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The Effects of Facilitating the Flow of Rural Workers to Urban Employment in China

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The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to economy-wide modelling of economic policy issues.

Abstract

The Second Agricultural Survey in China revealed that during 2006 about 130 million rural workers spent more than a month working outside the township of their residence. Most of these migrant workers engaged in industrial and services activities. They have played an increasingly important role in China's economic development. In this paper we introduce model mechanisms capturing demand and supply characteristics for these migrant workers under a MONASH-style dynamic Computable General Equilibrium framework. The model, SICGE (State Information Centre General Equilibrium), is applied in this study to analyse the effects of reducing institutional restrictions to the flow of rural labour to urban employment.

Key Words: China, CGE modelling, labour supply, rural-urban migration
JEL classifications:

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1. Introduction

When China started its economic reform in 1979, over 70 per cent of the population were earmarked rural by a residential registration system, the Hukou system. The Hukou system kept rural residents in rural areas and thus denied them access to an iron-rice bowl - a job at a work unit in an urban area and the social security benefits and social services provided by the work unit.

Rapid industrialisation in the past thirty years has resulted in rapid growth in labour demand in urban areas. While the Hukou system has lived on till today, its effectiveness in keeping rural residents in rural areas has been reduced significantly by work permits issued by the Government to rural workers working in urban areas. The Second Agricultural Survey revealed that during 2006 about 130 million rural people spent more than a month working outside the township of their residence. Most of these migrant workers engaged in industrial and service activities – 86 per cent in 2006 according to the National Fixed-Site Survey of Rural Households conducted by the Research Centre for Rural Economy (RCRE) of the Ministry of Agriculture[1]. The rest worked in agriculture, forestry and fishing.

However, being rural still means lack of access to social security benefits and social services in urban areas – schools, medical services, unemployment benefits, retirement benefits, and housing. For those rural workers who spend most of their time working in cities, sending their children to school requires an access fee in addition to what a city person pays.

While belonging to a socially disadvantaged group, rural migrant workers have played a significant role in China's rapid economic growth in recent decades. They have been an important source of labour supply to the rapidly growing non-agricultural sectors. They have served to maintain China's price competitiveness by slowing down the growth of labour costs in industrial sectors. By moving to industrial and service

[1] The RCRE survey defines migrant workers as those who worked for over three months outside their township. The percentage who worked in non-agricultural activities is calculated from the number of days spent in different activities.

sectors where they have a higher level of labour productivity, they have improved overall labour productivity in China – a direct contribution to economic growth.

The rural-urban migration of recent decades has had a fundamental impact on China's social and economic environment. It has therefore commanded priority in research on a broad range of government policy reforms, such as land policy, fiscal policy, infrastructure, and the social-security reforms.

In recent years, the Government has initiated policies to provide social security benefits and social services including children's education to the rural workers working in urban areas. This has further undermined the Hukou system. The purpose of this paper is to understand the effects of the gradual dismantling of institutional barriers to movement of labour from rural to urban areas such as has happened in recent years.

An extensive literature on rural migration in China has been evolving since the 1980s. Four major themes can be distinguished in this literature:

- the determinants of rural-urban migration;
- the earnings differential of rural and urban workers;
- labour market reforms such as the reform of the household registration (Hukou) system; and
- the contribution of rural-urban migration to economic growth.

Applied work in this area has mainly used econometric analysis based on time-series data or sample survey data (for instance, World Bank (1997), Zhao (1999), Cai and Wang (1999), Seeborg *et al.* (2000), Meng and Zhang (2001), Zhu (2002), Kuijs and Wang (2005), Shi *et al.* (2007), Démurger *et al*. (2009)). This has been augmented by the application of CGE modelling, in particular to the analysis of labour market distortions. Xu (1994) started this development with the introduction of rural surplus labour into a three-sector CGE model. Subsequently, further labour market distortions such as urban wage rigidity, imperfect labour mobility and transaction costs that contribute to the wage differential between agriculture and urban non-agricultural sectors have been incorporated into CGE models.

Recent CGE research on rural-urban mobility in China has two strands: multi-country modelling and single-country modelling. In the first strand, the multi-country GTAP (Global Trade Analysis Project) model has been used to explore the effects on income inequality of China's trade reform (for instance WTO accession) in the presence of labour market distortions [Gilbert and Wahl (2003), Anderson *et al.* (2004) and Chen and Ravallion (2004)]. This work is limited by the lack of explicit modelling of the labour market.

In the second strand, single country models have been used to investigate the effect of China's WTO accession on household income inequality by comparing alternative scenarios with and without labour market reform [Zhai and Li (2000), Zhai and Wang (2002) and Hertel and Zhai (2006)]. These studies model the labour market explicitly.

Zhai and Li (2000) distinguish between three categories of labour: agricultural labour, production workers and professionals. They capture the partial mobility of the labour force by allowing for migration of agricultural labour and production workers in response to changes in relative wages.

Zhai and Wang (2002) extend the labour market model by introducing wage rigidity of urban unskilled labour to reflect the abundant supply of unskilled labour in the Chinese economy. They simulate the effects of increasing rural-urban labour mobility during China's WTO accession process while the real wage rate of urban labour is fixed. They find that when more rural workers migrate to the city the rigid urban labour market, which cannot absorb all the unskilled labour, causes urban unemployment to increase sharply with consequent reductions in urban household income and saving. In an alternative simulation they relax the fixed wage assumption and find that the higher level of rural labour mobility leads to a higher level of welfare gain. The gain from WTO accession doubled with full labour market reform. Their simulation exercises suggest a need for co-ordination between China's rural–urban migration policy, labour market reform and the implementation of trade liberalisation. The net benefit from WTO membership will be maximised if China adopts a policy of gradually relaxing its rural–urban migration control in conjunction with its labour market reform.

Hertel and Zhai (2006) examine the consequences of land reform for rural urban migration. They measure the transaction costs of rural migration in a more sophisticated way than had been the case in earlier studies. They find that reforms in the rural land rental market and the Hukou system, as well as increasing off-farm labour mobility, would reduce urban–rural income inequality dramatically. Furthermore, the combination of WTO accession and factor market reforms improves both efficiency and equality.

A common feature of these CGE analyses is the combination of China's labour market distortions with trade reform. In this paper we look at the effects of rural-urban mobility directly. We use SICGE, a recursive dynamic CGE model of China created for China's State Information Centre (SIC) by the Centre of Policy Studies (CoPS). The specification of the year-t core of SICGE is based on ORANI (Dixon *et al.*, 1982) and the links between years are based on MONASH (Dixon and Rimmer, 2002).

To analyse the effects of a policy change with SICGE, we first develop a basecase forecast or a baseline, a business-as-usual scenario without the implementation of the policy change[2]. Then we conduct an alternative forecast with the policy change in place. The effects of the policy change are measured by deviation of variables in the alternative forecast from their baseline levels.

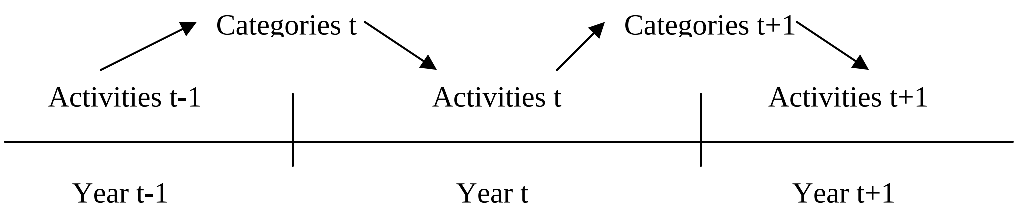
The features of SICGE that are most relevant for this paper concern the labour market module. This is adapted for Chinese conditions from Dixon and Rimmer (2003) and Dixon *et al.* (2009). Section 2 contains a description of the labour categories and activities recognised in SICGE. This material is non-technical and will be sufficient for readers who want just an overview of our approach to modelling the labour market. Section 3 presents the technicalities of our labour market specification, including equations. In Section 4 we apply the model to analyse the economic effects of facilitating rural-urban labour flows. Concluding remarks are in Section 5. Labour market employment data are described in the Appendix.

[2] For more detail about how the business-as-usual scenario is developed for the SICGE model, see Mai 2006

2. Rural and Urban Labour Categories and Activities

Two crucial concepts in the SICGE labour market module are categories and activities. At the start of year t, the person-years of labour that will be available during the year are allocated to categories. The categories are determined mainly on the basis of employment during year t-1. Activities in year t are what people do in that year. The relationship between activities and categories is illustrated in Figure 1. As we will see, categories play a major role in determining labour supply to activities.

Figure 1. Labour market dynamics



As indicated in Table 1, SICGE contains 10 labour-market categories: five employment categories, three unemployment categories, and two new entrant categories. The first eight of these categories have associated activities. For example, the category AG for year t refers to the number of person-years of employment in rural agriculture that took place in year t-1 and is still available for employment in year t. The activity AG for year t refers to the number of person-years absorbed in rural agricultural employment in year t. Most of the AG-category labour in year t is employed in activity AG in year t. However, some AG category labour flows to other activities and some labour from other categories flows to the AG activity.

As indicated in Table 2, different categories have different labour supply behaviour.

- Rural employment and unemployment categories (AG, RNAG, RUE, RAGU, and RUU) make offers to work only in rural activities[3] (AG, RNAG, and RUE).
- Rural new entrants (NRUR) make offers to rural as well as urban activities. This is based on the assumption that some urban enterprises recruit new entrants from rural areas and grant them urban residential status. Rural new entrants with university degrees may acquire a job in a skilled urban occupation and obtain urban residential status.
- Urban categories (UUSE, USE, UU, and NURB) make offers only to urban activities (UUSE and USE).

[3] A change in the residential status of rural migrant workers can be simulated as a policy change that shifts the workers exogenously from the RUE category to an urban employment category (for example, UUSE). However, when someone is in the RUE category, he or she cannot make labour market offers to urban categories of employment.

Table 1. Categories and Activities

	Employment categories and activities
AG	**AG**riculture - Person-years of employment in rural agriculture
RNAG	**R**ural **N**on-**AG**riculture – Person-years of employment of rural people in non-agriculture industries within their township of residence, such as in township and village enterprises and private enterprises in rural areas
RUE	**R**ural-**U**rban **E**mployment – Person-years of employment of rural people in non-agriculture industries outside of their township of residence
UUSE	**U**rban **U**n**S**killed **E**mployment – Person-years of employment of urban people in unskilled occupations
USE	**U**rban **S**killed **E**mployment – Person-years of employment of urban people in skilled occupations
	Unemployment categories and activities
RAGU	**R**ural **AG**ricultural **U**nemployment – Person-years spent by rural workers without a job in their township of residence
RUU	**R**ural-**U**rban **U**nemployment – Person-years spent by rural workers without a job outside their township of residence
UU	**U**rban **U**nemployment – Person-years of urban labour force that are not employed
	New entrants categories (no corresponding activities for these categories)
NRUR	**N**ew entrants **RUR**al – Person-years of new entrants into labour force with rural residential status
NURB	**N**ew entrants **URB**an – Person-years of new entrants into labour force with urban residential status

We assume no voluntary unemployment in China. Consequently, Table 2 shows no offers to unemployment.

As explained in section 3, the number of persons employed in an activity in the current year is determined by the demand for and supply to that activity. Those who make an offer to an employment activity but do not get a job in that activity will be forced back to their previous employment activity or to the relevant unemployment activity.

Table 2. Offers to labour market activities by categories of Labour Supply

Activity / Category	AG	RNAG	RUE	UUSE	USE	RAGU	RUU	UU
AG	*	*	*					
RNAG	*	*	*					
RUE	*	*	*					
UUSE				*	*			
USE				*	*			
RAGU	*	*	*					
RUU	*	*	*					
UU				*	*			
NRUR	*	*	*	*	*			
NURB				*	*			

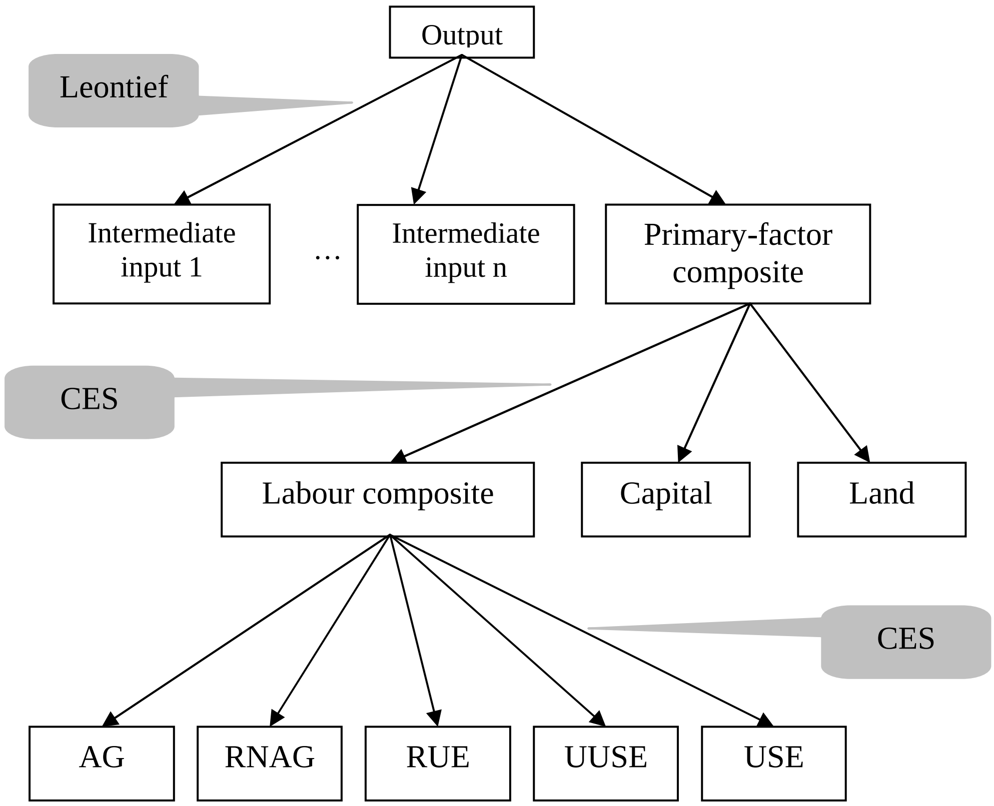
Note: * indicates where offers to labour market are made. * indicates that most people prefer to offer to the category in which they were employed last year.

3. The equation system of the labour market module

The labour market module of the SICGE model has the following equation blocks.

- demand for and employment of labour by activity;
- supply of labour by category;
- wage adjustment reflecting the gap between demand and supply;
- the determination of everyone's activity in year t; and
- linking the number of people in activity o in year t to number of people in category c in year t+1.

Figure 2. Labour demand in SICGE model



3.1 Demand and employment of labour by employment activities

In the SICGE model, to produce a certain level of output, a representative producer in an industry mixes intermediate inputs and a composite primary factor with Leontief technology (first level Figure 2).

Once the level of the primary-factor composite is determined, the representative producer chooses the levels of capital, land and composite labour to minimise costs subject to a CES constraint (second level Figure 2). The derived demand for composite labour in year t for each industry, $D_t^1(j)$, is a function[4] of: capital, $K_t(j)$; productivity (or technology), $A_t(j)$; and the real before-tax wage rate to the

[4] For simplicity, we ignore land in this stylized representation of the labour module but not in our SICGE computations.

industry, $BTW_t^1(j)$:

$$D_t^1(j) = f_j^1\left(BTW_t^1(j); K_t(j); A_t(j)\right), \quad j = \text{industry} \quad . \qquad (1)$$

The real before-tax wage rate to industry j in year t is a function of the real before-tax wage rates of labour by employment activities or equivalently occupations, $BTW_t(o)$:

$$BTW_t^1(j) = g_j^1\left(BTW_t(o), \forall \text{ employment activities o}\right), \quad j = \text{industry} \quad . \qquad (2)$$

At the next level in Figure 2, the representative producer in industry j chooses labour in different occupations via a CES function given the required level of labour composite. The derived demand for labour by occupation and industry, $D_t(o,j)$, is represented by:

$$D_t(o,j) = D_t^1(j) * h_{o,j}\left(BTW_t(oo) \ \forall \text{ employment activities oo}\right),$$
$$\text{o = employment activity, j = industry} \qquad (3)$$

where $BTW_t(o)$ is real before-tax wage rate of labour in employment activity o.

The total demand for labour in an employment activity o, $D_t(o)$, is the sum of demands over all industries:

$$D_t(o) = \sum_j D_t(o,j) \quad , \quad \text{o = employment activity} \quad . \qquad (4)$$

The employment of labour in an employment activity, $E_t(o)$, is determined by demand:

$$E_t(o) = D_t(o) \quad , \quad \text{o = employment activity;} \qquad (5)$$

3.2 Planned labour supply from categories to activities

The offer from each labour category c to each employment activity o, $L_t(c;o)$, is determined by an optimisation procedure where people in category c choose $L_t(c;o)$, for all activities o

$$\text{to maximise } U_c\left[ATW_t(o) * L_t(c;o) \ \ \forall \text{ activities o}\right]$$

$$\text{subject to } \sum_o L_t(c;o) = CAT_t(c),$$

where

$CAT_t(c)$ is the number of people in category c;
$ATW_t(o)$ is the real after-tax wage rate of labour in employment activity o; and
U_c is a homothetic function with the usual properties of utility functions (positive first derivatives and quasi-concavity).

In SICGE, U_c has the CES form:

$$U_c = \left[\sum_o \left(B_t(c;o) * ATW_t(o) * L_t(c;o) \right)^{\frac{\eta}{1+\eta}} \right]^{\frac{1+\eta}{\eta}} .$$

giving labour-supply functions of the form:

$$L_t(c\,;o) = CAT_t(c) * \left[\frac{\left(B_t(c;o) * ATW_t(o) \right)^{\eta}}{\sum_q \left(B_t(c;q) * ATW_t(q) \right)^{\eta}} \right],$$

$$c = \text{category};\ o = \text{employment activity}; \qquad (6)$$

where
$B_t(c;o)$ is a variable reflecting the preference of people in category c for earning money in activity o in year t; and
$\eta>0$ is a parameter (discussed in the Appendix) reflecting the ease with which people feel that they can shift between activities.

The variable $B_t(c;o)$ captures non-wage factors that might motivate people from category c to offer their labour to employment activity o. An example of such factors is a reduction in institutional barriers that might motivate people in rural categories to offer to urban employment activities. A 30% increase in $B_t(c;o)$ has the same effect on category c's labour supply as a 30% increase in the real after-tax wage rate $ATW_t(o)$.

$B_t(c;o)$ also allows the calibration of (6) to reflect the properties discussed in section 2, see Table 2. For example, by setting $B_t(c;o)= 0$ for all categories c and for all unemployment activities o, we ensure that there are no offers to unemployment activities:

$$L_t(c\,;u) = 0;\ c = \text{category};\ u = \text{unemployment activity}; \qquad (7)$$

The planned labour supply to each employment activity a, $L_t(a)$, is determined as the sum of offers to the activity by people from all categories:

$$L_t(a) = \sum_c L_t(c;a) \quad a = \text{employment activity} \quad . \tag{8}$$

The real after-tax wage rate $ATW_t(o)$ for each employment activity o is linked to the real before-tax wage rate $BTW_t(o)$ via:

$$ATW_t(o) = BTW_t(o) * (1 - T_t), \ o = \text{employment activity} \quad , \tag{9}$$

Where T_t is the payroll and income tax rate.

This equation can be thought of as determining the real before-tax wage rate $BTW_t(o)$. The real after-tax wage rate $ATW_t(o)$ is determined by wage adjustment equations to be discussed in the next subsection.

3.3 Wage Adjustment Equations Reflecting Demand and Supply

In policy simulations, we assume that wage rates adjust according to:

$$\frac{ATW_t(o)}{ATW_t^{base}(o)} - \frac{ATW_{t-1}(o)}{ATW_{t-1}^{base}(o)} = \alpha \left(\frac{D_t(o)}{D_t^{base}(o)} - \frac{L_t(o)}{L_t^{base}(o)} \right),$$

$$o = \text{employment activity} \quad , \tag{10}$$

where the superscript "base" refers to values in the basecase forecast and α is a positive parameter.

This equation implies that if a policy causes the market for employment in activity o in year t to be tighter than it was in the basecase forecast (i.e., if the policy causes a larger percentage deviation in demand than supply), then there will be an increase between years t-1 and t in the deviation in activity o's real after-tax wage rate. In other words, in periods in which a policy has elevated demand relative to supply, real wages will grow relative to their basecase values (for a more detailed discussion of the wage adjustment equation, see Dixon and Rimmer 2003).

3.4 The Determination of Everyone's Activity

The wage adjustment equations imply that gaps between supply and demand in employment activity o are allowed in the model. We therefore need to specify which offers to employment activity o are accepted and what activities are undertaken by those whose offers to employment activities are not accepted. For this purpose, we specify the flow from each category to each activity $H_t[c\,;a]$ in year t. Notice that $H_t[c\,;a]$ includes flows from all categories (employed, unemployed and new entrants) to all activities (employed and unemployed).

The starting point for determining $H_t[c\,;a]$ is the specification of vacancies, $V_t(o)$, in employment activity o:

$$V_t(o) = E_t(o) - H_t[o\,;o], \quad o = \text{employment activity} \quad . \tag{11}$$

where vacancies equals employment less jobs filled by incumbents, $H_t[o\,;o]$.

Next, "off-diagonal" flows are determined according to:

$$H_t(c\,;o) = V_t(o) * \left[\frac{L_t(c;o)}{\sum\limits_{s \neq o} L_t(s;o)}\right],$$

$$c = \text{category; } o = \text{employment activity; and } c \neq o \quad . \tag{12}$$

Equation (12) specifies that jobs in activity o given to non-incumbents are proportional to vacancies in o and to the share of category c in the supply of labour to activity o from people outside category o. Thus, if people in category c account for 10 per cent of the people outside category o who want jobs in employment activity o, then people in category c fill 10 per cent of the vacancies in o.

"Diagonal" flows are determined as a residual:

$$H_t(o;o) = CAT_t(o) - \sum_{a \neq o} H_t(o;a) \ , \ o = \text{employment category and activity} \quad . \tag{13}$$

Equation (13) specifies that the number of incumbents, $H_t[o\,;o]$, who remain in employment-activity o equals the number of people in category o less the number who move out of activity o to other employment activities as well as to unemployment activities.

The flows from each employment category to each unemployment activity are determined by:

$$H_t(c;u) = DUMMY(c;u) * \mu(c) * CAT_t(c),$$

$$c = \text{employment category; } u = \text{unemployment activity} \quad . \qquad (14)$$

where $\mu(c)$ is the fraction of category c people who become involuntarily unemployed. A dummy variable is included in (14) to ensure that involuntarily unemployed people move to the relevant unemployment activity: rural agricultural and rural non-agricultural people to rural agricultural unemployment; rural-urban people to rural-urban unemployment; and urban people to urban unemployment.

Normally, $\mu(c)$ is exogenous. However, it is possible for (14) in conjunction with (12) to give values for $H_t(c;c)$ in (13) that exceed $E_t(c)$. In this case, we see from (11) that $V_t(c)$ would be negative. We avoid this situation by treating $\mu(c)$ as an endogenous variable. If $V_t(c)$ is greater than zero, then $\mu(c)$ equals an exogenously given minimum value determined by the rate at which individuals are dismissed because of their performance or other factors unrelated to overall demand for people in activity c. Alternatively, $\mu(c)$ moves sufficiently above its minimal value to ensure that $V_t(c)$ equals zero. When $\mu(c)$ is above its minimum value, then there are involuntary flows from employment category c to unemployment caused by overall shortage of jobs. In a fast growing economy such as China's, endogenous determination of $\mu(c)$ will rarely be required.

The flow from an unemployment or new-entrant category c to unemployment is given by the number of people in c less those who find a job:

$$H_t(c;u) = DUMMY1(c,u) * (CAT_t(c) - \sum_{a \in \text{employment activity}} H_t(c;a))$$

$$c = \text{unemployment or new entrant category; and } u = \text{unemployment activity.} \qquad (15)$$

The dummy coefficient in (15) is used to ensure that: rural new entrants who don't get a job go to rural agricultural unemployment; urban new entrants who don't get a job go to urban unemployment; and people in unemployment category c who don't get a job stay in unemployment activity c;

The number of people in unemployment activities equal to the sum of the flow from all categories to unemployment activities:

$$E_t(a) = \sum_{c \in \text{categories}} H_t(c;a)), \quad a = \text{unemployment activity}; \tag{16}$$

A similar equation is not required for employment activities. Such an equation is implied by (11) and (12).

3.5 Linking the Previous-Year Activities to the Current-Year Categories

From (1) to (16), we can determine the number of people in each employment and unemployment activity in year t given the number of people in each category of labour supply at the beginning of the year and demands during the year. To complete the equation system, we need to determine the number of people in each category of labour supply at the beginning of year t. If t is the first year of a simulation, then we determine the number of people in categories mainly on the basis of data on activities for year t-1 (Appendix A). If t is a subsequent year then we determine the number of people in categories mainly on the basis of results for activities in year t-1.

For non new entrants:

$$CAT_t\left(c\right) = ACT_{t-1}\left(c\right) * S(c), \ c = \text{category; and } c \neq \text{ new entrant}; \tag{17}$$

where

$ACT_{t-1}\left(c\right)$ is the number of people in activity c in year t-1; and

S(c) is the proportion of people in activity c in year t-1 who are allocated to category c at the start of year t.

In SICGE, we assume $S(c) = 0.99$. This allows one per cent of people in every activity in year t-1 to drop out of the workforce at the beginning of year t either through retirement or death.

For new-entrant categories:

$$\mathrm{CAT}_t(c) = \text{exogenous}, \quad c = \text{new entrant}. \qquad (18)$$

4. The effects of facilitating the flow or rural labour to urban employment

This section contains an analysis of the effects of shifting people from Agricultural and rural non-agricultural employment to urban jobs through reducing the institutional barriers to such movement. In the simulation, we assume that the policy is implemented in five years from 2008.

The reduction in institutional barriers is simulated by increasing the variable $B_t(c;o)$,for c = AG, RNAG and RUE, and for o = RUE in (6). This increases the enthusiasm of the agricultural (AG) and rural non-agricultural (RNAG) workers to offer to work as rural-urban workers (RUE) and for existing RUE workers to stay as RUE workers. The increase in the relevant $B_t(c;o)$ variables was calibrated so that the gap between the wages of RUE and AG workers is reduced by about 28 per cent at the end of the policy implementation period . Shi (2002) found that approximately 28 per cent of the rural-urban wage difference can be explained directly by the coefficient on the institutional barriers to rural-urban labour flow.

4.1 Labour Markets and Effective Labour Input

The increase in the preference to work in the RUE activity leads to an excess supply of RUE workers and excess demand for AG and RNAG workers (Figures 3-5). The excess supply of RUE labour widens during the five years when the policy is implemented and subsequently narrows during the post-policy period. As a result, the real wage for RUE labour decreases relative to the baseline before it reaches its long-run deviation level (Figure 3).

Similarly, the excess demand for the AG and RNAG workers widens during the policy-implementation period leading real wages for these categories to increase relative to the baseline. In the long-run, real wages for these activities settle into their

Figure 3 Moving people from rural to urban: market for rural-urban workers (RUE)

(Percentage deviation from baseline)

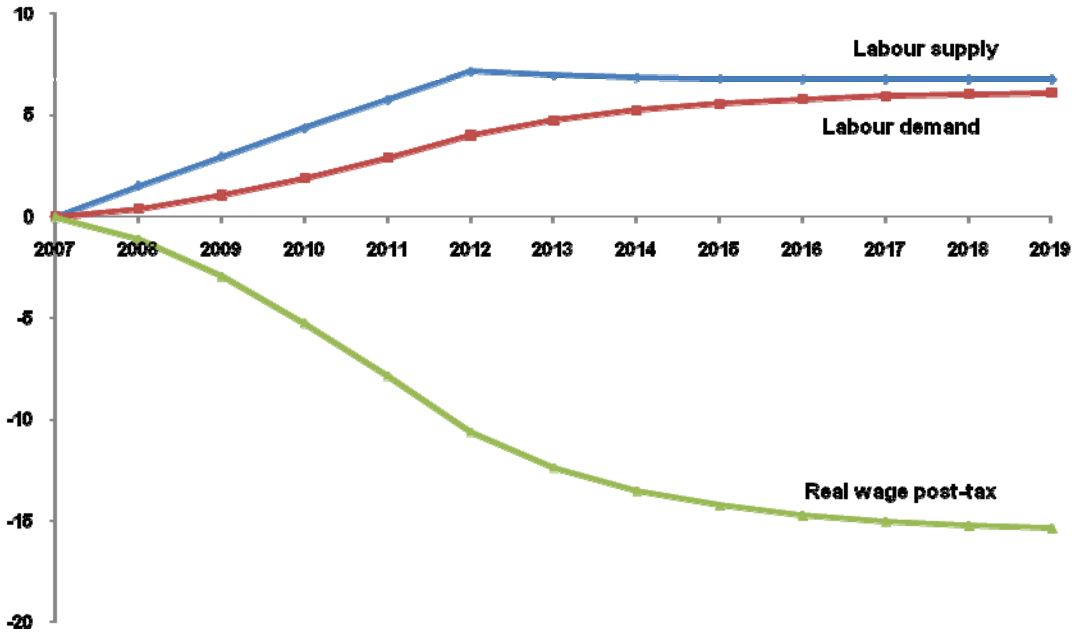


Figure 4 Moving people from rural to urban: market for agricultural workers (AG)

(Percentage deviation from baseline)

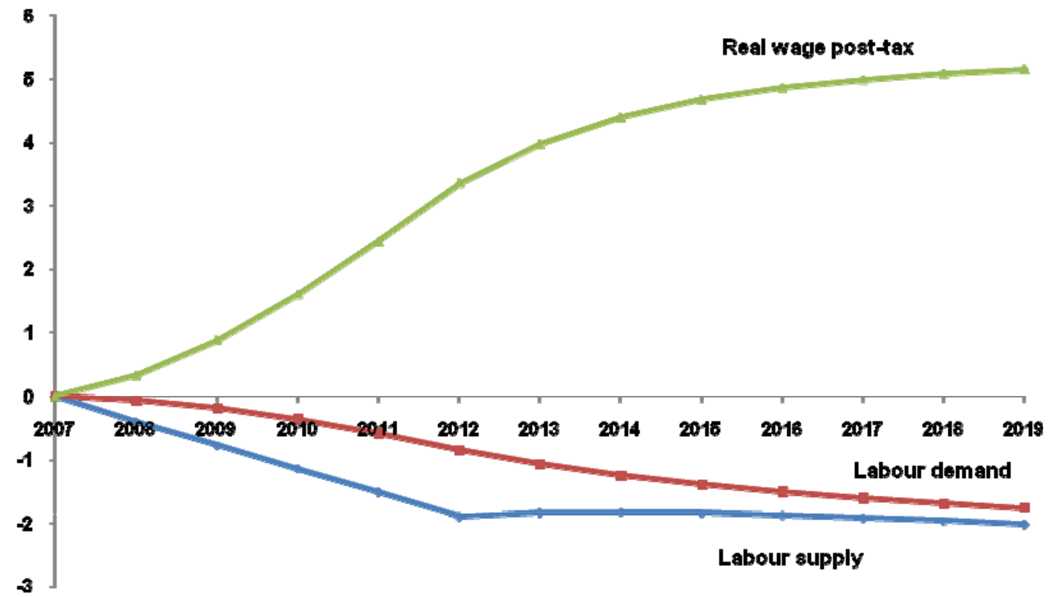
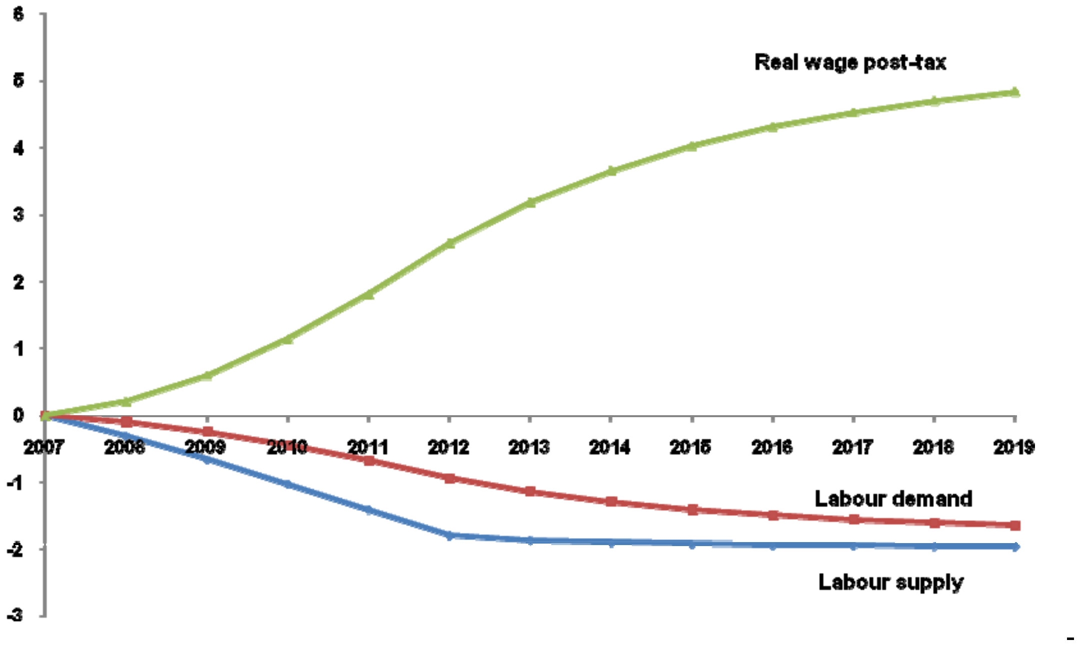


Figure 5 Moving people from rural to urban: market for rural non-agricultural workers (RNAG)

(Percentage deviation from baseline)



long-run deviation levels as excess demand reduces in the post-policy period (Figures 4 and 5).

In the long-run (2019), the changes in the markets for AG, RNAG and RUE workers lead to an increase in employment of RUE workers of 6.11 per cent relative to baseline and decreases in AG and RNAG employment of 1.76 and 1.64 per cent. The changes in urban employment are small compared to the changes in rural employment (Figure 6).

The movement from AG and RNAG to RUE leads to a greater long-run increase in effective labour input measured by wage-bill weights than employment of persons, 0.31 per cent compared with 0.07 per cent, Figure 7[5]. This is because labour productivity is higher in the RUE activity than in the AG and RNAG activities, reflecting the difference in their wage rates.

[5] While we identify 2019 as the long run, it is apparent that the economy has not completely adjusted to the shocks applied in 2008 to 2012. This explains why aggregate employment measured in people is still slightly above its baseline level in 2019: average real wages across the economy have not adjusted sufficiently to completely eliminate the increase in employment associated with the productivity-enhancing movement of people.

Figure 6 Moving people from rural to urban: employment by activities (Percentage deviation from baseline)

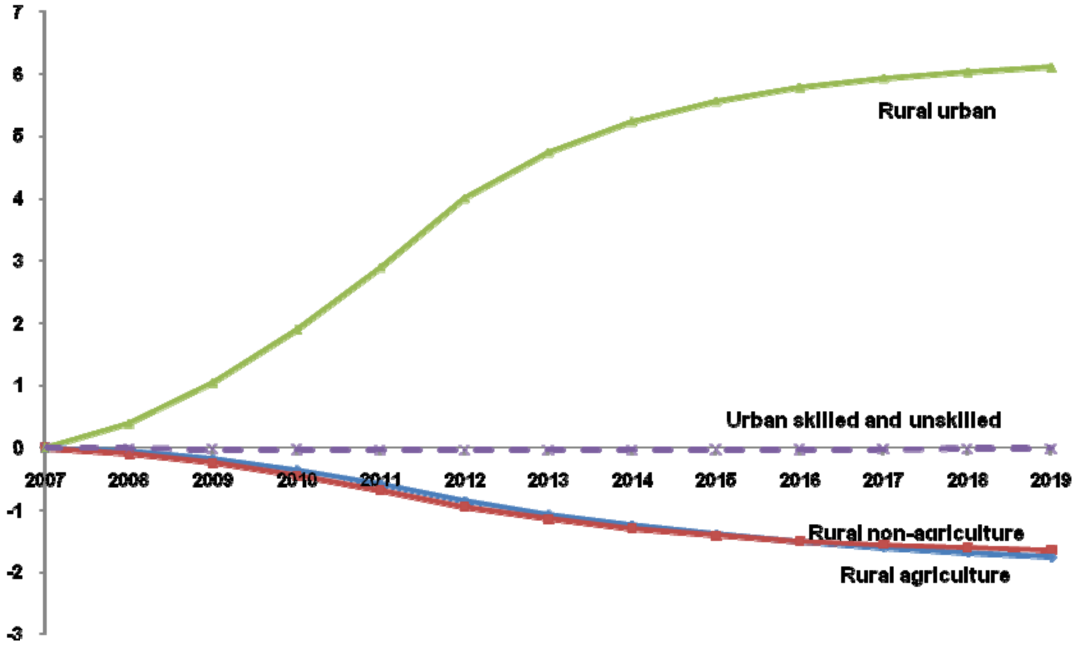
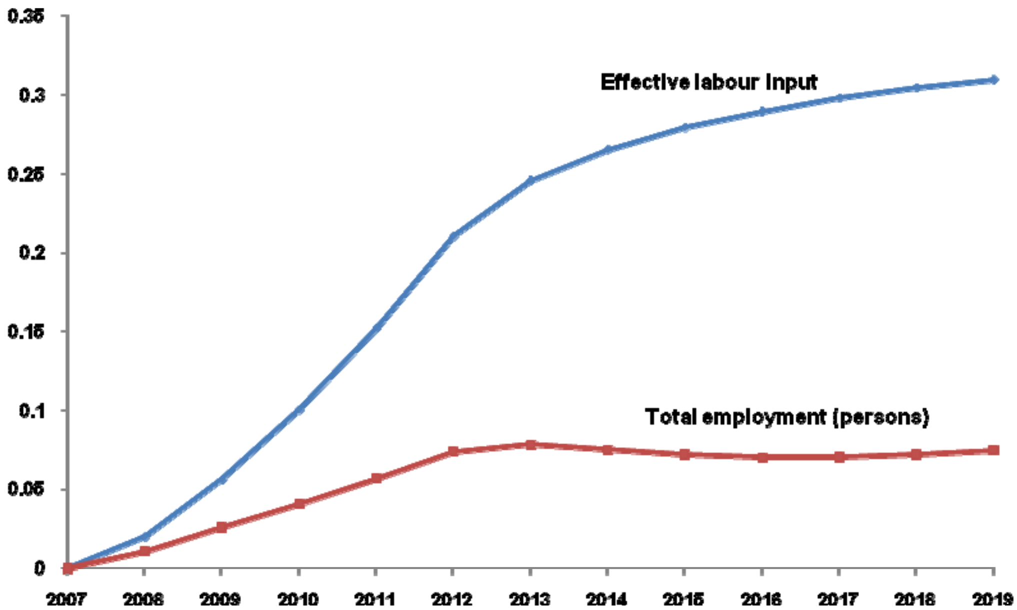


Figure 7 Moving people from rural to urban: total employment and effective labour input (Percentage deviation from baseline)



In Table 3 we present a calculation in order to comprehend the magnitude of the increase in effective labour input (0.31 per cent). This calculation is important because the magnitude of the increase in effective labour input determines the magnitude of the increase in real GDP due to the policy change.

Table 3 shows that, in terms of number of person-years, the percentage decreases in AG and RNAG employment means about 6.3 million (column 5: 4.093m+2.245m) people are moved out of the AG and RNAG activities.. The 6.11 percentage increase in RUE employment relative to baseline means about 7 million jobs are generated in RUE work due to the policy change. These changes result in an increase of 135,985 million RMB in total wage-bill employment which is 0.31 per cent of the total wage-bill employment in year 2019 in the baseline.

4.2 Aggregate Capital Stock

Figure 8 shows that, in the long-run, capital stock increases relative to baseline due to the movement of labour from AG and RNAG activities to the RUE activity. Furthermore, the positive deviation of capital stock from its baseline level is larger than the positive deviation of effective labour from its baseline level. This means that there is a long-run increase in capital-labour ratio relative to baseline.

The long-run increase in capital stock relative to baseline is mainly due to three factors: an increase in effective labour input; consumer goods becoming relatively more expensive than investment goods; and a shift in output mix towards capital intensity.

The first two factors are conveniently analysed via the equation:

$$\frac{Q}{P_{inv}} = \frac{P_{gne}}{P_{inv}} * \frac{P_g}{P_{gne}} * \frac{1}{A} * F_k\left(\frac{K}{L}\right) \quad . \tag{19}$$

This can be derived from (B3) and (B4) in Box 1.

Box 1 The BOTE Model

The Back-Of-The-Envelop (BOTE) model is a tool to comprehend CGE model results. It consists of key functional relationships in the model that are relevant to the policy issues at hand. Most of the ORANI- or MONASH-style CGE models applied in practical policy work are large models with up to millions of equations and variables to reflect the complicated nature of modern economies. The BOTE model is therefore a good starting point to see if key results produced by the large models can be understood by a group of equations representing fundamental macro- and micro-theories. When the BOTE model fails to explain all or most of the results, we seek the specific structures represented in the large applied model that are not captured by the BOTE model for further understanding.

The two most important relationships in the MONASH-style CGE models are the aggregate production function and GDP identity:

$$\mathrm{Y} = \frac{1}{\mathrm{A}} * \mathrm{F}(\mathrm{K}, \mathrm{L}) \text{ and} \qquad (1)$$

$$\mathrm{Y} = \mathrm{C} + \mathrm{I} + \mathrm{G} + \mathrm{X} - \mathrm{M} \qquad (2)$$

where
- Y is GDP;
- C is consumption;
- I is investment;
- G is government expenditure;
- X is exports;
- M is imports;
- K is aggregate capital stock;
- L is aggregate employment; and decreases in A allow for technological progress.

Equilibrium in the capital market requires the real cost of capital to be equal to the marginal physical product of capital. Hence:

$$\frac{Q}{P_g} = \frac{1}{A} * F_k\left(\frac{K}{L}\right) \quad . \qquad (3)$$

where
- Q is the rental per unit of capital;
- P_g is the price of a unit of GDP; and
- F_k is the partial derivative of F with respect to K. We write F_k as a function of K/L under the assumption that F is homogenous of degree one.

The real cost of capital on the left-hand-side of Equation (3) can be further written as:

$$\frac{Q}{P_g} = \frac{Q}{P_{inv}} * \frac{P_{inv}}{P_{gne}} * \frac{P_{gne}}{P_g} \qquad (4)$$

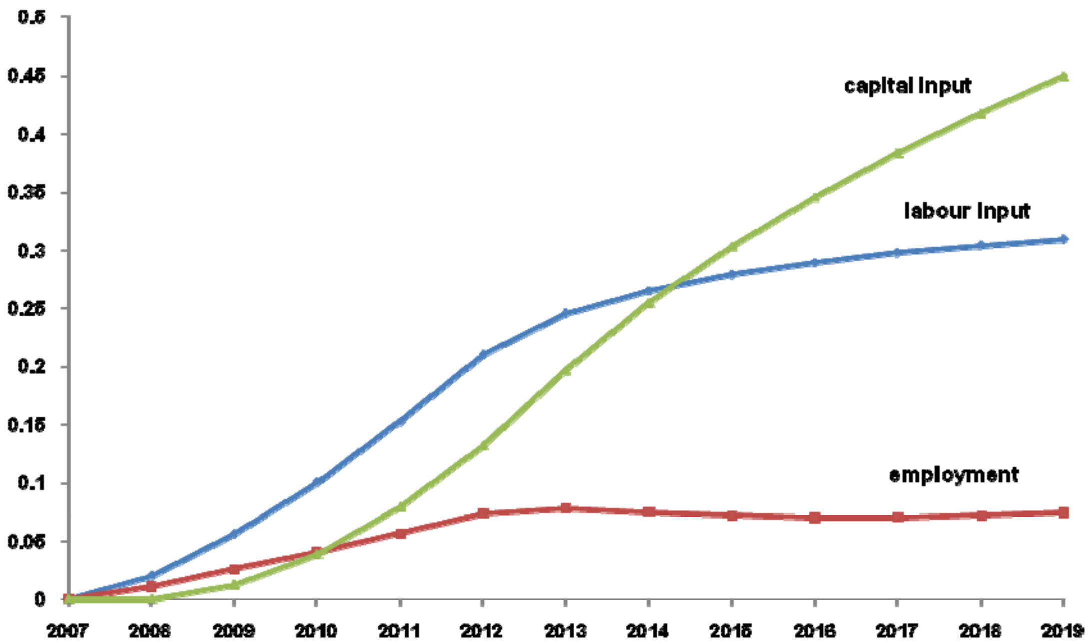
where
- P_{inv} is the price index of investment goods; and
- P_{gne} is the Gross National Expenditure (GNE) price index.

Table 3 Why Does Effective Labour Input Increase by 0.31%?

	Baseline 2019			Deviation from baseline 2019		
Categories	Wage rate ('000 RMB) (1)	Employ-ment ('000s) (2)	Wagebill (million RMB) (3) =(1)*(2)	Employ ment (per cent) (4)	Employ-ment ('000s) (5) = (4)*(2)	Wagebill employ-ment (million RMB) (6) =(1)*(5)
1 Agriculture (AG)	25.3	232,805	5,900,980	-1.76	-4093	-103,758
2 Rural non-agriculture (RNAG)	36.9	136,604	5,038,099	-1.64	-2245	-82,806
3 Rural urban (RUE)	46.0	114,807	5,277,582	6.11	7010	322,265
4 Urban unskilled (UUSE)	74.6	284,973	21,256,823	-0.01	-32	-2,356
5 Urban skilled (USE)	139.8	44,535	6,224,634	0.04	19	2,639
Total or Average	53.7	813,723	43,698,118	0.08	659	135,985
Percentage increase in effective labour input = 100*135,985/43,698,118 = 0.31%						

Figure 8 Moving people from rural to urban: factor inputs

(Percentage deviation from baseline)



In the long run, Q/P_{inv}, which reflects the rate of return on capital, is relatively unaffected by the movement of people from Agriculture to rural-urban employment. Thus, if there is no change in technology (A) and in relative prices, then in the long-run an increase in labour input will lead to an increase in capital stock to maintain the capital-labour ratio. This would lead us to think that in the long-run the percentage increase in capital stock relative to baseline should be the same as that of labour input.

However, relative prices move. In particular, there is a reduction in the price of investment goods relative to consumption goods leading to an increase in P_{gne}/P_{inv} (Figure 9). Moving labour from AG and RNAG activities to the RUE activity increases real labour costs in the agriculture sector relative to the industrial sector. This leads to consumer goods becoming expensive relative to industrial goods: agricultural and food products dominate China's consumption bundle. What about the other price ratio on the right hand side of (19), P_g/P_{gne}? The GNE price index contains prices for imports but not that of exports whereas the opposite is true for the GDP price index. Consequently, P_g/P_{gne} depends mainly on movements in the terms of trade. In the present simulation there is little movement in the terms of trade and therefore little movement in P_g/P_{gne}.

With P_{gne}/P_{inv} increasing and little movement in P_g/P_{gne} and Q/P_{inv}, (19) implies that the marginal product of capital must fall explaining a long-run increase in the capital-labour ratio relative to baseline.

The third factor that causes capital stock to increase relative to baseline is the change in output structure. Moving people from AG and RNAG activities to the RUE activity leads to lower labour costs for the industrial and services sectors, allowing these sectors to expand more rapidly than the agricultural sector (Figure 10). This increases the long-run capital-labour ratio because the industrial and services sectors are more capital intensive than the agricultural sector.

4.3 Real GDP and GDP Expenditures

The long-run increase in both effective labour input and capital stock leads to an increase in real GDP relative to its baseline level [(B1) in Box 1]. Figure 11 shows that the long-run deviation of real GDP from baseline in 2019 is about 0.36 per cent, higher than the increase in effective labour input in the same year (0.31 per cent). This is because the percentage increase in capital stock is larger than that of effective labour input relative to baseline as discussed above.

Figure 9 Moving People From Rural to Urban: Consumer and Investment Goods Prices, GNE and GDP price indices

(Percentage deviation from baseline)

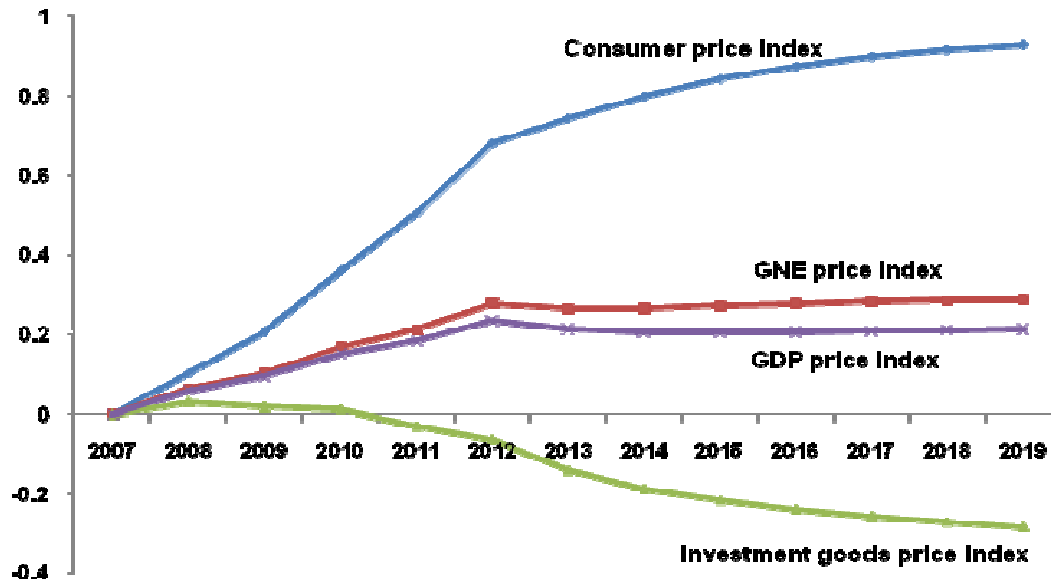


Figure 10 Moving People From Rural to Urban: Output of Agricultural, Industrial and Services Sectors

(Percentage deviation from baseline)

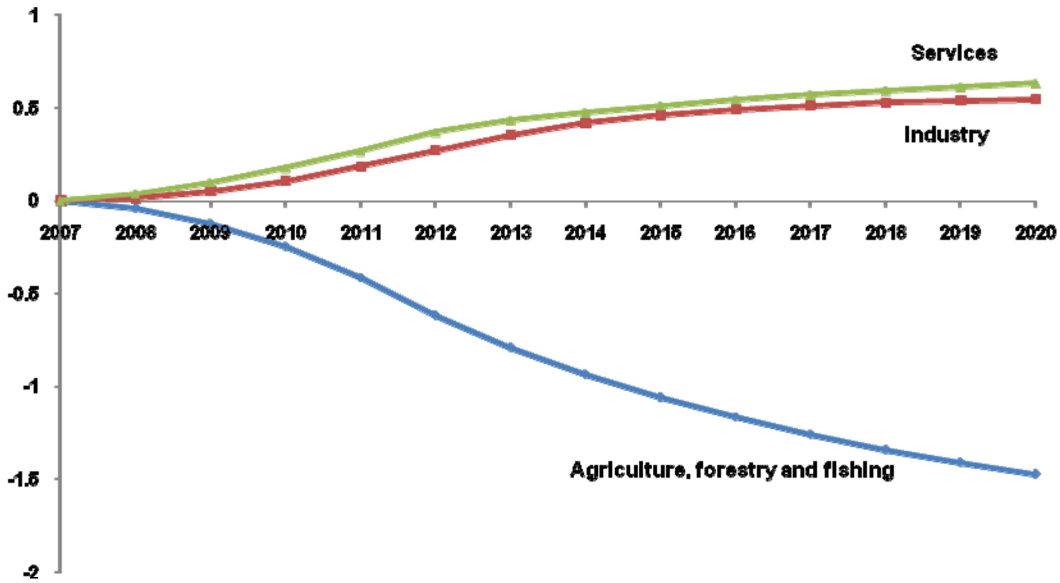


Figure 11 Moving People From Rural to Urban: Real GDP and Factor Inputs (Percentage deviation from baseline)

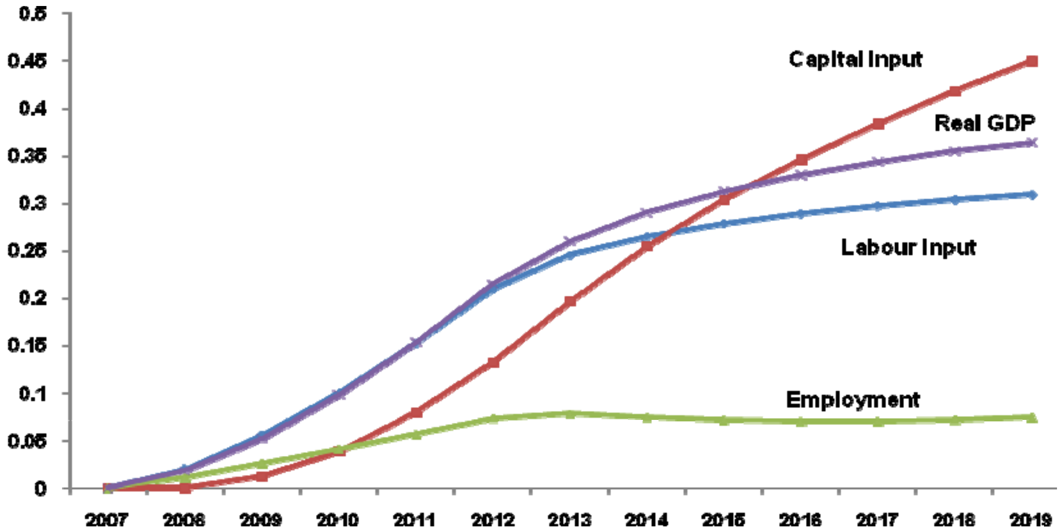
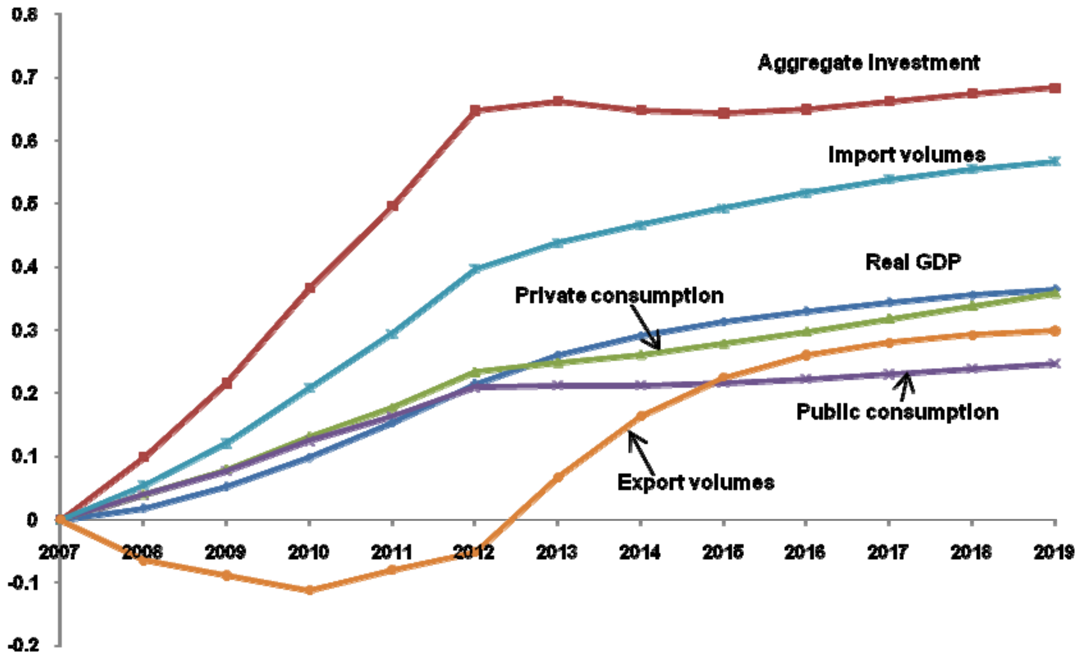


Figure 12 Moving People From Rural to Urban: Expenditure-Side GDP (Percentage deviation from baseline)



Due to the strong increase in capital stock discussed in Section 4.2, aggregate investment increases strongly relative to its baseline path, showing larger deviations than real GDP (Figure 12). Given that the increase in private and public consumption is similar in magnitude to that of real GDP, the GDP identity [(B2) in Box 1] implies that there must be a decrease in net exports relative to baseline. This is shown in Figure 12 where the percentage deviation in imports exceeds the percentage deviation in exports throughout the simulation period.

While, in the long-run, moving people from rural to urban activities lowers labour costs for the export sectors, in the short- to medium-run when capital stock is being accumulated, export performance is damped by real appreciation associated with an increased level of investment activities (Figure 13).

5. Concluding remarks

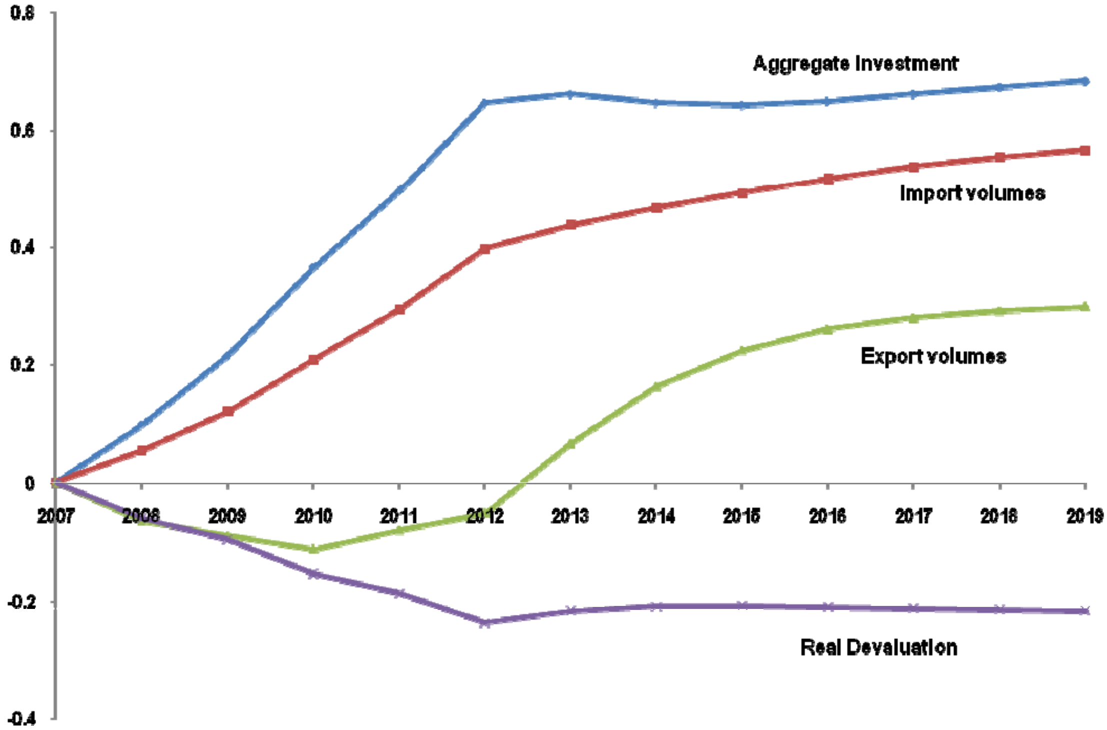
Institutional restrictions in China (notably the Hukou system) that inhibit the flow of labour from rural to urban areas are rapidly being dismantled. This paper shows that China will benefit from the resulting increase in rural-urban employment. Using a CGE model, we found that a dismantling of restrictions that encouraged an extra 6.3 million workers[6] to move out of agricultural and rural non-agricultural employment and into rural-urban employment would, by 2019:

- increase China's GDP by 0.36 per cent;
- increase consumption (combined public and private) by 0.31 per cent; and
- increase the real wages of agricultural and rural non-agricultural workers, China's lowest paid workers, by about 5 per cent while reducing the real wages of rural-urban workers by about 15 per cent. Even with these wage changes, rural-urban workers stay considerably better paid than agricultural and rural non-agricultural workers.

[6] This is a movement of about 1.7 per cent of agricultural and rural non-agricultural workers into rural-urban employment.

Figure 13 Moving People From Rural to Urban: Export and Import Volumes, and Real Devaluation

(Percentage deviation from baseline)



Our CGE model includes a relatively detailed labour-market module in which members of the labour force are allocated to categories at the beginning of each year, depending mainly on their labour market activity of the previous year. Separate labour supply behaviour is specified for each category. This allows us to model a gradual accumulation of workers in urban activities with a corresponding decumulation in agricultural activities in response to a dismantling of restrictions on rural-urban mobility. We expect that a similar approach to that adopted in this paper could be used to model other policy changes that affect the relative attractiveness of rural and urban work. An example is the current reform of social security arrangements which are likely to affect the welfare of agricultural workers differently from that of urban workers.

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Appendix A. Data on Labour by Employment Activities

In common with most CGE models, SICGE can be thought of as a system of m equations of the form:

$$F(X) = 0 \tag{1}$$

where X is a vector of n variables referring to year t, with n > m. To solve the model, it is necessary to make n – m variables exogenous. Then a dynamic solution is performed by moving the n – m exogenous variables from their year t levels to their year t+1 levels and calculating the effects via derivative methods[7] on the m endogenous variables. In this way we determine the movements in the m endogenous variables from their year t levels to their t+1 levels. For the procedure to work, we must have an X vector that satisfies (1) for a base year, say 2002. Then we can calculate a solution for 2003 and so on.

Most of the base year X vector for the version of the SICGE model used in this paper is obtained from the 2002 Chinese input-output table[8]. The use of input-output data in SICGE is quite standard and we will not describe it further. For this paper the key part of the base year X vector comprises employment by activity and unemployment. To derive a starting point for our dynamic simulations we needed to estimate the number of person years in 2002 spent in each of the 8 activities identified in Table 1.

A.1 Person-Year for the Five Employment Activities

The data sources for employment in person years by activities are identified in Figure A.1. The China Labour Statistical Yearbook provided totals on person-years of urban employment and rural employment. From the urban total we calculated the numbers of person-years in urban skilled employment (USE) using data (also from the China Labour Statistical Yearbook) on the shares of workers in urban sectors with post-high-school education. Urban unskilled employment (UUSE) was calculated by subtracting

[7] These include Newton and Euler methods.

[8] Input output tables for China are published by the National Statistical Bureau every five years. The latest available input-output table was for the year 2002 at the time the modelling work for this paper was conducted.

the USE employment from the total number of employed urban persons. The resulting employment data in person years for USE and UUSE is presented in Rows (4) and (5) of Table A.1.

Figure A.1 Number of persons employed by activities

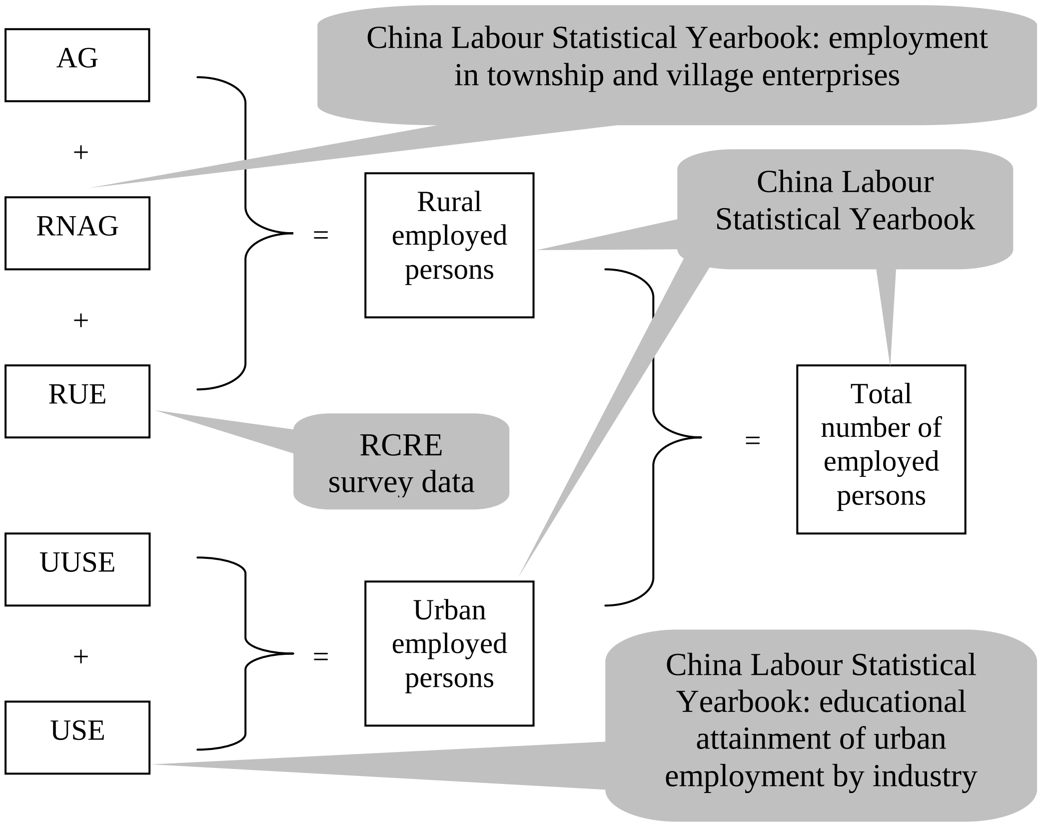

Table A.1 Number of person-years (millions) of employment by activity

Categories	2002	2003	2004	2005	2006	2007	2002-2007 (%)
(1) AG	312	305	294	284	272	260	-3.6
(2) RNAG	96	97	101	105	108	111	3.0
(3) RUE	82	86	93	97	101	107	5.6
(4) UUSE	209	219	225	231	238	246	3.0
(5) USE	38	38	40	42	45	47	5.8
(6) Total number of employed rural person (6)=(1)+(2)+(3)	490	488	487	485	481	479	-0.4
(7) Total number of employed urban person (7)=(4)+(5)	248	256	265	273	283	293	3.4

Sources: Estimated by Yinhua Mai from data in China Statistical Yearbook, various issues; China Labour Statistical Yearbook, various issues; RCRE National Fixed-Site Survey of Rural Households; and National Bureau of Statistics, Second Agricultural Survey.

Available data on the number of persons employed in the RUE activity (rural migrant workers) are very confusing. The First and Second Agricultural Survey concluded that the total number of employed rural people were 560.9 and 478.5 million persons respectively in 1997 and 2006. The corresponding numbers of people who worked more than a month outside their township were 72.2 and 131.8 million persons.

These numbers need to be translated into person-years of employment in the industrial and services sectors of the model. For this purpose, we requested data from RCRE (Table A.2) on numbers of working days as well as persons. RCRE data allowed us to calculate the share of RUE person-years in total employed rural persons. In calculating number of person-years in the RUE activity, we assumed that a typical rural employed person works for 326 days per year (6.5 days a week with a two-week holiday during Chinese New Year). The resulting number of person-years in the RUE category is presented in Row (3) of Table A.1. RCRE's National Fixed-Site Survey of Rural Households provides comparable data from 2003-2007. We derived numbers for 2002 by backwards extrapolation.

Table A.2 RCRE survey data, 2003-2007

	2003	2004	2005	2006	2007
(1) Number of rural migrant workers in the sample (persons)	15596	16063	17193	17576	18739
(1.1)Agriculture, forestry and fishing	2484	2729	3123	3142	2867
(1.2)Non-agriculture, forestry and fishing	13112	13334	14070	14434	15872
(2) Number of days worked outside township of residence (1,000 days)	4015	4183	4519	4626	4942
(2.1)Agriculture, forestry and fishing	471	520	614	622	554
(2.2) Non-agriculture, forestry and fishing	3545	3663	3904	4004	4388
(3) Total number of employed rural persons in the sample (person-years)	59041	55985	56966	55615	57192

Sources: RCRE National Fixed-Site Survey of Rural Households: data provided by RCRE in April 2008.

The estimates for number of person-years employed in the RNAG activity is mainly based on number of persons employed in township and village enterprises by sector published in China Labour Statistical Yearbook. Similar to rural migrant workers, employees of township and village enterprises also engage in agricultural, forestry and fishing production. Due to lack of direct statistics, we assumed that the percent of person-year labour spent by an average township-and-village-enterprise worker in non-agriculture production is similar to that of a rural migrant worker. We assume that an average township-and-village-enterprise worker spent a larger percentage of labour-year in agricultural production than an average rural migrant worker due to the former's proximity to home. The resulting employment in person years for the RNAG activity is presented in Row (2) of Table A.1.

The number of persons employed in the AG activity (Row (1) in Table A.1) is calculated by subtracting the person years employed in the RUE and RNAG activities from the total number of employed rural persons (Figure A.1). The total number of employed rural persons is published in the China Labour Statistical Yearbook.

Table A.1 shows that the employment in the RUE category grew by about 5.6 per cent per year on average during 2002-2007. In 2006, number of person years in the RUE category was estimated to be 101 million. There are two reasons for this number to be lower than the number of rural migrant workers published in the Second Agricultural Survey (130 million). First, in the Second Agricultural Survey, the 130-million migrant workers are those who worked more than one month outside their township of residence. In our model, two persons working half-year each are counted as one person-year of employment. Second, the Second Agricultural Survey data includes those who travelled outside their township and worked in agricultural, forestry and fishing sectors. In the model, the RUE category is defined as rural person-years employed in industrial and services sectors outside their township of residence.

A.2 Person-Years for the Three Unemployment Activities

Person-years for unemployment activities in 2002 are derived from assumptions about unemployment rates. We assumed that the urban unemployment rate is about 6 per cent, slightly higher than the urban unemployment rate published in the China Statistical Yearbook. We assumed that the unemployment rate for the RUE activity is about 4 per cent, similar to the level of unemployment rate published in China Statistical Yearbook. Unemployment in rural areas is very small because most rural people can work on the allocated family land. However, we allowed for a small rate of unemployment (about 1.4 per cent) to reflect time spend by rural employed persons in transition between the three different rural employment activities. The resulting person-years by activity for the 2002 model database are presented in Table A.3.

Table A.1 Number of person-years of employment by activity in 2002

Categories	Million person-years
(1) AG	312
(2) RNAG	96
(3) RUE	82
(4) UUSE	212
(5) USE	35
(6) RAGU	6
(7) RUU	3
(8) UU	15
(9) Total	761

Sources: Estimated by authors.