1.73%)	0.60	(7.74%)	2.57	(1.72%)
Urban	623.21	(98.27%)	7.14	(92.13%)	146.45	(98.27%)
Total	634.16	(100.00%)	7.75	(100.00%)	149.03	(100.00%)

Table 4: Parameter Values for the Relaxed Hukou Restrictions

	BM	Mig. Hiring Fee ↓	Mig. Cost (W) ↓	Both ↓	Mig. Cost (S) ↓
Mig. Hiring Fee υ	4.60	2.30	..	2.30	..
Mig. Cost (W) ψ_w	213.76	..	202.21	202.17	
Mig. Cost (E) ψ_s	5.86	..	..	..	-5.66

Note: The table only presents parameter values different from their benchmark values.

Table 5: The Effects of Relaxed Hukou Restrictions

Unit (%)	Migrant Hiring Fee ↓			Migration Cost - Work ↓			Both ↓		
	Share	Wage	Educ.	Share	Wage	Educ.	Share	Wage	Educ.
Rural	−0.37	−2.55	−0.08	−0.36	−0.44	−0.09	−0.53	−1.94	−0.09
Migrant	0.47	63.65	0.16	0.46	25.54	0.16	0.67	71.68	0.18
Students	−3.76	..	..	−0.00	..	..	−3.71	..	..
Workers	0.54	63.65	0.16	0.47	25.54	0.16	0.74	71.68	0.18
Urban	0.00	0.03	0.00	0.00	0.30	0.00	0.00	1.39	0.00
	Capital	Labor	Output	Capital	Labor	Output	Capital	Labor	Output
Rural	−6.00	−1.03	−3.54	−2.08	−1.22	−1.65	−5.01	−1.19	−3.12
Urban	0.07	5.36	2.68	0.60	1.48	1.04	2.79	6.91	4.83
Total	−0.04	4.86	2.57	0.55	1.27	0.99	2.66	6.28	4.69

Table 6: The Effects of a Reduction in the Fixed Cost of Migration for Education

Unit (%)	Share	Wage	Educ.
Rural	−7.81	−2.85	0.51
Migrant	9.37	10.74	0.85
Students	2.57	..	..
Workers	9.48	10.74	0.85
Urban	0.00	−2.46	0.00
	Capital	Labor	Output
Rural	0.75	6.75	3.70
Urban	−4.86	0.81	−2.07
Total	−4.76	1.27	−1.97

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

	Migrant Hiring Fee ↓	Migration Cost - Work ↓	Both ↓
Rural	−2.29	−1.76	−2.83
Migrant	70.71	28.23	83.11
Urban	−1.87	−1.68	−3.20
Total	4.50	1.32	6.20

Table 8: Earnings Inequality

	BM	Migrant Hiring Fee ↓	Migration Cost - Work ↓	Both ↓
Gini Coef.	0.2561	0.2376	0.2484	0.2323