Education and Rural-urban Migration: The Role of Zhaosheng in China

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Abstract

Because of hukou registration system, people in China lost the freedom of migration. This paper focuses on one of the formal channels to migrate to cities: zhaosheng. To better capture the reality, we also consider the migration of rural workers, or nongmingong, to cities. A general equilibrium model with endogenous education migration decision is employed. The framework is calibrated to data from China and then counterfactual experiments are conducted. In particular, the abolishment of government job assignment for college graduates in 1994 is examined in this paper. We find that if rural-urban migration is completely debarred, urban output would be 15.89 percent lower than that in the benchmark model and total output would be 7.75 percent lower during 1981-2007. We also find a complementarity between college graduates and nongmingong in production and migration via zhaosheng contributes to more of the increase in total output. Our counterfactual experiments indicate that (1) If the policy of government job assignment had been continued, total output would only increase by 0.72 percent during 1995-2007; (2) If China had adopted a more relaxing policy on rural migrant workers, total output would increase by 2.58 percent in 1981-2007; (3) If China had not loosened its control on rural migrant workers in the 1990s, total output would decrease by 1.51 percent in 1995-2007; (4) If the technology in urban production is improved by 5 percent, urban output would increase by 1.91 percent throughout 1981-2007.


Keywords: Rural-urban migration, education, urbanization, China development.

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1 Introduction

What causes rural-to-urban migration? Lucas (2004) points out two incentives for rural migrants. First, skilled and unskilled workers are complementary inputs of urban production. This increases the demand of unskilled migrants from rural areas. Second, in addition to getting jobs, cities are places for new technology, knowledge and skills to emerge, and human capital in cities are higher than that in rural areas. Hence, people can acquire better knowledge and skills through schooling or training in cities as well as benefit from the human capital externalities in urban areas. Therefore, moving to urban areas enables immigrants to accumulate human capital and obtain more opportunities in the future.

However, Chinese citizens did not have the right of free migration since the introduction of the unique hukou registration system in the early 1950s. Different from other countries, China used the hukou registration for government control and to define a citizen’s job, grain rations, education for children, health care, and obligations. Therefore, being an official urban citizen implied enjoying better benefits, having a good life, having a future for children, and become the elite class in the Chinese society. These motivated people to pursue an urban hukou. However, the hukou mechanism was designed to prevent undesirable rural-to-urban migration, so that agricultural production could support the growth strategy of rapid industrialization concentrated on heavy industries in cities. Thus, under the hukou registration system, it was difficult to obtain an urban hukou. People in China lost the freedom of migration within their own country.

Under China’s hukou registration system, a few specific types of migration were officially allowed. Zhaosheng, students attended college by passing the gaokao (National College Entrance Examination), was one of the formal channels to migrate to cities. Before 1994, all college graduates were assigned jobs by the government before graduation (hereafter government job assignment, or GJA), and could officially stay in urban areas to work and to enjoy urban benefits. Therefore, entering college implied obtaining an urban hukou, having a bright future, and moving upward in the society.\footnote{Wu and Treiman (2004) show that education was one of the main determinants of the upward mobility in China.} After 1994, jobs are not guaranteed. Instead, a college graduate has to find a job by himself. If he cannot get a job in urban areas, he may choose to move back to his hometown in rural areas.

This paper responds to Lucas (2004), with a focus on China. As mentioned previously, rural agents have two incentives to migrate to urban areas: to obtain better job opportunities, and to
acquire human capital or to enjoy the human capital externalities in cities. Our paper incorporates these two incentives. Moreover, we consider the intergenerational rural-urban migration decision. Following the spirit of zhaosheng, this paper employs a general equilibrium model with an endogenous decision on children’s education migration. To capture the reality, another migration type is also included – nongmingong (i.e., rural migrant workers).\textsuperscript{2} Then, the model is calibrated to data from China. To explore the effects of the abolishment of GJA in 1994, two regimes are considered: pre-1994 and post-1995. This framework enables us to examine the effects of varying migration policies on zhaosheng and nongmingong, and facilitates our understanding of the role of the rural-urban migration on the development of China.

The issue of rural-urban migration in China has drawn economists’ attention. Regarding the motivation of working migration, Rozelle, Taylor, and deBrauw (1999) conclude that constraints in the operation of farm labor and capital or insurance institution provide an incentive to migrate. Zhao (2003) shows that migrant networks play an important role in labor migration in China. Zhao (1999) suggest that some rural people choose not to migrate because of the existing arrangement of land management. Using a survey data in Hubei province, Zhu (2002) find that income gaps between rural and urban areas significantly influence migration decisions.

Liu (2005), Lu and Song (2006), and Hertel and Zhai (2006) step forward to indicate that migration restriction (due to the hukou registration system) is the major reason for rural-urban income gap. Instead of using an empirical approach, Whalley and Zhang (2007) investigate the influences of migration restriction by adopting numerical simulation methods. They show that all wage and most income inequality disappears when the migration restrictions are removed.

Most existing literature studies the migration issue by empirical approach and only pays attention to working migration. This paper, as a complement to the literature, explores the influence of both education and working migration on the Chinese economy. More specifically, we construct a general equilibrium model with intergenerational migration decision: education migration benefits not only the children but also the future descendants. We perform numerical analysis. To investigate the effects of rural-urban migration on output levels, we decompose the effects of the two channels of migration, zhaosheng and nongmingong, and examine the interaction between the two. We further conduct experiments on migration policies and study the effects of varying policies on

\textsuperscript{2}Our model is location basis. Thus, this paper dismisses the discussion of whether rural migrant workers have urban hukou or not. It is also difficult to distinguish migrant workers with and without urban hukou in the data.
the development of China. We also inspect the scenario where the urban production technology is improved.

We find that rural-urban migration has an important contribution to output in China. Without rural-urban migration, total output would be 7.75 percent lower during 1981-2007. The effect of migration on urban output is larger: without rural-urban migration, urban output would be 15.89 percent lower. We further find that more than a half of the contribution to total output is due to education migration. In contrast, the contribution of nongmingong is larger than zhaosheng when we focus on urban output.

In the experiment of conducting education migration policy, we find that the effect of GJA on output levels is very limited. With the continuation of GJA in the post-1995 regime, total output would only increase by less than one percent. On working migration policies, our results suggest that a loosening migration regulation on nongmingong will always help boosting output.

The rest of this paper is organized as follows. Section 2 summaries the basis of China’s hukou system, its reforms, and the role of zhaosheng. Section 3 presents the model and the theoretical analysis. The calibration strategy, the simulation, the decomposition of the effects of zhaosheng and working migration (alternatively, nongmingong), and counterfactual experiments are provided in Section 4. Finally, Section 5 concludes this paper.

2  Hukou System and Zhaosheng in China

China implemented an unique hukou system in 1958 in order to solve the serious problem of the “blind flows” (rural labor to cities) in the early 1950s. The system was still the basis of China’s registration system in the last decade.

The power of China’s hukou system did not come from the regulation of migration itself. Instead, it was from its integration with other social and economic controls. In the rural areas, with the commune system, all rural residents in communes had to participate in agricultural production to receive food rations for their households. In the urban areas, most recruitment and job transfers were controlled by the state government. There were few jobs outside the state enterprises. Danwei was the basic administrative unit for most urban adults. It assigned most social services for its employees, such as the access to good jobs, grain rations, education for children, health benefits, and purchasing house. Without a work unit, it was difficult to survive in a city. Therefore, in the pre-reform period, it was hard for people to survive outside their hukou registration place without
permissions.

However, in the late 1970s, because of the development of the market-oriented economy, more and more people stayed (i.e., actually worked and lived) outside their hukou registration place. They were so-called the “floating population”, nongmingong, or peasant workers. 3 The increase in the mobility resulted in a series of hukou reforms since 1980. In this session, first an introduction of the basis of China’s hukou system and the role of zhaosheng is provided. The second part describes the hukou reforms since the 1980s.

2.1 The basis of hukou system and zhaosheng

A citizen’s hukou was classified by two part: hukou suozaidi (the place of hukou registration) and hukou leibie (the type or status of hukou registration).4

- **Hukou suozaidi** was a person’s presumed regular residence. Everyone was required to register in one and only one place of his residence. The common categories of place of hukou registration were cities, towns, villages, and state farms. It determined where a person would receive his benefits and social welfare.

- **Hukou leibie** referred to “agricultural” and “non-agricultural” hukou. It was used to determine a person’s entitlements to state-subsidized food grain (commodity grain). A citizen with “non-agricultural” hukou status would lose the right of land rental and the right of inheriting the land that his parents rented.

The above two classifications were different. Urban areas contained both agricultural and non-agricultural hukou population. Non-agricultural hukou population may exist in both urban and rural areas. **Hukou** registration place and status mattered because it determined, for example, access to good jobs, grain rations, education for children, health benefits, and purchasing house.5 A formal rural-urban migration involved both a change in hukou residential place and in entitlement

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3 In other words, they were rural migrant workers. They actually worked in cities but had rural agricultural hukou. Our model is location basis, so we simply use nongmingong to refer to rural-to-urban migrant workers. They may or may not have urban hukou.

4 Before 1997, hukou registration place and status were inherited from a person’s mother. Since 1997, they can be inherited from a person’s mother or father.

5 See Whalley and Zhang (2007) for the detail.
status. In order to complete the process, a person had to satisfy both the migration requirements and obtained a space under the quota control.

Changing from agriculture to non-agriculture was commonly known as nongzhuanfei. The annual quota was controlled by the central government at about 0.15-0.2 percent of the non-agricultural hukou population in each area. The regular channels of nongzhuanfei included recruitment by a state-owned enterprise (zhaogong), enrollment in an institution of higher education (zhaosheng), and promotion to a senior administrative job (zhaogan). Therefore, zhaosheng was one of the formal channels for rural students to obtain an urban hukou in China.

The system of gaokao was established at the beginning of the 1950s. It was abolished for several years during the periods of Cultural Revolution and then was restored in 1977. Because of the scarcity of education resources, the acceptance rates were very low, especially in the 1980s. Students who passed gaokao could move their hukou to cities, enjoyed lots of social benefits, and were expected to become a pillar of society in the future.

At the beginning of entering an university or a college, a freshman could be voluntary to change his own hukou registration place to his school (a collective joint household). This would also change his hukou status to become non-agricultural. During the periods with the implementation of GJA (1951-1994), a graduate would be distributed to a stable government job. Thus, a graduate simply moved his hukou to the working unit after graduation. He still kept the non-agricultural status. In the periods that the GJA was abolished, a graduate could move his hukou to the working unit, temporarily put to the collective joint household of personal exchange center, or moved back to his own hometown. Thus, under China’s hukou system, entering college through gaokao implied a rural to urban migration. It was an upward mobility in the society.

2.2 Hukou reforms

Since the late 1970s, due to the economic reform, people have become easier to survive outside their hukou registration place. The economic reform relaxed the administrative control, such as

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6 The reform of the GJA started in 1989; but was officially abolished in 1996. Tibet, which abolished the system in 2007, was the last place to terminate the distribution system of graduation.
7 Even though a graduate moved his hukou back to his hometown, he still kept the non-agricultural status. This implied that he could not rent land and inherit the land rented by his parents.
8 Since 1996, China has introduced a series of education reforms. In particular, since 2003, universities in Hong Kong are allowed to enroll students in Mainland China. Since the reform, attending universities in Hong Kong is getting popular.
the abolition of the commune system, the introduction of the household responsibility system, and
the erosion of the rigid danwei-based rationing system. Furthermore, the growing market-oriented
economy demanded more cheap labor. Both the push and pull factors increased migrations from
rural to urban areas.

It was noted that in 1995 there was a “floating population” of some 80-100 million, who stayed
outside their own hukou registration place. The increase in mobility had forced the government to
change its hukou policies.

The main parts of hukou reforms were to relax the migration requirements. For example, state
governments implemented a new type of urban hukou with “self-supplied food grain” in 1984. People
actually living in urban areas other than their place of hukou registration were required to apply
for a temporary residence certificate. In addition, due to the demand of economic development,
some local governments introduced the “blue-stamp” urban hukou in the early 1990s in order to
attract professional workers and investors. The blue-stamps hukou system allowed them to obtain
a temporary urban hukou. It could be upgraded to a formal urban hukou under some conditions
and after some years. However, applying the blue-stamp hukou required an urban infrastructure
construction fee for any new comer, ranging from a few thousand to some fifty thousand yuans.
Blue-stamps hukou was different from the urban hukou obtained through nongzhuanfei that it only
had limited rights and obligations compared to regular urban residents.

In a statement of 2005, the deputy minister of public security stated that eleven provinces
had begun or would soon begin to implement unified urban-rural household registration system,
removing the distinctions between agricultural and non-agricultural hukou status. The ultimate
aim is to abolish the regulations of migration in the hukou system.

3 The model

In this section, we build a model to study the transition process of rural-to-urban migration under
the hukou system of China and to evaluate the policies on rural-urban migration. We use \((i, j, k)\)
to denote three consecutive generations and let \((H, L)\) denote high skill and low skill. There are

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9 See Chan and Zhang (1999) for the detail.
10 This was distinguished by a blue stamp, different from the formal urban hukou book with a red stamp.
11 However, Beijing was tentatively excluded. See Chan and Buckingham (2008) for the detail. An updated statement
in 2007 repeated the same points and included a list of twelve provincial-level units.
two geographical regions, rural and urban area (\(R\) and \(U\)), respectively. Our optimization problem focuses only on the decision of rural parents (generation \(i\)) in sending their children to urban area to get education. Therefore, our specification of the urban households is rather simple. Assume that there is an initial mass of workers in urban area given by \((N_H, N_L)\), where \(N_H\) (\(N_L\)) denotes the total number of high (low) skilled workers. To focus on rural-to-urban migration, we shut down the channel of endogenous decision of “moving back” from urban to rural and assume that the \textit{hukou} of urban households are passed from one generation to another. Also, to simplify our analysis, we assume that there is no population growth. That is, the total population in rural and urban area is constant over time.

### 3.1 Production

In urban area, production is taken place with the following nonhomothetic CES production function:

\[
Y_U = A \left[ \alpha \left( N_H + \psi \right) h^\rho + (1 - \alpha) N_L^\rho \right]^{1/\rho}, \quad \alpha \in (0, 1)
\]

where \(A > 0\) is the technology scaling factor in urban (or urban TFP, hereafter we will use the two terms interchangebly), \(\psi\) is a constant that resides in urban area, \(\rho < 1\) and \(1/(1 - \rho)\) is the elasticity of substitution in production for high and low skilled labor, and \(h\) is the level of human capital possessed by the high-skilled worker. With this specification, firms can still operate and have positive output even if there is no high-skilled workers.

As documented by Maurer-Fazio (1999), skilled labor wage in China was depressed due to the planned economy system. To capture this phenomenon, we introduce a wedge \(\tau \in (-1, \infty)\) facing by urban firms when hiring high skilled workers. Denote \(w_H\) as the effective high skilled wage received by high skilled workers, and \(w_L\) as the low skilled wage. The urban wage rates are determined by:

\[
(1 + \tau) w_H = \frac{\partial Y_U}{\partial (N_H + \psi) h},
\]

\[
w_L = \frac{\partial Y_U}{\partial N_L},
\]

and the skilled-unskilled wage ratio is thus given by:

\[
\frac{w_H h}{w_L} = \frac{1}{1 + \tau} \frac{\alpha}{1 - \alpha} \left( \frac{N_L}{N_H + \psi} \right)^{1-\rho} h^\rho
\]

Rural production uses raw (or unskilled) labor only and constant returns requires a linear production technology:

\[
Y_R = B N_R,
\]
where $N_R$ is the number of raw-labor workers in rural area and $B$ is the technology scaling factor in rural area. Competitive labor market implies that the rural wage rate is

$$w_R = B. \quad (5)$$

### 3.2 Rural households

Rural households (generation $i$) are altruistic and derive utility from both their own consumption ($c^i$) and their children’s consumption ($c^j$). There is no fertility decision and we assume that each adult agent gives birth to a child. Assuming the utility function $u(\cdot)$ is strictly increasing and strictly concave, then the representative household objective is:

$$\Omega^i \left( I^i | I^i = 0, I^k, x^j \right) = \max_{I^j} u(c^i) + \beta \mathbb{E}_X u(c^j) \quad (6)$$

where $\beta$ is the altruistic factor on children and $I^j$ is an indicator function such that

$$I^j = \left\{ \begin{array}{ll}
0 & \text{if the household does not send generation } j \text{ (children) to college in urban area} \\
1 & \text{if the household sends generation } j \text{ (children) to college in urban area.}
\end{array} \right.$$ 

We assume constant child-rearing cost $\phi^j$. Education of the children only takes place in urban area with cost $x^j$, which is a random variable that is inversely related to the talents of the child $z^j$, i.e., $z^j \equiv 1/x^j$. We note that $z^j$ is drawn from a distribution with cumulative distribution function denoted by $G(z^j)$. Finally, the migration cost (settle-down cost in cities) of moving from rural to urban is given by a constant $\sigma$. Then the budget constraint for a rural parent is

$$c^i + I^j \cdot (x^j + \sigma) + \phi^j = w_R. \quad (7)$$

Children become skilled workers after receiving education in urban area. They can either get high (low) skilled job in urban area, earning a skilled wage income $w_H$ ($w_L$) with probability $\gamma_H$ ($\gamma_L$), or otherwise are forced to move back to rural area, earning a rural wage income of $w_R$. Children that remain in the rural area do not incur any cost in education or migration. They either get recruited to serve as low skilled worker in urban area and earn $w_L$ (with probability $\pi$), or otherwise work as unskilled labor in rural area and earn $w_R$. The income for the children (generation $j$) when they become adults is

$$W^j = I^j \left[ \gamma_H w_H + \gamma_L w_L + (1 - \gamma_H - \gamma_L) w_R \right] + (1 - I^j) \left[ (1 - \pi) w_R + \pi (w_L - \sigma) \right]. \quad (8)$$
Then the children’s budget constraint is given by

\[ c^j + I^k \cdot \left[ I^j (1 - \gamma_H - \gamma_L) + (1 - I^j) (1 - \pi) \right] \left( x^k + \sigma \right) + \phi^j = W^j \]  

(9)

where

\[ I^k = \begin{cases} 0 & \text{if children do not send generation } k \text{ (grandchildren) to college in urban area} \\ 1 & \text{if children send generation } k \text{ (grandchildren) to college in urban area} \end{cases} \]

and \( x^k \) is the education cost of grandchildren going to college in cities. When households of generation \( i \) decide \( I^j \), \( x^k \) is unknown to them. We use \( X \) to denote the random variable of education cost.

An agent’s discrete-choice problem is to decide whether to send his or her child to urban area to attend college (\( I^j = 1 \) versus \( I^j = 0 \)). That is, the agent compares \( \Omega^i \left( 1|0, I^k, x^j \right) \) to \( \Omega^i \left( 0|0, I^k, x^j \right) \) and chooses the highest value among the two. By substituting \( c^j = w_R - I^j \cdot (x^j + \sigma) - \phi^j \) and \( c^j = W^j - I^k \cdot \left[ I^j (1 - \gamma_H - \gamma_L) + (1 - I^j) \right] (x^k + \sigma) - \phi^j \) into the value functions, with \( W^j \) given by (8), we have:

\[ \Omega^i \left( 1|0, I^k, x^j \right) = u \left( w_R - x^j - \sigma - \phi^j \right) + \beta \mathbb{E}_X u \left( \gamma_H w_H h + \gamma_L w_L + (1 - \gamma_H - \gamma_L) w_R \right) \]

\[ -I^k (X) (1 - \gamma_H - \gamma_L) (X + \sigma) - \phi^j \]

and

\[ \Omega^i \left( 0|0, I^k, x^j \right) = u \left( w_R - \phi^j \right) + \beta \mathbb{E}_X u \left( (1 - \pi) w_R + \pi (w_L - \sigma) - I^k (X) (1 - \pi) (X + \sigma) - \phi^j \right) . \]

Defining \( \Delta^i \left( I^k, x^j \right) = \Omega^i \left( 1|0, I^k, x^j \right) - \Omega^i \left( 0|0, I^k, x^j \right) \), we have:

\[ \Delta^i \left( I^k, x^j \right) = u \left( w_R - x^j - \sigma - \phi^j \right) - u \left( w_R - \phi^j \right) + \beta \mathbb{E}_X \left\{ u \left( \gamma_H w_H h + \gamma_L w_L + (1 - \gamma_H - \gamma_L) w_R - I^k (X) (1 - \gamma_H - \gamma_L) (X + \sigma) - \phi^j \right) - u \left( (1 - \pi) w_R + \pi (w_L - \sigma) - I^k (X) (1 - \pi) (X + \sigma) - \phi^j \right) \right\} . \]

(10)

To proceed further, we impose the following condition:

**Condition S** \( \min (w_H h, w_L) > w_R \).

That is, only under Condition S will rural parents consider sending their children to urban area.
to attend college. We also impose an assumption on the probabilities of getting urban jobs: the relative probability of getting an urban job via education cannot be too low.

**Assumption 1** $\gamma_H + \gamma_L > \pi$.

Assumption 1 states that the probability of getting an urban job after receiving college education cannot be lower than that for rural workers to find an urban job. Only when this assumption is satisfied, rural parents will have incentive to send their children to cities to attend college. Now, denote $c^j_U$ as the consumption of children if they are sent to urban area and $c^j_R$ as the consumption of children if they are kept in rural area. We have the following lemma:

**Lemma 1** Under Assumption 1, if Condition S is satisfied, $u\left(c^j_U\right) > u\left(c^j_R\right)$.

**Proof.** From (8) and (9) we have:

$$c^j_U = \gamma_H w_H + \gamma_L w_L + (1 - \gamma_H - \gamma_L) w_R - \mathbf{1}^k (X) (1 - \gamma_H - \gamma_L) (X + \sigma) - \phi^j,$$

$$c^j_R = (1 - \pi) w_R + \pi (w_L - \sigma) - \mathbf{1}^k (X) (X + \sigma) - \phi^j. \tag{11}$$

By substracting (12) from (11) and rearranging terms, under Condition S, we have:

$$c^j_U - c^j_R = \gamma_H w_H + \gamma_L w_L + (\pi - \gamma_H - \gamma_L) w_R - \mathbf{1}^k (X) (\gamma_H + \gamma_L) (X + \sigma) - \pi (w_L - \sigma)$$

$$= \gamma_H w_H + \gamma_L w_L - \pi w_L + (\pi - \gamma_H - \gamma_L) w_R + \mathbf{1}^k (X) (\gamma_H + \gamma_L) (X + \sigma) + \pi \sigma$$

$$> (\gamma_H + \gamma_L - \pi) (w_L - w_R) + \mathbf{1}^k (X) (\gamma_H + \gamma_L) (X + \sigma) + \pi \sigma$$

$$> 0.$$

Since $u \left( \cdot \right)$ is strictly increasing and strictly concave, we have

$$u\left(c^j_U\right) > u\left(c^j_R\right)$$

Thus, Condition S guarantees that $\mathbb{E}_X \left( u\left(c^j_U\right) - u\left(c^j_R\right) \right) > 0$ for all $x^k \in (0, x_{\text{max}}]$.

We are able to present our first finding on parents' decision for their children’s education choice.

**Proposition 1** Under Assumption 1, if Condition S is satisfied, parents will consider to send their children to urban area to attend college.

The intuition of the above proposition is straightforward. If the probability of finding an urban job is reasonably high (Assumption 1), it is worthwhile for parents to pay the educational and migration costs to send their children to urban area to receive education. Otherwise, sending children to urban area to attend college would not be a good “investment” from parents’ perspective.
3.3 Comparative statics

In the following, we examine how \( \Delta^i (I^k, x^j) \) responds to changes in the parameterization, i.e. we examine whether the “marginal” parent (parent who is indifferent between sending children to attend college in urban area or keeping children in rural area) will send her children to urban area or keep the children in rural area. Denote \( u_{cU}^i = u_c (c_{1}^i) \) as the marginal utility, we have

\[
 \frac{d\Delta^i (I^k, x^j)}{dx^j} = -u_{cU}^i < 0
\]

\[
 \frac{d\Delta^i (I^k, x^j)}{d\gamma_H} = \beta \mathbb{E}_X \left\{ u_{cU}^j \left[ (w_H - w_R) + I^k (X) (X + \sigma) \right] \right\} > 0
\]

\[
 \frac{d\Delta^i (I^k, x^j)}{d\gamma_L} = \beta \mathbb{E}_X \left\{ u_{cU}^j \left[ (w_L - w_R) + I^k (X) (X + \sigma) \right] \right\} > 0
\]

\[
 \frac{d\Delta^i (I^k, x^j)}{d\pi} = \beta \mathbb{E}_X u_{cR}^j \left[ w_R - (w_L - \sigma) - I^k (X) (X + \sigma) \right].
\]

We have the following proposition:

**Proposition 1** Under Assumption 1,

1. More parents will be willing to send their children to urban area to attend college when their children become more talented \((x_j \downarrow)\).

2. More parents will be willing to send their children to urban area to attend college when the chances for the children to obtain a job in cities are higher \((\gamma_H \uparrow, \gamma_L \uparrow)\).

3. When the net low-skilled urban wage income (net off migration cost) is higher than the rural wage income \((w_R < w_L - \sigma)\), less parents will be willing to send their children to urban area when the chance of being nongmin gong becomes higher \((\pi \uparrow)\).

To examine how changes in migration cost \((\sigma)\) affect parents’ decision, we compute

\[
 \frac{d\Delta^i (I^k, x^j)}{d\sigma} = -u_{cU}^i - \beta \mathbb{E}_X \left\{ u_{cU}^j (1 - \gamma_H - \gamma_L) I^k (X) - u_{cR}^j \left[ \pi + (1 - \pi) I^k (X) \right] \right\}.
\]

Then we have

**Proposition 2** Under Condition S, parents may be willing to send children to attend college in urban area even when the migration cost increases.
Proof. Under Condition S, \( c_j^U > c_j^R \) and \( u_{cU}^j < u_{cR}^j \). Define \( \Lambda \equiv u_{cU}^j (1 - \gamma_H - \gamma_L) I^k(X) - u_{cR}^j \pi (1 - \pi) I^k(X) \). Also,

\[
\Lambda = u_{cU}^j (1 - \gamma_H - \gamma_L) I^k(X) - u_{cR}^j \pi (1 - \pi) I^k(X) 
\]

< 

\[
- u_{cR}^j \pi + u_{cU}^j (1 - \gamma_H - \gamma_L) I^k(X) - u_{cU}^j (1 - \pi) I^k(X) 
\]

< 0.

Therefore, if \(-\beta \mathbb{E}_X \Lambda > u_{cU}^j, \frac{d\Delta^j(t^k, x^j)}{dt} > 0.\)

3.4 Evolution of workers

Only adult agents supply labor to the market and each agent gives birth to only one child, and hence the whole adult population participates in the labor market. Denote \((N_H^t, N_L^t)\) as the skilled and unskilled workers in the city and \(N_R^t\) as the rural labor force at time \(t\). Denote \(J, K = \{H, L\}\) as the type of jobs for generation-\(j\) and generation-\(k\) urban workers. Let \(\delta_{JK}\) be the transitional probability for an urban generation-\(k\) worker, born by generation-\(j\) urban worker with job \(J\) working as a type \(K\) worker in urban area. Thus, \(\delta_{JK}\) captures the job mobility across generations in urban area. In general, we shall expect that \(\delta_{JJ} > \delta_{JK}\) for \(J \neq K\). Under the assumption that the hukou of urban households are passed from one generation to another, we have

\[
\sum_K \delta_{JK} = 1. \tag{13}\]

Then the population of skilled, unskilled and rural laborers evolve according to the following law of motion equations:

\[
N_{H}^{t+1} = \delta_{HH} N_H^t + \delta_{HL} N_L^t + N_R^t \int \{ \hat{I}_j (z^j, \hat{I}^k) \} \gamma_H dG(z^j) \tag{14}
\]

\[
N_{L}^{t+1} = \delta_{HL} N_H^t + \delta_{LL} N_L^t + N_R^t \int \{ \hat{I}_j (z^j, \hat{I}^k) \} \gamma_L dG(z^j) + \int \{ 1 - \hat{I}_j (z^j, \hat{I}^k) \} \pi dG(z^j) \tag{15}
\]

\[
N_{R}^{t+1} = (1 - \delta_{HH} - \delta_{HL}) N_H^t + (1 - \delta_{LL} - \delta_{LL}) N_L^t 
+ N_R^t \int \{ \hat{I}_j (z^j, \hat{I}^k) (1 - \gamma_H - \gamma_L) dG(z^j) + \int \{ 1 - \hat{I}_j (z^j, \hat{I}^k) \} (1 - \pi) dG(z^j) \tag{16}
\]
with the initial labor force in the city and in the countryside, denoted by \(N_{0H}^0, N_{0L}^0\) and \(N_{0R}^0\), given, respectively. With the assumption given in (13), equations (14) - (16) can further be simplified as

\[
\begin{align*}
N_{t+1}^{H'} &= \delta_H N_H^t + (1 - \delta_{LL}) N_L^t + N_R^t \int P\left(\mathbf{z}, \mathbf{I}\right) \gamma_H dG(\mathbf{z}), \quad (17) \\
N_{t+1}^{L'} &= (1 - \delta_H) N_H^t + \delta_{LL} N_L^t + N_R^t \left\{ \pi + \int P\left(\mathbf{z}, \mathbf{I}\right) (\gamma_L - \pi) dG(\mathbf{z}) \right\}, \quad (18) \\
N_{R'}^{t+1} &= N_R^t \left\{ (1 - \pi) - \int P\left(\mathbf{z}, \mathbf{I}\right) (\gamma_H + \gamma_L - \pi) dG(\mathbf{z}) \right\}. \quad (19)
\end{align*}
\]

Finally, combining (17) and (18), we can see that the hukou of urban households are passed from one generation to another:

\[
N_{t+1}^{U'} = N_U^t + N_R^t \left\{ \pi + \int P\left(\mathbf{z}, \mathbf{I}\right) (\gamma_H + \gamma_L - \pi) dG(\mathbf{z}) \right\}
\]

where \(N_U^t \equiv N_H^t + N_L^t\) denotes the total urban workforce at time \(t\). Add no return assumption here

In the quantitative analysis below, we will focus on the case where \(\delta_{HH} = 1, \delta_{HL} = 0, 0 < \delta_{LL} < 1\) and \(\delta_{ LH} + \delta_{ LL} = 1\).

### 3.5 Equilibrium

First, all labor markets must be clear under the factor prices \{\(w_H, w_L, w_R\)\} given by (??) and (??):

\[
N_J^{dt} = N_J^t, \quad J = H, L, R \quad (20)
\]

\[
\text{NR} dt = \text{NR} t
\]

where \(N_J^{dt}\) denotes labor demand of type \(J\). Finally, there is the overall population restriction for each period:

\[
N_H^t + N_L^t + N_R^t = N \quad (21)
\]

where \(N\) is the constant population size in each period.

We are now ready to define the equilibrium for our model.

**Definition 1** A competitive equilibrium of the model consists of consumption, migration choice and wage rates, \{\(c^i, c^j, P^i, w_H, w_L, w_R\)\}, such that \(\{w_H, w_L, w_R\}\) are given by (??) and (??), and the parents (generation \(i\)) solve (6) subject to (7), (8) and (9), given initial distributions of population, \(N_{H0}^0, N_{L0}^0\) and \(N_{R0}^0\), in the two locations. In addition, \(\{w_H, w_L, w_R\}\) are such that labor markets clear in all locations as given by (20) and (21).
4 Numerical Analysis

China started a series of economic reform in December 1978, right after the 11th Central Committee of the Communist Party of China. The reform in 1994 abolished the system of joint job assignment for college graduates, and obtaining a college degree in cities does not guarantee an urban job with an urban hukou for rural college graduates anymore. We thus examine the period of 1980 to 2007 and divide the period of 1980 to 2007 into two regimes: (1) the pre-1994 regime, spanning from 1980 to 1994, and (2) the post-1995 regime, for the period from 1995 to 2007. The model is then calibrated to fit the data from China for the two regimes. Based on the calibrated parameters, we back out the urban TFPs for 1981 – 2007 and decompose the effects of zhaosheng and nongmingong on urbanization rates and income levels for both regimes, respectively. Experiments of varying policies on zhaosheng and nongmingong are performed as well.

4.1 Calibration

For calibration purpose, we assume that the utility function takes the CRRA form:

$$u(c) = \frac{c^{1-\varepsilon} - 1}{1-\varepsilon},$$

where $\varepsilon$ is the inverse of the elasticity of intertemporal substitution. We assume that the distribution of children’s talents to be Pareto because it is a distribution commonly associated with wealth and income, which may be correlated with talents. The cdf for talent $z^j$ is given by:

$$G(z^j) = 1 - \left( \frac{z_{\text{min}}}{z^j} \right)^\theta, \quad z^j \geq z_{\text{min}},$$

where $z_{\text{min}}$ and $\theta$ are the location and shape parameter of Pareto distribution respectively. Based on the expected wages in urban area, the job opportunities for college graduates and the migration cost, parents decide whether or not to send their children to urban to attend college. Denote $\hat{z}$ as the threshold of children’s talent such that parents are indifferent between sending their children to cities or keeping their children in rural area if the children possess talent $\hat{z}$. When children are talented such that $z^j \equiv 1/x^j \geq \hat{z}$, their parents will send them to cities to attend college ($\Delta^i(I^k, x^j) \geq 0$), and vice versa.

As what we have mentioned in Section 3.4, we focus on the case of no return migration and no migration from urban to rural area. Also, we are interested in learning the relative economic positions of rural and urban China and how the regional technological disperities shape individuals’
incentives in migration. Therefore, rural per capita income is normalized to one in both regimes, i.e. the rural technology scaling factor $B$ is set at one.\footnote{Although we normalize the rural per capita income to one in both regimes, it should be noted that the annual growth rate of rural real per capita disposable income over 1980-2007 is 6.36\% according to authors’ computation based on Table 10-2, China Statistical Yearbook 2011.} Because of the change in the GJA policy in 1994, our calibration thus involves calibrating parameters for two regimes: the pre-1994 and the post-1995 regime. We assume that the parameters for preference ($\varepsilon$ and $\beta$), child-rearing cost in rural area ($\phi$), talent distribution ($z_{\text{min}}$ and $\theta$), the CES technology parameters ($\alpha$, $\rho$ and $\psi$) are deep parameters and are common across the two regimes. The abolishment of the GJA for college graduates in 1994 justifies that the job finding rates for college graduates ($\gamma_{H}$ and $\gamma_{L}$) are different in two regimes. We also allow the urban TFP ($A$), the level of human capital associated with the high-skilled worker ($h$), the migration cost ($\sigma$), the job finding rates for nongmingong ($\pi$), and the intergenerational job mobility ($\delta_{LL}$) to be different across the two regimes. In the following, we elaborate how we calibrate these parameters.

The model period is set to be 25 years. Data on population by rural and urban residence is obtained and total population is normalized to one in every period as if there is no population growth for the whole economy.\footnote{Source: China Population and Employment Statistics Yearbook.} We categorize workers with educational attainment of college or above as high skilled workers and workers with below college educational attainment as low skilled workers, and compute the stocks of high and low skilled workers in cities based on the data of employment by educational attainment accordingly.\footnote{We only have data on 2002-2007 urban employment by educational attainment. For 1982, 1990, 1995-1999 and 2001, we compute $N_{H}$ and $N_{L}$ using the whole country data with adjustments based on 2002-2007 urban-to-whole country employment by educational attainment data. For 1980, 1985 and 2000, we do the similar adjustments using Barro-Lee (2000) data. For years with no available data, we compute $N_{H}$ and $N_{L}$ with intrapolation.} Following Liao (2013), the annual time preference rate for China is set at 4.43 percent, and hence the parental altruistic factor on children $\beta$ is set to be 0.3384. There is no consensus in the literature regarding the value of the inverse of the intertemporal elasticity of substitution $\varepsilon$. The real business cycle literature conventionally sets $\varepsilon$ to be one. Hall (1989) argued that the inverse of the intertemporal elasticity of substitution is very high. Balvers and Bergstrand (2002) estimated the value of $\varepsilon$ to be 2.04. Chang (1998) chose to set $\varepsilon$ at two. We thus choose to set $\varepsilon$ at two. For the Pareto distribution parameters, following the literature on firm size, productivity and international trade, we first set the location parameter $z_{\text{min}}$ equal to
Besides paying for the tuition and the migration costs if they are to send their children to urban area, rural parents also have to pay for their own consumption and child-rearing expenses. Thus, setting $z_{\text{min}}$ to one means that not every rural parent can afford sending her child to urban area: only parents with relatively talented kids can afford to do so. For the Pareto distribution shape parameter $\theta$, because talents are believed to be correlated with income levels and there is no such estimate for China, we have to borrow the estimate for the U.S. economy. According to Feenberg and Poterba (1993), the estimated average Pareto distribution shape parameter for the income inequality in the U.S. during 1980-1990 is 1.92. We thus set $\theta$ to be 1.92.

There is no nationwide survey on child-rearing cost in rural China. Zhu and Zhang (1996) estimate the child-rearing cost in rural villages in Xianyang, Shaanxi province. They find that the average child-rearing cost for an age 0-16 child in 1995 was 17.4% of family income. We thus set $\phi$ at 0.174 – child-rearing cost amounts to 17.4% of rural household income.

We next turn to calibrate the level of human capital possessed by high-skilled workers ($h$) relative to low-skilled workers in two regimes. We compute $h$ based on the Mincerian method. To do this, we use the return on years of schooling reported by Zhang et al. (2005), together with the data on the average years of schooling for educational attainment of below college and college or above, to compute $h$ for both regimes. The computed $h$ for the pre-1994 and the post-1995 regime are 1.3381 and 1.5922, respectively. Table 1 reports urban employment by education and the years of schooling we assign to each educational attainment, and the average years of schooling by educational attainment computed based on Table 1 is reported in Table 2.

Now we turn to determine the deep CES production function parameters and the wedge of hiring high-skilled workers, $A$, $\alpha$, $\rho$, $\psi$ and $\tau$. We take $\rho$ to be 0.4012 so that the elasticity of substitution between high- and low-skilled labor $1/(1 - \rho)$ equals 1.67 according to Krusell et al. (2000). From the average low-skilled labor share, $\alpha$ can be expressed in terms of $\psi$. Then using the data of the skill premium ($w_H/h/w_L$) and the urban premium ($w_L/w_R$) in two regimes, once $\psi$ is determined, $\tau$ and $A$ in two regimes can be pinned down immediately. We relegate the sources of the data on

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16 The average estimate of the Pareto distribution shape parameter of the US income inequality from 1950-1990 is 2.11.

17 There are estimates for child-rearing costs in urban China. Ye and Ding (1998) study the child-rearing cost for age 0-16 children in Xiamen Special Economic Zone in 1996. They find that average child-rearing cost in Xiamen accounted for 34% of annual family income, and the number for Beijing in 1995 was roughly 20%.
skill premium and urban premium to the Appendix. To determine $\psi$, we write down firms’ unit cost function first:

$$
\Xi(w_H, w_L, \bar{Y}_U; \tau, \psi) = \frac{1}{A} \left\{ \alpha \frac{1}{1-\rho} [(1 + \tau) w_H]^\frac{\rho}{1-\rho} + (1 - \alpha) \frac{1}{1-\rho} w_L^\frac{\rho}{1-\rho} \right\}^{-(1-\rho)} - (1 + \tau) \frac{\psi}{N_H} SR_H
$$

where $SR_H \equiv w_H \cdot N_H h / \bar{Y}_U$ and $\bar{Y}_U$ is the level of urban output. Examine the unit cost function above. The first big term on the right-hand-side of the equation is the costs of hiring high and low skill workers to produce one unit of good, while the second term is the unit cost “saved” by the constant $\psi$. Define $\Psi(w_H, w_L, \bar{Y}_U; \tau, \psi) \equiv A (1 + \tau) \frac{\psi}{N_H} / \left\{ \alpha \frac{1}{1-\rho} [(1 + \tau) w_H]^\frac{\rho}{1-\rho} + (1 - \alpha) \frac{1}{1-\rho} w_L^\frac{\rho}{1-\rho} \right\}^{-(1-\rho)}$, i.e. $\Psi(w_H, w_L, \bar{Y}_U; \tau, \psi)$ is the share of the unit cost reduced by the existence of $\psi$. We set $\Psi(w_H, w_L, \bar{Y}_U; \tau, \psi)$ at 0.5 because China’s urban labor share only amounts to 50% of total urban output during 1980-2007. $\psi$ is thus solved as 0.0422, and $\alpha$ is solved as 0.7277. Urban TFP $A$ and wedge $\tau$ in two regimes are solved as well. The results are reported in Table 5.

We proceed on determining the job finding rates for rural workers ($\pi$) and college graduates ($\gamma_H$ and $\gamma_L$) from data. Note that our model abstracts from issues such as endogenous fertility, marriage and mortality. Since China adopts a much stricter one-child policy in urban area than in rural area and there is no available nationwide survey on migration in China, we believe that the change in urban population is a good proxy for rural to urban migration. Hence, we multiply the change in urban population by working related migration reasons (column 3-5 in Table 4) to obtain the total number of migrant workers, and we then divide the total number of migrant workers by rural population stocks to obtain the probability for a rural worker to migrate to cities to work. The average probabilities for the pre-1994 and post-1995 regime are 0.3554% and 0.8282%, respectively. We hence set these two numbers as $\pi$ in the model for the two regimes. For job finding rates for college graduates, under the GJA scheme before 1994, college graduates were assigned jobs immediately upon or before graduation. Usually the assigned jobs are either in the government sector or in the state-owned enterprises. It is thus straightforward to set $\gamma_H = 1$ and $\gamma_L = 0$ for the pre-1994 regime. For the post-1995 regime, we define $\gamma \equiv \gamma_H + \gamma_L$ as the urban employment rate and $1 - \gamma$ as the unemployment rate for migrant college-graduates. In this way we can write

18 Data on migration by reasons are taken from the 1990 and 2000 census. The 1990 census reports information on the immigration by reasons (by residence of 1985) and the 2000 census reports information on emigration by reasons. To match the notion of migration in our model, we categorize immigration (emigration) flow due to learn and train as migration through zhaosheng, and categorize immigration (emigration) flow due to work and business, work and transfer, assign and employ as “working migration” or “migration due to work”.
\( \gamma_H = \gamma - \gamma_L \). From the data, the average employment rate in city districts in 1995-2007 is 0.9627.19

Albeit we do not have information on job mismatching rate for college graduates, we believe that the job mismatching rate should be low over 1995-2007 and hence we choose to set \( \gamma_L \) at 0.05. Thus, \( \gamma_H \) is solved as 0.9127.

With the assumptions \( \delta_{HH} = 1, \delta_{HL} = 0, 0 < \delta_{LL} < 1 \) and \( \delta_{LH} + \delta_{LL} = 1 \), high-skilled parents always have high-skilled children while low-skilled parents may have high-skilled children. To calibrate \( \delta_{LL} \), we first compute the zhaosheng flow from data in the same way that we compute the numbers of working migrants. Based on the computed zhaosheng flow, we compute the model implied stocks of rural workers and urban high- and low-skilled workers according to the evolution of workers equations, (17)-(19). We then match the model computed \( N_H/N_L \) ratio to the average \( N_H/N_L \) data for the pre-1994 and post-1995 regimes. \( \delta_{LL} \) is thus solved as 0.9996 and 0.9885 for the pre-1994 and post-1995 regimes, respectively. Our calibration result shows that the upward occupational mobility in China has improved over 1995-2007.

We finally turn to calibrate the migration costs \( \sigma \) for both the pre-1994 and post-1995 regime. We will use the indifference boundary (10) to pin down \( \sigma \). For the indifference boundary (10), there is still one variable that is unknown to us – the threshold talent \( \hat{z} \). Rural children will be sent to urban area to accept college education if the level of their talents is higher than \( \hat{z} \). The endogenous threshold in talent \( \hat{z} \) therefore dichotomizes the “destiny” of rural children, deciding whether they belong to the “sent” group or the “stay” group. More specifically, define \( \tilde{N}_E^t \) as the zhaosheng flow at time \( t \). Because children’s talent follows Pareto distribution, \( \tilde{N}_E^t \) can be written as:

\[
\tilde{N}_E^t = N_R^t \int I^j \left( z^j, I^k \right) dG(z^j) = N_R^t \left( \frac{z_{\min}}{\hat{z}} \right)^\theta.
\]

It can be easily seen that \( \hat{z} = z_{\min} (N_R^t/\tilde{N}_E^t)^{1/\theta} \) from (22). Hence, \( \hat{z} \) can be computed using zhaosheng flow data, and the average \( \hat{z}'s \) for the pre-1994 and post-1995 regime are equal to 42.3628 and 28.6075, respectively. By setting the indifference boundary (10) to zero \( (\Delta^i(I^k, z^j) = 0) \) and plugging in the computed \( \hat{z}'s \) for the two regimes, the migration costs \( \sigma \) are solved as 0.1132 and 0.1262, respectively.20

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19 In the model, \( \gamma \) refers to the employment rate for college graduates migrating from rural area. However, there is no counterpart in the data. We thus have to use urban employment rate, computed by the formula: 1—total registered unemployed persons (with urban non-agricultural hukou)/total work force in urban area. We are aware that the actual employment rate in urban area should be lower, but this is the best data we have.

20 Based on the estimates in Zhao (1999b), Liu (2011) sets the migration costs at the level of 15% of annual income. Our results are not far away from hers.
Table 5 summarizes the calibration results for the two regimes. Our task next is to calibrate the annual urban TFP for the period of 1981-2007. Once the annual urban TFP is obtained, we are able to decompose the effects of the urban inflows of zhaosheng and migrant workers on output levels as well as conducting policy experiments on varying migration policies.

4.2 Simulation and calibrating the annual urban TFP

To calibrate annual urban TFP, we simulate the model so that the skill premium and the urban premium in the model exactly match the data. In the following, we elaborate the procedure of the simulation.

In the two-regime calibration, the human capital possessed by high-skilled workers \((h)\) are computed based on Mincerian method and is equal to 1.3381 and 1.5922 in the pre-1994 and post-1995 regime, respectively. We assume that the annual growth rate of human capital holds constant during the period of 1980-2007. We then derive the \(h\) series for 1980-2007 so that the average human capital for the pre-1994 and post-1995 regime are equal to 1.3381 and 1.5922. Similar to that in the two-regime calibration, the rural TFP is normalized to one throughout 1980-2007. The simulation procedure goes as follows: given the 1980 data on \(N_R\), \(N_H\) and \(N_L\) and the initial guess of the threshold talent \(\hat{z}\) for 1980-2007, we compute \(N_R\), \(N_H\) and \(N_L\) according to the evolution of workers equations, (14)-(16). Based on the computed \(N_R\), \(N_H\) and \(N_L\) and the data on the urban premium and skill premium, the high-skilled workers hiring wedge \(\tau\) and the urban TFP \(A\) are solved and the high- and low skilled wages, \(w_H\) and \(w_L\) are computed. Next, taking the wages in urban area and their children’s decision rule as given (i.e. taking the threshold talent \(\hat{z}\) of their grandchildren as given), we solve parents’ maximization problem (6) and obtain the new thresholds of talent \(\hat{z}\) for 1980-2007. Finally, we compare the new thresholds \(\hat{z}\) to the initial guess. If the \(\hat{z}\)s are different, we update the guesses of \(\hat{z}\) with the new \(\hat{z}\)s. The urban TFP series and the wedges \(\tau\) over 1981-2007 are solved when the thresholds of each year converges, under which the equilibrium wages in urban area, urban population inflows, and the stocks of workers in urban and in rural areas are found as well.

Figure 1 plots the calibrated urban TFP (relative to rural TFP) over 1981-2007. It can be noted that the urban TFP relative to rural TFP decreases in 1981-1985, showing that the rural area was “catching up” with the urban area after a series of economic reforms started in 1978. This pattern is not surprising because when the economic reforms first started, the focus was on the decollec-
tivization of agriculture under which rural households are allowed to run privately-owned business. After 1985, the urban TFP relative to rural TFP exhibits a slightly upward trend, corresponding to the economic reform policies on privatization of state-owned enterprises and deregulations of price controls.

Define the urbanization rate \( N_U \) as the percentage of total workers in urban area, i.e. \( N_U = N_H + N_L \). Figures 2(a)-(b) compare the model performances to the data on the urbanization rates (panel (a)) and the stocks of urban high- and low-skilled workers (panel (b)). It is not surprising to see our model showing a lower urbanization rate than that in the data, and the discrepancy between the model and the data widens as time goes by. The reason is that migration due to education and working reasons only accounts for about 50% of total migration. Migrants due to non-educational or non-working reasons shall be classified as low-skilled workers in the model; however, we do not account for these people when calibrating the model. As a result, our model underperforms in urbanization rates, and the discrepancy mainly comes from the undercounting in low-skilled worker, as shown in Figure 2(b).

Figure 3(a)-(b) further compare the model and the “computed” data on urban output per capita and aggregate output levels in the economy. Since there are fewer low skilled workers in urban area in the model than in the data, the urban output per capita in the model is higher than that in the computed data. For total output levels, as there are more workers being “kept” in rural area in the model than that in the data and rural technology is less productive, aggregate total output levels in the data are lower than that in the computed data.

### 4.3 Decomposition: The effects of zhaosheng and nongmingong workers

To examine the effects of migration on output levels and urbanization rates, we examine the output levels by shutting down the migration through zhaosheng, migration via working, and finally we completely shut down the rural-urban migration. We then compare the urban and total output levels as well as the urbanization rates under the three scenarios to that of the benchmark model. By doing this, we are able to decompose the effects of zhaosheng and nongmingong on the development of China.

Figures 4 (a)-(c) depict the urban output per capita, the total output levels and the urbaniza-

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21 Based on equations (1) and (4), we use the data on \( N_H, N_L \) and \( N_R \) to obtain the computed data on urban output per capita and aggregate output levels.
tion rates for the benchmark model for the three scenarios: (1) migration is allowed only through zhaosheng; (2) migration is allowed only through working; and (3) both channels of migration are shut down. When only migration through zhaosheng channel is allowed, urban area is populated by more productive high-skilled workers so that urban output per capita is higher compared to that in the benchmark model. Regarding urbanization rate, there is very little increase in urbanization if only migration through zhaosheng is allowed. For the scenario where only working migration is allowed, urban output per capita decreases and is lower than the benchmark model with no surprise; urbanization rate is now very close to that in the benchmark model. This result indicates again the fact that zhaosheng only constitutes a very small proportion of rural-urban migration. The magnitude of the depression in total output level is about the same level to that when zhaosheng is shut down. This result shows that albeit small in terms of quantity for migration through zhaosheng, the contribution of zhaosheng to output levels cannot be neglected.

To learn more about the effects of migration on output levels, we compute the output levels in urban area and in the whole economy relative to the benchmark model in the three scenarios, and we report the contributions of each migration channel to urban and total output in Table 6 and Table 7. We find that urban output would be 15.89 percent lower than that in the benchmark model and total output would be 7.75 percent lower during 1981-2007. We also find a complementarity between college graduates and migrant workers in production: and migration via zhaosheng contributes to more of the increase in total output. When migration is completely shut down, the average urban output decreases by 7.51 percent and 24.91 percent for the pre-1994 and the post-1995 regime, respectively. This result indicates that the contribution of migration on income levels intensifies as time goes by. We see the similar pattern but smaller magnitude for total output: when migration is completely shut down, the total output will be 2.87 percent and 13.01 percent lower than that in the benchmark model for the pre-1994 and post-1995 regime. Among the two channels of migration, Table 6 and Table 7 also show that the channel of zhaosheng is almost equally important to the channel of nongmingong. For urban output, the contributions of zhaosheng and working migration on urban output are at the similar level of 3.59 percent and 3.64 percent in the pre-1994 regime. The working migration becomes more important for urban output levels in the post-1995 regime, contributing to 13.70 percent of total urban output. Turn to total output levels. Table 7 shows that zhaosheng actually contributes more to total output in both regimes.

We also find complementarity between high- and low-skilled workers, although the complemen-
tary is more important for urban production in the post-1995 regime, explaining 0.92 percent of urban output in the model. It is easy to understand why there exists such complementarity in production: When both channels of migration are allowed, the complementarity between the high and low-skilled workers in production leads to a higher high-skilled wage when there is a larger stock of low-skilled workers in urban area. This makes college education more attractive, and more rural parents are willing to send their children to cities to attend college. We dismiss the discussion on the effects of migration on urban output per capita and relegate the table reporting the decomposition of urban output per capita to the Appendix.

4.4 Counterfactual analysis

We consider the following policy experiments including: (1) continuation of the GJA in the post-1995 regime; (2) experiments on the working migration policies; (3) constant migration costs throughout 1980-2007; (4) decreases in child-rearing cost; and (5) urban TFP increases by 5 percent relative to that in the benchmark model over 1981-2007. The results of (1)-(4) are reported in Tables 8 and 9, and the results of (5) are reported in Table 10. In the following, we discuss each of the cases one by one.

(1) Continuation of the Government Job Assignment

We first examine the case where the GJA is being implemented in the post-1995 regime. One would expect that when there is continuation of the GJA, the expected payoff of college education will be higher and college education becomes more attractive. Rural parents will thus be more willing to send their children to attend college in urban area, resulting in a higher high-to-low-skilled-labor ratio and a higher urbanization rate. Despite a very moderate increase in the high-to-low-skilled-labor ratio and the urbanization rate, the patterns shown in Figures 5(a)(b) are in line with such expectation. Both the increases in the urban output level and total output are very small: the urban output and total output increase by 1.09 percent for the post-1995 regime. The reason why continuation of the GJA only leads to slight increase in output levels is that the job finding rate for college graduates is very close to one. Our result thus provides justification for the abolishment of the GJA in 1994 because the negative impact of the annulment of the GJA is minor, and the Chinese government should stopped “subsidizing” college graduates in terms of providing guaranteed jobs.

(2) Policies on working migration

What would happen if China had loosened the control over the hukou system and allow more
rural migrant workers to work in cities since 1980? What would be the consequences if China had not loosened the control over rural-urban migration in the 1990s? Here we examine two cases of varying regulations on working migration. More specifically, in the first case, we keep $\pi$ at 0.0083 throughout 1980-2007 (i.e. the pre-1994 regime has the same regulation on rural-urban migration as that in the post-1995 regime); in the second case, we set $\pi$ at 0.0036 in the period of 1980-2007 (i.e. the post-1995 regime has the same strict regulation on rural-urban migration as that in the pre-1995 regime). Again, the results are reported in Table 8 and Table 9, and Figure 7 and Figure 8 plot the urbanization, the high-to-low-skilled labor ratios, the urban output per capita and the total output for these two cases.

We find that, with a more relaxing migration policy in the pre-1994 regime, the urbanization rate will be 4.46 percent more than that in the benchmark model, reaching 37.65 percent by the year 2007. The influx of low-skilled workers from rural area in the pre-1994 regime keeps contributing to output production (as their children also stay in urban area to work) in the post-1995 regime, and attracts more migration through zhaosheng as high-skilled wages are higher as the stock of low-skilled worker is larger. The average increase in urban output amounts to 4.81 percent and 9.18 percent to that of the benchmark model in the pre-1994 and post-1995 regime. Because there are more low-skilled workers in urban area, urban output per capita will be depressed as a result, though the total output level will still increase due to the fact that there is a higher labor force in the more productive urban sector. Total output for the entire economy will increase by 1.16, 4.11 and 2.58 percent for the pre-1994 regime, the post-1995 regime and over 1981-2007, respectively.

As for the case where the regulation on working migration in China had not been slackened in the post-1995 regime, the average urban output and total output would be 3.57 percent and 1.51 percent lower than that in the benchmark model over 1995-2007. The urbanization rate is also depressed as well, reaching only 28.94 percent by 2007 – about 4.25 percent lower than that for the benchmark model. Not surprisingly, with a smaller influx of low-skilled workers from countryside, the urban per capita income is higher, and the high-to-low-skilled labor ratio is higher as well. The result also indicates that when the low-skilled labor in the cities is smaller, the marginal productivity of high-skilled workers will be smaller, leading to a lower high-skilled wage and depressing parents’ incentive to send children to cities to attend college.

(3) Constant migration cost

We now turn to examine the case where the migration cost is held constant over 1981-2007.
Recall that rural household income is normalized to one over 1980-2007 in the calibration and simulation. The result from the two-regime calibration shows that the migration cost relatively to rural household income has increased by about 11.45 percent in the post-1995 regime – an increase that cannot be considered small. The raise in migration cost could be attributed to the increasing living cost in urban area as pointed out by Zhang and Song (2003). We thus consider performing an experiment, assuming that migration cost is held constant (relative to rural household income) at the pre-1994 level. The results are reported in Panels C of Tables 8 and 9.

When migration cost is lower in the post-1995 period, rural parents’ costs of sending children to urban area to attend college is lower. Therefore, there will be more migration through the zhaosheng channel. As shown in Figures 9 and 10, the results of this experiment is very similar to that of the continuation of the GJA policy but the impacts on output levels and urbanization rate are much bigger: the average increases in urban output, urban output per capita and total output are 4.01, 2.23 and 2.59 percent during the period of 1995-2007, respectively.

(4) Decreases in the child-rearing cost

We consider the case where child-rearing cost is lowered down by 10 percent for the entire period of 1980-2007. Panels D of Tables 8 and 9 report the results of this experiment, and Figures 11 and 12 plot the urbanization rate, the high-to-low-skilled labor ratio, the urban output per capita and total output for 1981-2007. A decline in the child-rearing cost relaxes rural parents’ budget constraint, and now rural parents are more affordable to send their children to cities to accept education. We find that the effect of a lower child-rearing cost is very similar to that of lowering down the migration costs: urbanization rate slightly increases, urban output, urban output per capita and total output all increase as a result. Moreover, Table 9 shows that, the overall impact on total output from a smaller child-rearing cost for 1980-2007 is very close to that from holding migration cost constant in the post-1995 regime (1.27 percent vs. 1.25 percent).

Based on the results in experiments (3) and (4) we conclude that if the Chinese government were to promote educational migration, providing financial support to reduce rural students’ living costs in cities will be a better way than providing universal subsidy to rural children.

(5) Improvement in the urban TFP

Finally, we examine the effects of the improvement in the urban TFP on migration and output levels. When the urban TFP is increased, both the high- and low-skilled wage will increase. As
rural migrant workers are entirely passive in our model (they are relocated to urban area because of “luck”), only rural parents will respond to such improvement in the urban TFP. Therefore, an increase in the urban TFP will not result in a “one-to-one” increase in urban output: a five percent increase in the urban TFP (throughout 1981-2007) will boost up urban output, urban per capita output and total output by 1.91 percent, 1.17 percent and 1.11 percent over 1981-2007, respectively, showing an output elasticity with respect to the urban TFP of between 0.22 to 0.38.

Because the increases in migration mainly come from the zhaosheng channel, the urbanization rate and the high-to-low-skilled labor ratio only increase slightly, similar to what we have seen in scenarios (1), (3) and (4). The urbanization rate is only only 0.33 percent higher than that in the benchmark model by 2007, and the high-to-low-skilled labor ratio is only 1.34 percent higher than that in the benchmark model by 2007. We report in Table 10 the results and plot in Figures 13 and 14 the urbanization rate, the high-to-low-skilled labor ratio, the urban output per capita and total output for 1981-2007.

5 Conclusions

The unique household registration system, or hukou system, in China has aroused more and more interests in research recently. This paper attempts to explore the economic impact of the hukou system on the Chinese economy, with a focus on one of the important migration channels: zhaosheng. To examine the effects of working migration on the development of China, we also incorporate the channel of working migration, albeit in a more reduced-form manner, in our model. More specifically, we develop a general equilibrium framework and formally model rural parents’ decision on whether to send children to cities to attend college. The model is calibrated to fit the Chinese economy. Decomposition analysis on examining the effects of zhaosheng and working migration is performed, and counterfactual experiments such as varying migration policies and migration costs are carried out.

We find that migration indeed contributes greatly to the development of China: If rural-urban migration is completely debarred, urban output would be 15.89 percent lower than that in the benchmark model and total output would be 7.75 percent lower during 1981-2007. Despite the small quantity of high-skilled workers and migration through zhaosheng, we find that the contribution of

\[ \text{Since the total population is normalized to one, if there are more workers in urban area and more rural parents sending children to attend college, there will be less migration through the working channel.} \]
Our counterfactual analysis shows that the continuation of the government job assignment scheme for college graduates would not bring much benefits to the economy, and thus our results provide justification for the abolishment of the government job assignment scheme in 1994. Had China adopted a more relaxing policy on rural migrant workers, the total output would be 2.58 percent higher in 1981-2007. We also find that, providing urban living support for college students from rural areas may be a good way to promote educational migration. Furthermore, the output elasticity with respect to the urban TFP is found to be fall within the range of 0.22 to 0.38.

This paper starts with the aim of examining the contribution of zhaosheng on the development of China. It would be interesting to extend the framework developed here to study various issues on migration for developing countries, such as rural workers’ decision on working migration or domestic workers’ decision on moving to foreign countries. We will put this in our research agenda.
References


Figure 1: Calibrated urban TFP over 1981-2007

Note: Rural TFP is normalized to one throughout.
Figure 2: Benchmark - urbanization rates and urban high and low skilled workers

(a) Urbanization rate

(b) Urban high and low skilled labor
Figure 3: Benchmark - urban output per capita and total output
Figure 4: Decomposition

(a) Urban output per capita
(b) Total output
(c) Urbanization rate
Figure 5: Continuation of the GJA policy ($\gamma_H = 1$ in the post-1995 regime)

(a) Urbanization rate

(b) Urban high to low skilled labor ratio
Figure 6: Continuation of the GJA policy ($\gamma_H = 1$ in the post-1995 regime)

(a) Urban per capita output

(b) Total Output
Figure 7: Policies on working migration

(a) Urbanization rate

Benchmark model
Better job opportunities
Worse job opportunities

(b) Urban high to low skilled labor ratio

Year
Figure 8: Policies on working migration

(a) Urban output per capita
- Benchmark model
- Better job opportunities
- Worse job opportunities

(b) Total Output
- Year
- Total output
- 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7

Figure 9: The same migration cost

(a) Urbanization rate

(b) Urban high to low skilled labor ratio
Figure 10: The same migration cost

(a) Urban output per capita

(b) Total output
Figure 11: Subsidy on child-rearing cost

(a) Urbanization rate

(b) Urban high to low skilled labor ratio
Figure 12: Subsidy on child-rearing cost

(a) Urban output per capita

(b) Total output
Figure 13: An increase in urban TFP

(a) Urbanization rate

(b) Urban high to low skilled labor ratio
Figure 14: An increase in urban TFP

(a) Urban output per capita

(b) Total output
Table 1: Urban employment by education

<table>
<thead>
<tr>
<th>Education Attainment</th>
<th>Years of schooling</th>
<th>1995</th>
<th>2002</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>College or above</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate</td>
<td>10.6%</td>
<td>15.9%</td>
<td>16.2%</td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>16.4%</td>
<td>4.4%</td>
<td>5.8%</td>
<td></td>
</tr>
<tr>
<td>Junior college</td>
<td>14.2%</td>
<td>9.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average years of schooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College or above</td>
<td>14.63</td>
<td>14.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below college</td>
<td>89.4%</td>
<td>84.1%</td>
<td>83.8%</td>
<td></td>
</tr>
<tr>
<td>Senior high</td>
<td>89.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior high</td>
<td>39.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>20.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-illiterate or illiterate</td>
<td>4.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average years of schooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below college</td>
<td>8.72</td>
<td>9.19</td>
<td>8.99</td>
<td></td>
</tr>
</tbody>
</table>

Source:

Table 2: Average years of schooling

<table>
<thead>
<tr>
<th>Year</th>
<th>Below college</th>
<th>College or above</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>7.79</td>
<td>14.00</td>
</tr>
<tr>
<td>1988</td>
<td>8.25</td>
<td>14.21</td>
</tr>
<tr>
<td>1995</td>
<td>8.72</td>
<td>14.42***</td>
</tr>
<tr>
<td>2002</td>
<td>9.19</td>
<td>14.63</td>
</tr>
<tr>
<td>Average years of schooling</td>
<td>8.49</td>
<td>14.31</td>
</tr>
</tbody>
</table>

Note: 1981 and 1988 are obtained from backward extrapolation using on 1995, 2002 and 2009 data.

Table 3: Zhaosheng flow and the probability of working migration

<table>
<thead>
<tr>
<th>Zhaosheng flow</th>
<th>Prob. of working migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1994</td>
<td>0.00058946</td>
</tr>
<tr>
<td>Post-1995</td>
<td>0.00114381</td>
</tr>
</tbody>
</table>

Source: Authors' calculation using the average of 1990 and 2000 migration reasons.
Table 4: Migration by reasons

<table>
<thead>
<tr>
<th>Cause of Migration</th>
<th>Total</th>
<th>Job Transfer</th>
<th>Job Assignment</th>
<th>Work or Business</th>
<th>Study or Training</th>
<th>Other than working and studying</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>100.00%</td>
<td>29.57%</td>
<td>8.04%</td>
<td>3.08%</td>
<td>11.26%</td>
<td>48.05%</td>
</tr>
<tr>
<td>2000</td>
<td>100.00%</td>
<td>5.32%</td>
<td>3.76%</td>
<td>33.55%</td>
<td>6.84%</td>
<td>50.53%</td>
</tr>
<tr>
<td>Average</td>
<td>100.00%</td>
<td>17.44%</td>
<td>5.90%</td>
<td>18.32%</td>
<td>9.05%</td>
<td>49.29%</td>
</tr>
</tbody>
</table>

Note:
1. Source: Authors’ computation based on 1990 census and 2000 census data.
2. In the census, migration reasons include migration due to job transfer, job assignment, work or business, study and training, to relative and friend, retired or resigned (1985 data only), moved with family, marriage, pull down and move (2000 data only) and other reasons. We categorize migration due to job transfer, job assignment and work or business as migration via the channel of nongmingong, and migration due to study or training as migration via zhaosheng.
Table 5: Parameters and calibrated results

<table>
<thead>
<tr>
<th>Data</th>
<th>Pre-1994</th>
<th>Post-1995</th>
<th>Source/Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_H/h/w_L$</td>
<td>1.2296</td>
<td>1.6576</td>
<td></td>
</tr>
<tr>
<td>$w_L/w_R$</td>
<td>1.7781</td>
<td>2.0076</td>
<td></td>
</tr>
<tr>
<td>Preset parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\phi$</td>
<td>0.174</td>
<td>0.174</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.3384</td>
<td>0.3384</td>
<td></td>
</tr>
<tr>
<td>$\theta$</td>
<td>1.92</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>$z_{min}$</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$h$</td>
<td>1.3381</td>
<td>1.5922</td>
<td></td>
</tr>
<tr>
<td>$\psi$ value</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.4012</td>
<td>0.4012</td>
<td></td>
</tr>
<tr>
<td>$B$</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>-</td>
<td>0.9627</td>
<td></td>
</tr>
<tr>
<td>$\gamma_L$</td>
<td>0</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>$\pi$</td>
<td>0.0036</td>
<td>0.0083</td>
<td></td>
</tr>
<tr>
<td>$\delta_{HH}$</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Calibrated parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.7277</td>
<td>0.7277</td>
<td></td>
</tr>
<tr>
<td>$\gamma_H$</td>
<td>1</td>
<td>0.9127</td>
<td></td>
</tr>
<tr>
<td>$\delta_{LL}$</td>
<td>0.9996</td>
<td>0.9885</td>
<td></td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.1132</td>
<td>0.1262</td>
<td></td>
</tr>
<tr>
<td>$A$</td>
<td>10.6498</td>
<td>10.3071</td>
<td></td>
</tr>
<tr>
<td>$\tau$</td>
<td>4.9942</td>
<td>3.1595</td>
<td></td>
</tr>
</tbody>
</table>
Table 6: Dynamics - Urban output decomposition

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Output level relative to the benchmark model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No rural-urban migration</td>
<td>92.49%</td>
<td>75.09%</td>
<td>84.11%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>96.07%</td>
<td>85.38%</td>
<td>90.92%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>96.13%</td>
<td>88.80%</td>
<td>92.60%</td>
</tr>
<tr>
<td><strong>B. Contribution of each channel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total migration</td>
<td>7.51%</td>
<td>24.91%</td>
<td>15.89%</td>
</tr>
<tr>
<td>Zhaosheng and nongmingong (no interaction)</td>
<td>7.23%</td>
<td>23.99%</td>
<td>15.30%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>3.59%</td>
<td>10.29%</td>
<td>6.81%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>3.64%</td>
<td>13.70%</td>
<td>8.49%</td>
</tr>
<tr>
<td>Residual (interaction)</td>
<td>0.28%</td>
<td>0.92%</td>
<td>0.59%</td>
</tr>
</tbody>
</table>

Note: The benchmark is 100%. Contribution of total migration is the difference between the benchmark model and no rural-urban migration.

Table 7: Dynamics - Total output decomposition

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Output level relative to the benchmark model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No rural-urban migration</td>
<td>97.13%</td>
<td>86.99%</td>
<td>92.25%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>99.00%</td>
<td>93.47%</td>
<td>96.34%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>97.98%</td>
<td>92.89%</td>
<td>95.53%</td>
</tr>
<tr>
<td><strong>B. Contribution of each channel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total migration</td>
<td>2.87%</td>
<td>13.01%</td>
<td>7.75%</td>
</tr>
<tr>
<td>Zhaosheng and nongmingong (no interaction)</td>
<td>2.71%</td>
<td>12.39%</td>
<td>7.37%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>1.86%</td>
<td>6.49%</td>
<td>4.09%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>0.85%</td>
<td>5.90%</td>
<td>3.28%</td>
</tr>
<tr>
<td>Residual (interaction)</td>
<td>0.16%</td>
<td>0.63%</td>
<td>0.38%</td>
</tr>
</tbody>
</table>

Note: The benchmark is 100%. Contribution of total migration is the difference between the benchmark model and no rural-urban migration.
### Table 8: Dynamics on policy analysis - urban output

<table>
<thead>
<tr>
<th>Counterfactual analysis</th>
<th>Output level relative to the benchmark model (benchmark model = 100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Policies on GJA</strong></td>
<td></td>
</tr>
<tr>
<td>Continuation of GJA</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>B. Policies on nongmingong</strong></td>
<td></td>
</tr>
<tr>
<td>Better job opportunities</td>
<td>104.81%</td>
</tr>
<tr>
<td>Worse job opportunities</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>C. Policy on migration cost</strong></td>
<td></td>
</tr>
<tr>
<td>Same migration cost</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>D. Reduction of child-rearing cost</strong></td>
<td></td>
</tr>
<tr>
<td>10% lower</td>
<td>101.21%</td>
</tr>
</tbody>
</table>

### Table 9: Dynamics on policy analysis - total output

<table>
<thead>
<tr>
<th>Counterfactual analysis</th>
<th>Output level relative to the benchmark model (benchmark model = 100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Policies on GJA</strong></td>
<td></td>
</tr>
<tr>
<td>Continuation of GJA</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>B. Policies on nongmingong</strong></td>
<td></td>
</tr>
<tr>
<td>Better job opportunities</td>
<td>101.16%</td>
</tr>
<tr>
<td>Worse job opportunities</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>C. Policy on migration cost</strong></td>
<td></td>
</tr>
<tr>
<td>Same migration cost</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>D. Reduction of child-rearing cost</strong></td>
<td></td>
</tr>
<tr>
<td>10% lower</td>
<td>100.63%</td>
</tr>
</tbody>
</table>
## Table 10: Dynamics - improvement on urban TFP

<table>
<thead>
<tr>
<th></th>
<th>Output level relative to the benchmark model (benchmark model = 100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban output</td>
<td>101.42%</td>
</tr>
<tr>
<td>Urban per capita output</td>
<td>100.91%</td>
</tr>
<tr>
<td>Total output</td>
<td>100.73%</td>
</tr>
</tbody>
</table>

## Table A.1: Dynamics - Urban per capita output decomposition

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Output level relative to the benchmark model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No rural-urban migration</td>
<td>103.79%</td>
<td>111.30%</td>
<td>107.41%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>106.29%</td>
<td>118.58%</td>
<td>112.21%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>97.45%</td>
<td>92.92%</td>
<td>95.27%</td>
</tr>
<tr>
<td><strong>B. Contribution of each channel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total migration</td>
<td>-3.79%</td>
<td>-11.30%</td>
<td>-7.41%</td>
</tr>
<tr>
<td>Zhaosheng and nongmingong (no interaction)</td>
<td>-3.85%</td>
<td>-11.11%</td>
<td>-7.34%</td>
</tr>
<tr>
<td>Zhaosheng only</td>
<td>2.49%</td>
<td>7.28%</td>
<td>4.80%</td>
</tr>
<tr>
<td>Nongmingong only</td>
<td>-6.34%</td>
<td>-18.39%</td>
<td>-12.14%</td>
</tr>
<tr>
<td>Residual (interaction)</td>
<td>0.05%</td>
<td>-0.19%</td>
<td>-0.07%</td>
</tr>
</tbody>
</table>

Note: The benchmark is 100%. Contribution of total migration is the difference between the benchmark model and no rural-urban migration.

## Table A.2: Dynamics on policy analysis - urban per capita output

<table>
<thead>
<tr>
<th>Counterfactual analysis</th>
<th>Output level relative to the benchmark model (benchmark model = 100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Policies on GJA</strong></td>
<td></td>
</tr>
<tr>
<td>Continuation of GJA</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>B. Policies on nongmingong</strong></td>
<td></td>
</tr>
<tr>
<td>Better job opportunities</td>
<td>93.60%</td>
</tr>
<tr>
<td>Worse job opportunities</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>C. Policy on migration cost</strong></td>
<td></td>
</tr>
<tr>
<td>Same migration cost</td>
<td>100.00%</td>
</tr>
<tr>
<td><strong>D. Reduction of child-rearing cost</strong></td>
<td></td>
</tr>
<tr>
<td>10% lower</td>
<td>100.77%</td>
</tr>
</tbody>
</table>
Appendix A: Data sources

The ratio of high-skilled to low-skilled wage ($w_H/w_L$)

- **Pre-1994:**

  In the model, both high-skilled and low-skilled workers live in urban areas. However, the data that exactly matches the definition of our model is not available. Thus, we use the data of the whole country instead.

  The average wage of staff and workers by sector are used to compute this ratio. First, because in our model high-skilled and low-skilled workers are both in urban areas, the following agricultural sectors are excluded: farming, forestry, animal husbandry, and fishery sector and the mining and quarrying sector. Then we sort the average wage data (average of 1980-1994) and divide those sectors into two groups. The group with higher wages is called high-skilled wage. Another group is called low-skilled wage. Wages in each sector is weighed by the corresponding proportion of employed persons. Finally, weighted average wage in each group is computed and the ratio of high-skilled to low-skilled wage is obtained.

  The wage data is from Table 5-24: average wage of staff and workers by sector. The number of employed persons is from Table 5-6: number of employed persons at the year-end by sector. Both are from China Statistical Yearbook 2005.

- **Post-1995:**

  The computation procedure is the same as that in the pre-1994 regime. However, due to the availability of employed persons data, we only use data during 2003-2007. The wage data is from Table 4-15: average wage of employed persons in urban units by sector. The employed persons data is from Table 4-6: number of employed persons in urban units at year-end by sector and region. Both are from China Statistical Yearbook 2011.

The ratio of low-skilled to rural wage ($w_L/w_R$)

- **Pre-1994 and Post-1995:**

  The ratio is computed by dividing per capita annual disposable income of urban households by per capital annual net income of rural household. Both are from Table 10-2: per capita
annual income and Engel’s coefficient of urban and rural households (in Chinese) in China Statistical Yearbook.

The ratio of high-skilled to low-skilled workers \( (N_H/N_L) \)

- Pre-1994 and Post-1995:

Following the procedure in computing \( w_H/w_L \), the data of number of employed persons is divided into two groups: high-skilled and low-skilled workers. Then the ratio of high-skilled to low-skilled workers is computed for each year.

As described in the explanation of computing \( w_H/w_L \), there are two data sets available: number of employed persons by sector in 1980-2002 and number of employed persons in urban units by sector in 2003-2011. The former one is the data of the whole country but the latter one is in urban units. Therefore, the computed ratios of high-skilled to low-skilled workers are inconsistent. To deal with this problem, we choose the latter one as the baseline (for \( N_H/N_L \) in 2003-2011). Then, we use the \( N_H/N_L \) growth rate obtained from the former data set to calculate the \( N_H/N_L \) ratio of 1980-2002 accordingly.

Number of employed persons in 1980-2002 is from Table 5-6: number of employed persons at the year-end by sector in China Statistical Yearbook 2005. Number of employed persons in 2003-2011 is from Table 4-6: number of employed persons in urban units at year-end by sector and region in China Statistical Yearbook 2011.

The ratio of migrants via zhaosheng to rural population \( (\tilde{N}_E/N_R) \)

- Pre-1994 and Post-1995:

Distribution of reported causes of migration is available in population census of 1990 and 2000. To match the definition of the model, we choose immigration flow (or emigration flow) due to learn and train to be migrants via zhaosheng. First, the ratios of migrants via zhaosheng to total migrants for 1985 and 2000 are both computed.\(^{23}\) Second, we take a simple average of these two ratios to be the percentage of migrants via zhaosheng. Due to data availability, we assume the percentages of migrants via zhaosheng in the two regimes are the same. Third, we

\(^{23}\) The population census of 1990 reports the data of 1985.
multiply the net inflow of urban population by the percentage of migrants via zhaosheng to obtain the population of migrants to urban areas via zhaosheng, $\tilde{N}_E$. Finally, we divide the population of migrants to urban areas via zhaosheng by rural population to obtain $\tilde{N}_E/N_R$.

Distributions of reported causes of migration are take from: (1) Table 11-6: number of the immigrants by type of usual residence of July 1, 1985 and cause of migration in 1990 Population Census of the People’s Republic of China; and (2) Table L7-5: population by age, sex, and reasons for emigration in 2000 Population Census of the People’s Republic of China. The data of urban and rural population are from Table 1-4: population by urban and rural residence in Chinese Population and Employment Yearbook 2010.

The ratio of migrants via nongmingong to rural population ($\tilde{N}_W/N_R$)

- Pre-1994 and Post-1995:
  
  To match the model, we choose immigration flow (or emigration flow) due to work and business, work and transfer, and assign and employ to be migrants via nongmingong. The calculation procedure and data sources are the same as those of calculating the ratio of migrants via zhaosheng to rural population.

Employment rate of migrate college graduates ($\gamma$)

- Pre-1994:
  
  According to the GJA policy, this employment rate is equal to 1.

- Post-1995:
  
  The data that exactly matches the definition of our model is not available. Thus, we use urban employment rate instead. Urban employment rate is equal to 1-urban unemployment rate. Urban unemployment rate is defined as the ratio of total registered unemployed persons to total labor force in city district. We use the average of 2000-2007 to be the employment rate of migrate college graduates in our model. Total registered unemployed persons and total labor force are both from China City Statistical Yearbook 2000-2007 (in Chinese).
The income share of high-skilled labor \((\alpha)\)

- Pre-1994 and Post-1995:

  Following the same procedure of computing \(w_H/w_L\), the data of total wage bill of employed persons in urban units by sector is divided into two groups: high-skilled and low-skilled. Then, the ratios of wage bill of high-skilled workers to wage bill of total workers in 2003-2007 are calculated. Finally, we use the average of 2003-2007 to be the income share of high-skilled labor. Total wage bill of employed persons in urban units by sector is obtained from Table 4-14: total wage bill of employed persons in urban units by sector and region in China Statistical Yearbook 2011.