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Hitting The Great Wall: Rural-Urban Migration and China's GrowthSlowdown

by

Longfeng Ye
Xi'an Jiaotong-Liverpool University

and

Peter E. Robertson
Business School
University of Western Australia

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Longfeng Ye
Xi'an Jiaotong-Liverpool University

Peter E. Robertson*
University of Western Australia

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Abstract

China is facing slowing growth rates, slowing rates of rural to urban migration and resistance to reforms that would liberalize internal migration restrictions (Hukou). We develop a two-sector Ramsey model and use counterfactual simulations to quantify the impact of internal migration and labor market reforms. We find that the impact of sectoral labor reallocation on growth is amplified by capital accumulation and is more than twice as large as conventional growth accounting measures. While these effects have diminished as agricultural labor declines, we also find that, once we allow for capital dynamics, Hukou reform could add 1.1-1.5 percentage points to China's growth over the next decade.

Keywords: Rural-Urban Migration, Economic Growth, Capital Accumulation, China.

JEL: O1, O41, J60

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*Corresponding author Peter Robertson, University of Western Australia, M251, Perth, 6009, W.A. Australia, peter.robertson@uwa.edu.au. The authors also acknowledge the support of the World Wide Universities Network WUN and The Australian Research Council DP110101316. We have also benefited from the comments of many colleagues.

1 Introduction

A key feature of China's growth miracle has been the migration of more than 200 million workers from rural to urban areas. China's growth is slowing, however, and there is a widely held expectation that a growing shortage of rural to urban migrants will exacerbate this problem. According to Krugman (2013), for example, China's growth is about to "hit its Great Wall" as it is "running out of surplus peasants".

Nevertheless relatively few studies have tried to assess the impact of labor reallocation on China's growth or how labor market reforms might mitigate any slowdown. In particular the literature on labor reallocation and growth in China consists mainly of growth accounting studies. These only give a historical perspective on the past importance of labor reallocation and, by design, exclude general equilibrium and dynamic interactions between labor reallocation, prices, investment, and growth. This limits the usefulness of these methods for investigating how the slowing migration might affect China's growth and how reforms to existing labor market barriers (Hukou) might moderate this anticipated slowdown.

In this paper we aim to obtain quantitative measures of the contribution of labor reallocation and labor market reforms to China's growth. To allow for general equilibrium effects and capital dynamics we construct a two-sector Ramsey–Cass–Koopmans growth model that incorporates factor mobility and a sectoral wage gap. The model simulations trace the impact of sector biased TFP growth on labor migration, allocative efficiency, prices, capital and per capita income growth. We use counterfactual simulations to determine the importance of labor migration to China's growth.

Consistent with recent growth accounting studies we find that the impact of labor reallocation on TFP growth is relatively small, under 1 percentage point per year out of China's annual GDP per worker growth rate of 8 percentage points per year. Nevertheless we also find that, once we allow for induced capital accumulation, the impact of labor reallocation on per capita GDP growth is amplified to approximately 2 percentage points per year. Thus we find that the overall effect of labor reallocation on growth is much larger than suggested by growth accounting, though still a relatively modest component of China's overall growth over the last 30 years.

Second we consider the impact of changes in the Hukou system on China's future growth, under alternative future growth scenarios. We find that a relaxation of Hukou would add 1.1-1.5 percentage points to China's growth over the next decade. This is a significant effect in the context of China's anticipated growth slowdown. Thus our results suggest that reforms to Hukou could serve as an important source of growth for China over the next decade.

The paper is organized as follows. Section 2 briefly discusses some of the recent literature on labor migration and China's growth. Section 3 describes the model and defines an equilibrium. In Section 4 we describe experiment design and calibration. The results of the simulations are discussed in Section 5 and Section 6 concludes.

2 Labor Reallocation and Growth in China

China's economic growth has slowed in recent years and is widely expected to slow further. There are a number of reasons for this including a slowdown in the rate of technological catch-up as China approaches the world technology frontier, and the effect of convergence as it approaches a steady-state growth path. Commentators have also pointed to the need for institutional reforms, reducing the inefficiency of state enterprises, export diversification, and re-balancing towards consumption. At the same time the Chinese central government is trying to bring in reforms to the household registration system to address concerns about rising inequality and possibly also economic growth.[1]

In particular it has been widely argued that the Hukou restriction is a major reason for the rural-urban divide and segmentation in the urban labor market (Knight and Song, 1999; Meng and Zhang, 2001; Cai et al., 2008; Meng, 2012). Thus, relaxing Hukou would potentially reduce the rural-urban inequality (Whalley and Zhang, 2007; Mai et al., 2014).[2]

In addition, however, slowing rural-urban migration has been a key point of concern over China's growth prospects. As shown in Figure (1),[3] the decline in agricultural employment shares has been dramatic and it is likely that this movement has resulted in allocative efficiency gains. This view is emphasized by a wide range of studies such as Meng and Bai (2007), Rodrik (2010), Yao (2011), Li et al. (2012), Meng (2012), and Zhu (2012). It is also emphasized in an extensive growth accounting literature that finds large gains from factor reallocation (He and Kuijs, 2007; Bosworth and Collins, 2008;

[1] Related to these ideas is the notion of a middle-income trap which emphasizes the historical difficulty of maintaining a high rate of catch-up growth over the long run.

[2] There are also several studies on geographical considerations associated with Hukou (Au and Henderson, 2006a,b; Bosker et al., 2012).

[3] A similar change is also reported by Holz (2006). Brandt et al. (2008) shows an even larger decline from 0.7 to 0.32 of the total labor force over 1978-2004.

Bloom et al., 2010).[4] The view that migration has been an important source of growth in the past, along with the view that migration is necessarily slowing, gives rise to the growth pessimism of Rodrik (2010), Li et al. (2012), The Economist (2013), and Krugman (2013).

[Figure (1) about here]

Nevertheless there is an alternative view in the literature that the efficiency gains from factor reallocation have been small, despite large apparent sectoral productivity gaps (Cao et al., 2009; Bulman and Kraay, 2011; Ye and Robertson, 2016). Insofar as they find small labor reallocation effects on growth, these studies suggest that the slowing rural-urban migration may not be a big factor in causing a growth slowdown.

Growth accounting studies, however, only provide a proximate understanding of the causes of growth (Barro, 1999). This limits their usefulness for understanding the interactions between growth and policy variables such as controls on migration rates. To understand the impact of labor reallocation we need to account for the general equilibrium relationships between productivity, migration and allocative efficiency and investment decisions. Likewise these general equilibrium relationships are critical to evaluating the impact of a relaxation of Hukou restrictions, on capital accumulation and growth.

In particular, an insight of the neoclassical growth model is that capital accumulation responds to changes in productivity, so increases in total factor productivity, including improvements in allocative efficiency, will have an amplified effect on the growth rate.[5] Hence, if labor reallocation results in an improvement in allocative efficiency, it will also induce capital accumulation. Likewise sectoral labor reallocation will also induce price changes that will affect the return to capital, and hence investment spending. In what follows we therefore develop a two-sector model of agricultural and non-agricultural production to examine the impact of inter-sectoral labor migration in China and the implications of Hukou reform on China's future growth.

Two-sector versions of the standard neoclassical growth model have been widely used to consider interactions between growth and structural change. Examples include Echevarria (1997), Robertson (1999), Kongsamut et al. (2001), Caselli and Coleman II (2001),

[4] Similarly many recent studies have argued that factor misallocation is not only a ubiquitous feature of developing economies, but also a key part of the growth process (Young, 1995, 2003; Vollrath, 2009; McCaig and Pavcnik, 2013; Gollin et al., 2014).

[5] This endogenous capital response is the key difference between the traditional growth accounting literature and the recent "development accounting" literature such as Hall and Jones (1999), Caselli (2005), and Hsieh and Klenow (2010). For a discussion of these amplification effects in the context of two-sector models see Landon-Lane and Robertson (2007) and Landon-Lane and Robertson (2009).

Restuccia (2004), Ngai and Pissarides (2007), Gollin et al. (2007), Landon-Lane and Robertson (2007), Restuccia et al. (2008), Acemoglu and Guerrieri (2008), Alvarez-Cuadrado and Long (2011), Esteban-Pretel and Sawada (2014) and Cai (2015).[6]

Our paper is most closely related to Cao and Birchenall (2013) and Dekle and Vandenbroucke (2012) who also construct calibrated growth models of the Chinese economy.[7] Cao and Birchenall (2013) consider whether observed TFP in the agricultural sector can explain the changes in employment and output shares in China but don't consider allocative efficiency issues. Dekle and Vandenbroucke (2012) construct a similar model but their focus is on the role of government in China's structural transformation. Neither of these papers, however, considers the impact of Hukou reform on China's future growth prospects.

3 The Model

We consider an economy that consists of two sectors, the agriculture (a) and the non-agriculture (m). An infinitely lived representative household supplies homogeneous labor and rents capital to firms in both sectors. Firms minimize costs by choosing labor, L, and capital, K, inputs under constant returns to scale. Capital and labor are mobile across sectors. As described below, however, we also assume an exogenous wedge between the value of the marginal product of labor in each sector in order to allow for China's Hukou restrictions.

3.1 Households

We begin by considering the utility maximization problem of the household. We assume the household has an instantaneous utility function given by

$$u(q) = \frac{q^{1-\theta} - 1}{1 - \theta} \tag{1}$$

[6]The salient feature of structural change in the growth process, was documented initially by Kuznets and Murphy (1966) and Clark (1967). See also Syrquin (1998).

[7]Brandt and Zhu (2010) consider simulations in a simple growth model with fixed investment rates. Their focus, however, is on factor reallocation between state and non-state enterprises. This is also the focus of Song et al. (2011). Using a multi-region model, Whalley and Zhang (2007) investigate the role of Hukou in explaining China's rising inequality historically. Mai et al. (2014) use an adaptive expectations model to quantify welfare impacts of facilitating rural-urban migration in China.

where q is per capita consumption of a composite good. Following Ngai and Pissarides (2007), Acemoglu and Guerrieri (2008), and Alvarez-Cuadrado and Long (2011) we assume that q is a CES function, $q = q(q_a, q_m)$.[8]

Dual to q is an expenditure function. Taking the price of nonagricultural goods as numeraire, and denoting the price of agricultural goods by p, the unit expenditure function is

$$\epsilon(p) = [(1-\gamma_u)p^{\rho_u} + \gamma_u 1^{\rho_u}]^{1/\rho_u} \tag{2}$$

where $1 - \rho_u \equiv \sigma_u$ is the substitution elasticity between two goods.

By Shephard's Lemma the unit consumption demand for agricultural goods is $q_a = \frac{\partial \epsilon(p)}{\partial p} q$.

The paths of the household's population and labor augmenting technology are given by $L(t) = L(0)e^{nt}$, and $A(t) = A(0)e^{xt}$, where $L(0) = A(0) = 1$, and n and x denote, respectively, the growth rates of labor and labor augmenting technology.

Letting ρ denote the time discount rate, the objective function facing the representative household is

$$\int_0^\infty e^{-(\rho-n)t} u(q) dt \tag{3}$$

The household maximizes (3) subject to the law of motion of capital K

$$\dot{K} = (R - \delta)K + w_a L_a + w_m L_m - \epsilon(p)Q \tag{4}$$

where: L_a and L_m are sectoral employment levels and $L_a + L_m = L$; R is the marginal product of capital; w_a and w_m are sectoral wage rates, and; $Q = q\ L$ is the total consumption of the composite good.

Rewriting (4) in terms of capital per efficiency worker gives

[8] Some authors have built in structural change to their models by imposing non-homotheticity using Stone-Geary preferences. See for example, Echevarria (1997), Caselli and Coleman II (2001), Gollin et al. (2007), and Restuccia et al. (2008). As noted by Herrendorf et al. (2014) this is not necessary since, as in our model, structural change also arises from differential rates of sectoral productivity growth and different factor intensities. Our approach is consistent with the view that China's growth over the last three decades has been mainly driven by sector biased productivity growth and our choice of utility function simply reflects a desire for parsimony.

$$\dot{\hat{k}} = (R - \delta - n - x)\hat{k} + \hat{w}_a l_a + \hat{w}_m l_m - \epsilon(p)\hat{q} \tag{5}$$

where $\hat{k} = K/AL$, $\hat{q} = Q/AL$, $\hat{w}_a = w_a/A$, $\hat{w}_m = w_m/A$, $\hat{q} = Q/AL$, $l_a = L_a/L$, $l_m = L_m/L$.

The Hamiltonian is

$$H = e^{-(\rho-n)t}u(\hat{q}e^{xt}) + \mu\left[(R - \delta - n - x)\hat{k} + \hat{w}_a l_a + \hat{w}_m l_m - \epsilon(p)\hat{q}\right] \tag{6}$$

where $\hat{q}$ is the control variable, μ is the costate variable, and $\hat{k}$ is the state variable. The first order conditions for a maximum are $\frac{\partial H}{\partial \hat{q}} = 0$ and $\frac{\partial H}{\partial \hat{k}} = -\dot{\mu}$ which give

$$\hat{q}^{-\theta} = \tilde{\mu}\epsilon(p) \tag{7}$$

where $\tilde{\mu} = \mu e^{-[x-(\rho-n)-x\theta]t}$

$$-\dot{\tilde{\mu}} = \tilde{\mu}\,(R - \delta - \rho - x\theta) \tag{8}$$

Combining (7) and (8) give the Euler equation

$$\frac{\dot{\hat{q}}}{\hat{q}} = \frac{1}{\theta}\left(R - \delta - \rho - x\theta - \frac{\dot{\epsilon}}{\epsilon}\right) \tag{9}$$

Note that if two goods are identical, or if we have a small open economy facing fixed world prices, then p is constant and $\dot{\epsilon}/\epsilon = 0$. In this case (9) reduces to the standard Euler equation in the one-sector Ramsey model. More generally, in a two-sector model, changes in consumption price index, $\epsilon(p)$, will affect the optimal consumption path and the optimal rate of investment.

3.2 Firms

A representative firm in sector i, $i \in a, m$, employs labor and capital to produce goods under the sector-specific technology and the assumption of constant returns to scale. Firms minimize cost by choosing capital and labor inputs subject to the labor mobility constraints between agricultural firms and non-agricultural firms – due to the household registration system or Hukou. We model this wedge as a tax, $\tau > 0$ on nonagricultural labor, with a lump sum transfer $T = \tau\ w_m\ L_m$. Thus the cost function for firms in each sector is $w_i L_i + RK_i$, where $w_a = w_m\ (1-\tau)$.

The minimized unit cost function is then given by

$$c_i = c^i(\hat{w}_i, R) = \phi_i \left[\gamma_i \hat{w}_i^{\rho_i} + (1-\gamma_i) R^{\rho_i}\right]^{1/\rho_i}, i \in a, m \tag{10}$$

where $\hat{w}_i$ denotes the wage per efficiency unit of labor, ϕ_i is the constant for the unit cost function, and γ_i is the distribution parameter, and $1-\rho_i \equiv \sigma_i$ is the substitution elasticity between capital and labor. By Shephard's Lemma the unit factor demand function for capital is given by $\partial c_i/\partial \hat{R}$. Likewise firms' unit labor demand is given by $\partial c_i/\partial \hat{w}_i$.

3.3 Equilibrium

We characterize an equilibrium in the model by first describing a static equilibrium, that holds for a given value of the state variable, $\hat{k}$, and the steady-state equilibrium that holds for the steady-state value of $\hat{k}$.

3.3.1 Static Equilibrium

Definition 1: Static Equilibrium. A static equilibrium is a set of goods prices, p, factor prices, $\hat{w}_a$, $\hat{w}_m$, R, sectoral output levels, $\hat{y}_a$, $\hat{y}_m$, and a real consumption level, $\hat{q}$, that hold for a given state variable $\hat{k}$, costate variable $\tilde{\mu}$, and set of exogenous variables $L = 1$, A_a and A_m, that satisfy:

zero profits,

$$1 = c_m = c^m(\hat{w}_m, R) \tag{11}$$

$$p = c_a = c^a(\hat{w}_a, R) \tag{12}$$

labor market clearing,

$$1 = \frac{\partial c_a}{\partial \hat{w}_a}\hat{y}_a + \frac{\partial c_m}{\partial \hat{w}_m}\hat{y}_m \tag{13}$$

capital market clearing,

$$\hat{k} = \frac{\partial c_a}{\partial R}\hat{y}_a + \frac{\partial c_m}{\partial R}\hat{y}_m \tag{14}$$

goods market clearing for the agricultural sector,

$$\hat{y}_a = \frac{\partial \epsilon(p)}{\partial p}\hat{q} \tag{15}$$

and goods market clearing for the nonagricultural sector,

$$\hat{y}_m = \hat{q}_m + \dot{\hat{k}} + (\delta + n + x)\hat{k} \tag{16}$$

where, $\hat{q}_m = \epsilon(p)\hat{q} - \frac{\partial \epsilon(p)}{\partial p}\hat{q}$, is the consumption demand for nonagricultural goods per efficiency worker and $\dot{\hat{k}} + (\delta + n + x)\hat{k}$ is the investment demand for nonagricultural goods per efficiency worker. Rearrangement of (15) and (16) gives $\hat{y}_m + \hat{y}_a p = \epsilon(p)\hat{q} + \dot{\hat{k}} + (\delta + n + x)\hat{k}$ which shows that in equilibrium expenditure equals income.

Thus given the state variable $\hat{k}$ and costate variable $\tilde{\mu}$, a static equilibrium consists of 6 static equations, equations (11)-(16), and 6 endogenous variables ($\hat{w}_a$, R, p, $\hat{q}$, $\hat{y}_a$, $\hat{y}_m$).

3.3.2 Steady State

A steady-state path requires that all real variables: consumption, capital and output, grow at a rate of $n + x$, such that the real variables per efficiency unit, e.g. $\hat{k} = k/A$, $\hat{y} = y/A$, and $\hat{q} = q/A$, are constant. This will also require that the prices, p, $\hat{w}_a$, $\hat{w}_m$, and R are constant.

To characterize the steady-state path note that if consumption per efficiency worker is constant, $\dot{\hat{q}}/\hat{q} = \dot{\epsilon}/\epsilon = 0$, (9) gives

$$R^* = \delta + \rho + x\theta \tag{17}$$

Thus we have

Definition 2: Steady State. The steady-state path is a sequence of static equilibria where (17) is also satisfied.

3.3.3 Dynamic Equilibrium

We can now define a dynamic equilibrium.

Definition 3: Dynamic Equilibrium. A dynamic equilibrium is a sequence of static equilibria, where the path of the state variable $\hat{k}$ satisfies (5) and the costate variable $\tilde{\mu}$ satisfies (8), for all t, and also (17) is satisfied as $t \to \infty$.

In practice we solve the dynamic equilibrium numerically by finding a path that reaches the steady state in a finite time. This involves solving a two-point boundary value problem consisting of differential equations (5) and (8).[9]

3.4 Calibration

We aim to calibrate the model so that it reproduces the key aspects of China's growth experience from 1978 to 2008. We model this growth as a transition from an initial steady-state equilibrium in 1978, to a new steady state, that arises as a result of a positive productivity shock to the non-agriculture.

We begin by calibrating the initial steady state using balanced path conditions and 1978 data. For the balanced path we assume a population growth rate of $n = 0.01$, a labor augmenting productivity growth rate of $x = 0.02$, a depreciation rate of $\delta = 0.05$, and an investment rate of $I/Y = 0.35$. The balanced path condition $I/K = x+n+\delta$ determines the value of K/Y.

In the initial steady state the non-agricultural sector accounts for 30% of the total employment and 70% of the total output. Evidence from Dekle and Vandenbroucke (2012) and Young (2013) suggests a wage ratio in the region of $w_m/w_a = 4$ which implies $\tau = 0.75$. We assume that $R^* = 0.10$, based on Bai et al. (2006).[10]

Using these shares, wage ratio, and capital-output ratio, we can solve to obtain the capital income shares for the agricultural sector (α) and the nonagricultural sector (β).[11] The implied capital income share for the nonagricultural sector is found to be, $\beta = 0.49$, and the implied capital income share for the agricultural sector, α, is 0.31. These are well within the range of values reported in the literature such as Woo (1998), Young (2003),

[9] The solution is obtained using the relaxation algorithm described in Robertson (1999) and Trimborn et al. (2008).

[10] Bai et al. (2006) find the real return to capital in China since 1978 fluctuated between 8 percent and 12 percent.

[11] Specifically as long as the production functions are homogeneous of degree one, the definition of the factor income shares implies that $\frac{w_m L_m}{w_a L_a} = \frac{(1-\beta)Y_m}{(1-\alpha)pY_a}$.

Brandt et al. (2008), Bosworth and Collins (2008), Chong-En and Zhenjie (2010), Bulman and Kraay (2011), and Dekle and Vandenbroucke (2012).

By choice of units we set $p = 1$, and we normalize the initial total employment and total output to be unity. These initial conditions, together with factor income shares and the substitution elasticity between capital and labor, are then used to solve for the CES unit cost distribution parameters (γ_a and γ_m) and the unit cost function constants (ϕ_a and ϕ_m), so that the zero profits condition holds in both sectors. We assume initially that the substitution elasticities σ_a and σ_m are equal to unity and then experiment with alternative values in sensitivity checks.

The inverse of inter-temporal substitution elasticity, θ, is assumed to be 1.1. This implies an inter-temporal substitution elasticity of 0.91.[12] Given $R^* = \rho + \delta + \theta x = 0.10$, the implied time discount rate $\rho = 0.028$, is close to the value used by Roe et al. (2010) and Cao and Birchenall (2013).

Finally we consider the elasticity of substitution in consumption between agricultural and nonagricultural goods, σ_u. Official data from the National Bureau of Statistics of China show that the expenditure share of food in China declined from 57% in 1978 to 37% in 2008 for urban residents, and from 67% to 43% for rural residents. This declining food share, in conjunction with an increasing price of food relative to manufacturing and services, suggests that the elasticity of substitution between agricultural and nonagricultural goods exceeds unity, $\sigma_u > 1$. We use a value of $\sigma_u = 2.5$ which generates changes in the employment shares that are very close to the historically observed changes in China.[13] Table (1) summarizes these parameter choices.

[Table (1) about here]

To generate the non-steady-state baseline path, a positive productivity shock to the non-agriculture is imposed such that, over the transition period of three decades (1978-2008), the nonagricultural employment share follows its historical path from 0.3 to 0.6 of the total labor force, and the annual growth rate of GDP per worker is 8 percentage points

[12]The empirical evidence on inter-temporal substitution elasticity is mixed. Empirical studies using aggregate consumption data often find a value close to zero. See for example Hall (1988). While calibrated macroeconomic models, for example Weil (1989) and Lucas (1990), tend to choose an value close to unity to match growth and business cycles. We follow the latter treatment.

[13]Our baseline model suggests a decline from 46% to 18% in consumption budget share of agricultural goods. A large σ_u can also be seen as a parsimonious way of capturing the fact that China has a relatively open economy so that substitution in consumption can actually occur through trade.

per year, as reported, for example, by Bulman and Kraay (2011).[14] This requires a productivity shock of 98% to the non-agriculture over the last three decades.

Table (2) summarizes key aspects of our baseline model. In terms of structural change, it predicts a total change in employment share of the nonagricultural sector from 30% of the total labor force in 1978 to 60% in 2008. The baseline calibration also predicts a change in the output share of the non-agricultural sector from 70% of the total output in 1978 to 89% in 2008, which is also in the range of data in Bulman and Kraay (2011), Cao and Birchenall (2013), and Ye and Robertson (2016). The properties of other key variables of interest are also shown in Table (2). These values are all within the range of values reported in the literature, particularly in Brandt and Zhu (2010), Bulman and Kraay (2011), and Ye and Robertson (2016).

[Table (2) about here]

Finally we note that the baseline path is not a steady state. GDP per worker and capital per worker in 2008 are 82% and 90% of their steady-state values in the baseline. Hence the baseline traces out a nearly full transition path from an initial position to the new steady state.

4 Quantifying the Impact of Labor Reallocation on Growth

4.1 Experiment Design

Growth accounting studies consider the impact of labor reallocation for a given capital stock. But labor reallocation will also generate efficiency gains and price responses that will influence investment decisions and capital accumulation. Hence the total impact of labor reallocation on the growth rate is likely to exceed the standard growth accounting measure, which is limited to the impact of labor reallocation on TFP. It is important to understand these additional general equilibrium and capital accumulation responses, in order to understand the possible effect of Hukou reform on China's growth, and the relationship between rural-urban migration and growth more generally.

[14] Similar values for capital accumulation, but for slightly shorter periods, are given in Holz (2006), Bosworth and Collins (2008), Perkins and Rawski (2008), and Zheng et al. (2009).

We therefore consider the impact of labor reallocation in China using the preceding model. First we consider how labor reallocation has contributed to China's growth since the beginning of reforms in 1978. For this experiment we calibrate the model to a 1978 benchmark and then compute a counterfactual growth path where sectoral allocation of labor is held fixed. By comparing this with a benchmark path we can quantify the historical impact of labor reallocation on China's growth. Second we consider the importance of labor reallocation effects in China over the coming decade as China's growth slows, and how the relaxation of Hukou restrictions might mitigate the anticipated growth slowdown. In this case we consider alternative future growth paths against counterfactual paths where we vary the Hukou restrictions.

4.2 Measuring Labor Reallocation Effects

A number of studies have used the standard growth accounting method, as outlined by Denison (1967) and Barro (1999), to decompose China's per capita income growth into a capital accumulation term and TFP growth. Typically they find per capita income growth of 8 percent per year over a three-decade period; a contribution from capital accumulation of 4-5 percent, and; TFP growth of 3-4 percentage points.

The labor reallocation effect, as a component of TFP, can be found by subtracting the appropriately weighted TFP growth in each sector from the total TFP growth (Syrquin, 1998; Barro, 1999). Thus, for example, a prominent recent study by Bulman and Kraay (2011) find that out of the 3.7 percentage points of TFP growth, 0.8 percentage points can be attributed to labor reallocation effect. Likewise Ye and Robertson (2016) find TFP growth to be 3.05 percentage points per year of which the labor reallocation effect is 0.77 percentage points per year.[15]

While this approach to measuring labor reallocation effect is informative, it has several limitations as a tool for assessing the impact of policy changes. First it only provides a historical description of the role of labor reallocation for given paths of other variables such as capital accumulation, output shares, and the aggregate capital share, that will respond endogenously to policy changes and other exogenous shocks that might be con-

[15]The literature also reports numbers as high as 2 percentage points per year, which is obtained when more approximate measures are used such as Brandt et al. (2008) and Bosworth and Collins (2008). Ye and Robertson (2016) show, however, that these large values follow from the method which tends to dramatically overstate the actual labor reallocation effect as defined by Kuznets and Murphy (1966), Denison (1967), Syrquin (1998), and Barro (1999). In addition once other inputs are controlled for, such as human capital, the labor reallocation effect can be found to be much smaller. Ye and Robertson (2016) find a human capital adjusted value of 0.25. Moreover Cao et al. (2009), using a more comprehensive index of inputs, find that the labor reallocation effect is approximately zero.

sidered in a counterfactual. Likewise the paths of investment and capital will respond endogenously to policy changes and exogenous shocks. Thus in order to consider how a shortage of labor might affect China's growth we need a more sophisticated technique that can take account of these general equilibrium and accumulation responses. In what follows we consider comparative dynamic comparisons of alternative growth paths, taking account of endogenous capital and transitional dynamics.

4.3 Historical Results

We now consider the impact of labor reallocation in China during China's economic development. Specifically we compare the historical baseline path with a counterfactual path (hereafter C1) where the sectoral allocation of labor is held fixed. The difference in per worker GDP growth between the counterfactual (C1) and the baseline, quantifies the effect of historical labor reallocation on China's growth. We can then decompose the aggregate growth difference into components attributed to additional TFP growth, through efficiency gains, and growth associated with capital accumulation. The results are reported in Table (3) and Figures (2) - (3).

[Table (3) about here]

[Figure (2) about here]

[Figure (3) about here]

It can be seen from Table (3) that TFP in the counterfactual C1 is 23% lower than the baseline. The difference in TFP growth rate between the baseline and the C1 is 0.89% per year. This represents the direct allocative efficiency gains from labor reallocation.

This is close to the above growth accounting numbers of 0.77-0.8% per year. These numbers are alternative measures of the additional productivity growth generated by labor reallocation from the low marginal product of labor sector to the high marginal product of labor sector. Thus the simulation model produces allocative efficiency effects on TFP that are very similar to growth accounting measures.

Nevertheless it can also be seen that per worker GDP in the counterfactual is approximately 44% lower than the baseline. This amounts to a difference of 2.1 percentage points of per worker GDP growth per year. Thus we also find that the impact of labor reallocation on growth is more than twice as large as its impact on TFP – as measured by standard growth accounting.

The reason for this difference can be seen in the change in capital per worker where there is also significantly lower capital accumulation in the counterfactual. The results in Figures (2) - (3) and Table (3) also show that there are two separate mechanisms that drive this capital accumulation response. The first is the effect of the TFP gains on the marginal product of capital. In our two-sector model the increase in the marginal product of capital generates capital accumulation, as it would in a standard one-sector Ramsey model.[16]

In addition labor reallocation reduces the price of investment relative to agricultural output. This can be seen in Table (3) where the relative price of the agriculture, p, is 35 percent lower in the counterfactual – i.e. labor reallocation reduces the price of investment, $1/p$, relative to the no-labor-reallocation counterfactual C1. Likewise the price of consumption, ϵ, is 9.75 percent lower in the counterfactual C1 than the baseline.[17] Thus labor reallocation also reduces the price of investment relative to consumption and so consumers reduce consumption and increase investment.

Commensurate with this endogenous capital accumulation response the results show the change in investment per worker (I/L) and the investment rate (I/Y). As shown in Figure (3), the investment rate falls sharply initially in response to the counterfactual migration restriction in the C1 as does the return to capital. Both variables then recover significantly because the lower investment rate eventually causes incomes to fall as well, so that the investment rate begins to recover.

Thus in the two-sector model we see that there are two factors affecting capital accumulation – the TFP gains from allocative efficiency and the fall in the relative price of investment. Together these induce a two percentage points gains in capital per worker.

[16]The steady-state impact of TFP on capital accumulation in a one-sector neoclassical growth model is straight-forward to compute. For example suppose the aggregate production function in intensive form is $y = Ak^{\gamma}$, where A denotes the aggregate TFP, and γ is the aggregate capital income share. At a steady state, the marginal product of capital R^* is uniquely determined by eq (17), which depends on a set of exogenous parameters. By definition, the marginal product of capital can be expressed as $R^* = A\gamma(k^*)^{\gamma-1}$. Thus, the steady-state capital per worker k^* can be written as $k^* = R^{*1/(\gamma-1)}A^{1/(1-\gamma)}\gamma^{1/(1-\gamma)}$, which suggests that an increase in A would increase the steady-state capital k^* with an elasticity of $1/(1-\gamma)$. See also Landon-Lane and Robertson (2009) that find a quantitatively large indirect capital deepening effects from inter-sectoral resource reallocation for several East Asian economies though they use a simpler Solow-Swan growth model.

[17]This investment price response is in line with the existing literature on the linkage between the relative price of investment and growth, such as Summers (1981), Agarwala (1983), Edwards (1989), De Long and Summers (1991), Jones (1994) and Greenwood et al. (1997) though in these models the price response is due to technological change not labor reallocation.

Along with the direct gains from TFP this then results in the 2 percentage points gains in output per worker. This is how labor reallocation induces a much larger response in economy than its impact on TFP and part of the so-called "capital contribution" in growth accounting can be attributed to labor reallocation. Likewise the standard growth accounting contribution of labor reallocation underestimates the total impact of labor reallocation on the growth rate by a factor of a half.

Finally we turn to consider the labor market impact of the experiment. It can be seen from Table (3) and Figure (3) that the counterfactual produces a large fall in real agricultural wages and little change in real wages in the non-agriculture. Thus, as would be expected the migration of labor from the agriculture to the non-agriculture boosts agricultural incomes by increasing scarcity.[18]

4.4 Sensitivity

Next we consider some sensitivity analysis and experiment with alternative substitution elasticities between capital and labor in each sector, σ_a and σ_m. The results are reported in Table (A1) in the Appendix. The alternative choices of sectoral substitution elasticities are guided by empirical evidence. Specifically, we consider a range of σ_m less than unity, and a range of σ_a greater than unity. For example, many time series studies on manufacturing find a substitution elasticity less than unity, such as Arrow et al. (1961), Dhrymes (1963), and Clague (1969), but a higher substitution elasticity in the agriculture has been found for example in Behrman (1972) and Herrendorf et al. (2013).[19] Recent studies like Alvarez-Cuadrado and Long (2011) also consider a higher substitution elasticity in the agriculture than the non-agriculture as one of the driving forces of structural change.

For each alternative scenario, we re-calibrate the model by adjusting σ_u in the utility function and the productivity shock to ensure that the model yields a historical growth path such that the average growth rate of per worker GDP is 8% per year and the nonagricultural sector's labor share increases from 0.3 to 0.6 of the total labor force over 1978-2008.

It can be seen that the historical labor reallocation effect is stable at around 2% per year across scenarios. If one compares the TFP growth between the baseline and the

[18]This is consistent with Mai et al. (2014) that find relaxing Hukou would increase the wage in the rural areas, and have very little impact on urban wage rate. Similarly, as found in Whalley and Zhang (2007), the wage rate in the rural sector would be higher if there had been no Hukou restrictions historically.

[19]For example, Herrendorf et al. (2013) find capital and labor are most substitutable in agriculture with a substitution elasticity of 1.5. This compares to an elasticity of 0.80 for manufacturing, and 0.7 for services.

counterfactual C1, again the difference is close to 1% per year.

Thus we find that, in our dynamic general equilibrium setting, the total impact of labor reallocation on growth far exceeds the value implied by simple growth accounting, generating around 2 percentage points of growth – more than double the conventional growth accounting measure. Labor reallocation also prevented what would have been a substantial rise in China's non-agricultural wages at the expense of agricultural wages, thus easing inequality over China's industrialization. This result is also stable for a range of alternative assumptions regarding the elasticity of substitution between capital and labor in each sector.

Nevertheless, while providing historical context, these results do not necessarily tell us very much about the impact of slowing migration on China's future growth, which is the concern of Krugman (2013) and others. To explore this issue more fully, therefore, we need also to consider the possible interactions between labor reallocation and China's future growth prospects.

5 Labor Reallocation and China's Growth Prospects

The preceding analysis suggests that, despite large amplification effects from capital accumulation, labor reallocation effects have been a modest component of China's overall per capita GDP growth. To explore this further we now consider the role of labor reallocation in China today. As noted by Krugman (2013) and others, there is evidence that migration rates are slowing. In our general equilibrium setting this slowing of migration can be caused by two factors. First as China's underlying productivity growth slows, then also the rate of labor reallocation can be expected to slow. The causation here, however, is the reverse of that implied by Krugman (2013) insofar as productivity growth slowdown causes migration to slow, not the other way around.

Second, as labor in the agricultural sector becomes more scarce and hence, l_m approaches unity, the responsiveness of labor reallocation to changes in nonagricultural productivity increases will decline. As $l_m \to 1$ it becomes increasingly difficult to maintain the same growth rate in l_m and, hence, to maintain the same induced productivity growth through allocative efficiency gains. To see this consider Figure (4) which plots the elasticity of the nonagricultural labor share l_m with respect to nonagricultural sector productivity A_m, $(dl_m/dA_m)(A_m/l_m)$, calculated by numerical simulations across the domain of l_m from zero to unity, given the baseline calibration. It can be seen that this elasticity declines steadily from above unity to a value of approximately 0.2 when $l_m = 0.7$. This shows therefore that the initial conditions are important for evaluating the size of labor reallocation effects, and that we would anticipate labor reallocation effects in China to be smaller now, as l_m approaches unity.

[Figure (4) about here]

Thus to consider the consequences of labor reallocation in China over the next decade, we first re-calibrate the model to a new growth path that begins in 2015, and then reconsider some counterfactual simulations given these new initial conditions with a much higher value of $l_m = 0.7$.[20]

Given the new initial conditions we then consider three alternative scenarios for China's future growth prospects. Specifically we suppose that the underlying growth rates of GDP per worker are 2% (*low growth*), 4% (*medium growth*), and 6% (*high growth*) per year respectively. We regard the medium growth scenario as the most likely scenario based on OECD long-run forecasts for 2015-2025. These alternative baseline growth paths are generated by productivity shocks of, respectively, 0%, 13%, and 27% to the nonagricultural sector. These productivity shocks are fully anticipated from 2015 and we solve the model to a steady state, but then focus on the transition path 2015-2025. Note that the productivity shocks induce growth directly and also through the mechanisms discussed above, namely, by inducing labor reallocation and the associated allocative efficiency gains in TFP, and by inducing capital accumulation.

Thus the different baseline growth paths also imply different baseline paths for the sectoral allocation of labor. In the high growth case l_m increases from 0.7 in 2015 to 0.79 in 2025 and in the medium growth case it increases to 0.75. In the low growth case however the projected growth rate is simply the steady-state growth path. Hence in this case l_m remains fixed at 0.70.

For each baseline path, we then consider two further counterfactual simulations. To quantify the contribution of labor reallocation over the next decade we consider counterfactuals where the allocation of labor is held fixed (hereafter the counterfactual C2). Thus the wage gap τ adjusts such that the counterfactual sectoral labor shares of the nonagricultural sector (l_m) are held fixed at 0.7 until 2025. This experiment is the same

[20] Given the employment share of the nonagricultural sector (l_m) of 0.7, the equation $\frac{w_m L_m}{w_a L_a} = \frac{(1-\beta)Y_m}{(1-\alpha)pY_a}$ then implies that the output share of the agricultural sector is around 7%, which is in line with the data in Ye and Robertson (2016). We further choose parameters of ϕ_a, ϕ_m and the investment rate I/Y such that zero profits conditions and the steady-state $R^* = 1$ hold. Other parameters remain unchanged.

as C1 but it looks at future, rather than past, growth scenarios. These counterfactual values indicate the contribution of labor reallocation in each of the baseline scenarios, which then provides a way of comparing the role of labor reallocation in these experiments with the historical role discussed above. We expect the results to differ due to the lower labor reallocation responsiveness and lower expected productivity growth.

In addition, we also want to consider the relevant policy question which is the extent to which Hukou reform might facilitate further migration and mitigate slowing growth in the coming decade. Thus we also consider the impact of a relaxation of Hukou in order to see if this might significantly mitigate a slowdown in China's growth. This is modeled by a reduction in the wage gap τ (hereafter the counterfactual C3).

5.1 Labor Reallocation and China's Growth Slowdown

The results for C2 ("no migration") are presented in Table (4). Beginning with the medium growth scenario, holding the labor allocation fixed we find that GDP per worker grows at 3.6% per year in the counterfactual, compared to 4% per year in the baseline. Thus the contribution of labor reallocation in this case is 0.4% per year of growth in per worker GDP over the next decade, compared to the historical value of 2 percentage points per year found in the previous section. Thus the combination of lower productivity growth and lower labor reallocation responsiveness generates a much smaller contribution from allocative efficiency.

[Table (4) about here]

This contribution increases to 0.8 percentage points in the high growth scenario. The number is larger because a large fraction of labor, 0.09 of the total labor force, is reallocated to the non-agriculture in this higher productivity growth scenario. In contrast in the low growth scenario there is no labor reallocation because this scenario corresponds to a steady-state path where the labor allocation is fixed. Thus, by design, there is no growth gain from labor reallocation.

Thus for the various growth scenarios, we find that over the decade 2015-2025, labor reallocation adds 0, 0.4 and 0.8 percentage points of growth in per capita income in the low, medium and high growth scenarios respectively. Hence the baseline scenarios all feature a more modest role for labor reallocation in the absence of Hukou reform. Nevertheless this also shows that the importance of labor reallocation effects depends very much on the underlying productivity growth scenario. If non-agricultural productivity growth slows severely then this will also reduce the migration rate from agriculture to non-agriculture. Moreover if the growth scenario remains strong, with 6 percent growth over the next decade, then we find that the contribution of labor reallocation at 0.8 percentage points remains a nontrivial contributing factor to China's growth.

Thus labor reallocation effects in China today will be smaller than in the past, as expected, but the contribution is not necessarily trivial and could potentially be important. Under modest to high growth scenarios, facilitating migration from agricultural sectors or rural provinces, thus remains an important policy consideration.

5.2 Hukou Reform

The preceding results, regarding the potential importance of labor reallocation over the next decade, raise the important policy question of whether China can mitigate the anticipated slowdown through further Hukou reform, thereby stimulating an acceleration in rural-urban migration.

To gain some quantitative view on this question we now consider the implications of Hukou relaxation, C3. As suggested by Gollin et al. (2014), the median agricultural productivity gap for middle-income countries is around 3.0. In conjunction with sectoral labor income share ratio $(1-\beta)/(1-\alpha) = 0.73$, this implies a 2-fold wage gap. Hence in the C3, we reduce τ from 0.75 to 0.5, so that the wage gap is reduced from an initial 4-fold gap to a 2-fold gap. The results from this counterfactual reduction in the sectoral wage gap, for each growth scenario, are reported in Table (5).

Beginning with the case of the medium growth scenario it can be seen that a relaxation of Hukou causes the employment share of the nonagricultural sector to rise from 0.7 in 2015 to 0.93 in 2025 – compared to 0.75 in 2025 if there had been no relaxation of Hukou. Thus Hukou relaxation induces a significant reallocation of labor. Moreover this generates 1.3 percentage points of additional annual growth over the next 10 years on top of the baseline of a 4 percent growth rate. In the context of the baseline growth of 4 percent per year, this extra 1.3 percentage points is quite significant.

[Table (5) about here]

As shown in Table (5) in the low and high growth scenarios we observe similar growth gains from Hukou reform around 1.1-1.5% per year over 2015-2025. Thus it can be seen that the growth gains are larger when the underlying baseline growth is slower. This implies that Hukou reform is likely to be more beneficial if China's growth slowdown is more severe.

These results are interesting since, from a political perspective, Hukou reform may well become more difficult if the growth rate is slower, due to greater resistance from provincial governments amid fewer job opportunities and less revenue for public infrastructure projects needed to support migration (Zhang and Tao, 2012; Song, 2014).[21]

Furthermore by summing the results from C2 and C3 we obtain differences in growth rate of 1.45 percentage points per year in the *low* growth scenario and 1.9 percentage points in the high growth scenario. These quite large differences reflect the potential impact of more severe and more liberal Hukou policies. Thus notwithstanding the far smaller pool of agricultural labor in China today, the results suggest that whether China undertakes a tightening of Hukou or manages to institute reforms, will have important consequences for its growth rate in the next decade.

Finally we also experiment with alternative substitution elasticities between capital and labor. Again the results remain stable. For example, Tables (A2) - (A3) in the Appendix report the results of labor reallocation effects without and with Hukou reform for the medium growth scenario, with alternative σ_a and σ_m as specified in Table (A1). For each alternative scenario, we re-calibrate the productivity shock to ensure that the underlying per worker GDP growth is 4% per year in the baseline. We can see that in the absence of Hukou reform, the contribution from labor reallocation remains at around 0.4 percentage points of growth per year, and the growth gains from Hukou reform will be 1.3-1.4% per year, across various combinations of substitution elasticity.

Thus, even though we find that labor reallocation has a fairly small historical effect on TFP, and that these effects are likely to be smaller in the future, Hukou relaxation is likely to have a very important moderating effect on China's anticipated growth slowdown. Specifically in the medium growth scenario, an additional 1.3 percentage points of growth, in addition to the 4% per year baseline growth, is a very significant gain. Likewise in the low growth scenario, the growth gains amount to 1.5% per year on top of a 2 percent per year underlying baseline growth. These values therefore suggest that Hukou reform would not only reduce the wage gap between sectors, thereby reducing inequality, but also significantly mitigate China's anticipated growth slowdown.

[21] The main motive of provincial governments against further Hukou reform is the increasing burden associated with migrants. For example, providing equal public goods and services to migrants would imply a fiscal deficit of 5% of its GDP for Shanghai city (Zhang and Tao, 2012).

6 Conclusion

China's massive rural-urban migration is widely regarded as an important growth source of China's miracle. After three decades, however, policy makers are faced with slowing migration and rising rural-urban inequality. There is a push from the central government for Hukou reform and less restrictive criterion for migration to smaller cities, but also resistance to this from provincial governments and urban residents.

Nevertheless there has been very little analysis of what the slowdown in rural-urban migration might imply for China's growth or whether reforms to Hukou might mitigate the anticipated growth slowdown, with the weight of evidence coming from standard historical growth accounting studies. Moreover there are widely different views on the importance of slowing migration for China's growth prospects. For example Zhu (2012) and Krugman (2013) are quite pessimistic while others such as Cao et al. (2009) and Bulman and Kraay (2011) find little or no evidence that labor reallocation has been important for China's growth.

We investigate these questions using comparative dynamic experiments in a two-sector growth model. The model allows for the impact of migration on allocative efficiency, the investment rate, capital accumulation, and growth. As such we are able to explore interactions between labor reallocation and capital accumulation that cannot be assessed using conventional growth accounting techniques. This therefore provides the flexibility to consider a comparative dynamic counterfactual analysis of Hukou reforms.

We find that, TFP gains from labor reallocation are quite modest, around 0.89 of a percentage point per year out of China's average GDP per worker growth rate of 8 percentage points per year. This is consistent with recent growth accounting studies. Nevertheless we also show that growth gains from migration, including the induced capital accumulation, is more than double this at 2% per year. We also show that this endogenous capital accumulation arises as a consequence of allocative efficiency gains and a falling relative price of investment.

Next we consider implications for China's growth prospects over the decade 2015-2025 and consider the effects of labor reallocation under different growth scenarios. We find that slower productivity growth and the lower responsiveness of labor reallocation as the nonagricultural labor share approaches unity, both serve to reduce the importance of labor reallocation effects compared to China's experience over the last three decades. In addition however we consider the impact of Hukou reforms under alternative future growth scenarios. We find a relaxation of Hukou would add 1.1-1.5 percentage points over the next decade. Moreover the upper end of this range applies to scenarios where China's underlying productivity growth slowdown is more severe – which illustrates that the case for Hukou reform is likely to be stronger when political resistance from provincial governments is also at its strongest. If these challenges can be overcome, however, our simulation results suggest that Hukou reform, and its implications for inducing a greater rate of labor reallocation and capital accumulation, can significantly mitigate the growth slowdown.

Appendix

[Table (A1) about here]

[Table (A2) about here]

[Table (A3) about here]

References

Acemoglu, Daron, and Veronica Guerrieri (2008) 'Capital deepening and nonbalanced economic growth.' *Journal of Political Economy* 116(3), 467–498

Agarwala, Ramgopal (1983) 'Price distortions and growth in developing countries'

Alvarez-Cuadrado, Francisco, and Ngo Van Long (2011) 'Capital-labor substitution, structural change and growth.' CIRANO-Scientific Publications 2011s-68

Arrow, Kenneth J, Hollis B Chenery, Bagicha S Minhas, and Robert M Solow (1961) 'Capital-labor substitution and economic efficiency.' *The Review of Economics and Statistics* pp. 225–250

Au, Chun-Chung, and J Vernon Henderson (2006a) 'Are chinese cities too small?' *The Review of Economic Studies* 73(3), 549–576

_ (2006b) 'How migration restrictions limit agglomeration and productivity in china.' *Journal of development economics* 80(2), 350–388

Bai, Chong-En, Chang-Tai Hsieh, and Yingyi Qian (2006) 'The return to capital in China.' NBER Working Paper 12755

Barro, Robert J (1999) 'Notes on growth accounting.' *Journal of Economic Growth* 4(2), 119–137

Behrman, Jere R (1972) 'Sectoral elasticities of substitution between capital and labor in a developing economy: Times series analysis in the case of postwar Chile.' *Econometrica: Journal of the Econometric Society* 40(2), 311–326

Bloom, David E et al. (2010) 'The contribution of population health and demographic change to economic growth in China and India.' *Journal of Comparative Economics* 38(1), 17–33

Bosker, Maarten, Steven Brakman, Harry Garretsen, and Marc Schramm (2012) 'Relaxing hukou: Increased labor mobility and chinas economic geography.' *Journal of Urban Economics* 72(2), 252–266

Bosworth, Barry, and Susan M Collins (2008) 'Accounting for growth: Comparing China and India.' *The Journal of Economic Perspectives* 22(1), 45–66

Brandt, Loren, and Xiaodong Zhu (2010) 'Accounting for China's growth.' IZA Discussion Paper

Brandt, Loren et al. (2008) 'Growth and structural transformation in China.' In *China's Great Economic Transformation,* ed. Loren Brandt and Thomas G Rawski (Cambridge University Press)

Bulman, David, and Aart Kraay (2011) 'Growth in China 1978-2008: Factor accumulation, factor reallocation, and improvements in productivity.' World Bank Policy Working Paper

Cai, Fang, Albert Park, and Yaohui Zhao (2008) 'The chinese labor market in the reform era.' *Chinas great economic transformation* pp. 167–214

Cai, Wenbiao (2015) 'Structural change accounting with labor market distortions.' *Journal of Economic Dynamics and Control* 57, 54–64

Cao, Jing, Mun S Ho, Dale W Jorgenson, Ruoen Ren, Linlin Sun, and Ximing Yue (2009) 'Industrial and aggregate measures of productivity growth in china, 1982–2000.' *Review of Income and Wealth* 55(s1), 485–513

Cao, Kang Hua, and Javier A Birchenall (2013) 'Agricultural productivity, structural change, and economic growth in post-reform China.' *Journal of Development Economics* 104, 165–180

Caselli, Francesco (2005) 'Accounting for cross-country income differences.' *Handbook of economic growth* 1, 679–741

Caselli, Francesco, and Wilbur John Coleman II (2001) 'The US structural transformation and regional convergence: A reinterpretation.' *Journal of Political Economy* 109(3), 584–616

Chong-En, Bai, and Qian Zhenjie (2010) 'The factor income distribution in china: 1978–2007.' *China Economic Review* 21(4), 650–670

Clague, Christopher K (1969) 'Capital-labor substitution in manufacturing in underdeveloped countries.' *Econometrica: Journal of the Econometric Society* pp. 528–537

Clark, Colin (1967) *The Conditions of Economic Progress* (London: Macmillan)

De Long, J Bradford, and Lawrence H Summers (1991) 'Equipment investment and economic growth.' *The Quarterly Journal of Economics* 106(2), 445–502

Dekle, Robert, and Guillaume Vandenbroucke (2012) 'A quantitative analysis of China's structural transformation.' *Journal of Economic Dynamics and Control* 36(1), 119–135

Denison, Edward F. (1967) *Why growth rates differ: Post-war experiences in nine western countries* (Washington, D.C.: Brookings)

Dhrymes, Phoebus J (1963) 'A comparison of productivity behavior in manufacturing and service industries.' *The Review of Economics and Statistics* pp. 64–69

Echevarria, E Cristina (1997) 'Changes in sectoral composition associated with economic growth.' *International Economic Review* 38(2), 431–52

Edwards, Sebastian (1989) 'Openness, outward orientation, trade liberalization and economic performance in developing countries.' NBER Working Paper

Esteban-Pretel, Julen, and Yasuyuki Sawada (2014) 'On the role of policy interventions in structural change and economic development: The case of postwar japan.' *Journal of Economic Dynamics and Control* 40, 67–83

Gollin, Douglas, David Lagakos, and Michael E Waugh (2014) 'The agricultural productivity gap.' *The Quarterly Journal of Economics* 129(2), 939–993

Gollin, Douglas, Stephen L Parente, and Richard Rogerson (2007) 'The food problem and the evolution of international income levels.' *Journal of Monetary Economics* 54(4), 1230–1255

Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell (1997) 'Long-run implications of investment-specific technological change.' *The American Economic Review* pp. 342–362

Hall, Robert E (1988) 'Intertemporal substitution in consumption.' *Journal of Political Economy* 96(2), 339–357

Hall, Robert E, and Charles I Jones (1999) 'Why do some countries produce so much more output per worker than others?' *The Quarterly Journal of Economics* 114(1), 83–116

He, Jianwu, and Louis Kuijs (2007) 'Rebalancing China's economy–modeling a policy package.' World Bank China Research Paper No.7

Herrendorf, Berthold, Christopher Herrington, and Akos Valentinyi (2013) 'Sectoral technology and structural transformation.' CEPR Discussion Paper No. DP9386

Herrendorf, Berthold, Richard Rogerson, and Akos Valentinyi (2014) 'Growth and structural transformation.' In *Handbook of Economic Growth,* ed. Phillippe Aghion and Steven N. Durlauf, vol. 2B (Elsevier)

Holz, Carsten A (2006) 'Measuring chinese productivity growth, 1952-2005.' *Available at SSRN 928568*

Hsieh, Chang-Tai, and Peter J Klenow (2010) 'Development accounting.' *American Economic Journal: Macroeconomics* 2(1), 207–223

Jones, Charles I (1994) 'Economic growth and the relative price of capital.' *Journal of Monetary Economics* 34(3), 359–382

Knight, John, and Lina Song (1999) 'Employment constraints and sub-optimality in chinese enterprises.' *Oxford Economic Papers* 51(2), 284–299

Kongsamut, Piyabha, Sergio Rebelo, and Danyang Xie (2001) 'Beyond balanced growth.' *The Review of Economic Studies* 68(4), 869–882

Krugman, Paul (2013) 'Hitting china's wall.' *Available at http://www.nytimes.com/2013/07/19/opinion/krugman-hitting-chinas-wall.html*

Kuznets, Simon, and John Thomas Murphy (1966) *Modern Economic Growth: Rate, Structure, and Spread,* vol. 2 (Yale University Press New Haven)

Landon-Lane, John S, and Peter E Robertson (2007) 'Reassessing the impact of barriers to capital accumulation on international income differences.' *International Economic Review* 48(1), 147–154

_ (2009) 'Factor accumulation and growth miracles in a two-sector neoclassical growth model.' *The Manchester School* 77(2), 153–170

Li, Hongbin, Lei Li, Binzhen Wu, and Yanyan Xiong (2012) 'The end of cheap chinese labor.' *The Journal of Economic Perspectives* 26(4), 57–74

Lucas, Robert E (1990) 'Supply-side economics: An analytical review.' *Oxford economic papers* 42(2), 293–316

Mai, Yinhua, Xiujian Peng, Peter Dixon, and Maureen Rimmer (2014) 'The economic effects of facilitating the flow of rural workers to urban employment in china.' *Papers in Regional Science* 93(3), 619–642

McCaig, Brian, and Nina Pavcnik (2013) 'Moving out of agriculture: structural change in vietnam.' Working Paper WP 19616, National Bureau of Economic Research

Meng, Xin (2012) 'Labor market outcomes and reforms in china.' *The Journal of Economic Perspectives* 26(4), 75–101

Meng, Xin, and Junsen Zhang (2001) 'The two-tier labor market in urban china: occupational segregation and wage differentials between urban residents and rural migrants in shanghai.' *Journal of comparative Economics* 29(3), 485–504

Meng, Xin, and Nansheng Bai (2007) 'How much have the wages of unskilled workers in china increased?' *China: Linking markets for growth* pp. 151–175

Ngai, L Rachel, and Christopher A Pissarides (2007) 'Structural change in a multisector model of growth.' *The American Economic Review* 97(1), 429–443

Perkins, Dwight H, and Thomas G Rawski (2008) 'Forecasting chinas economic growth to 2025.' *Chinas great economic transformation* pp. 829–86

Restuccia, Diego (2004) 'Barriers to capital accumulation and aggregate total factor productivity.' *International Economic Review* 45(1), 225–238

Restuccia, Diego, Dennis Tao Yang, and Xiaodong Zhu (2008) 'Agriculture and aggregate productivity: A quantitative cross-country analysis.' *Journal of Monetary Economics* 55(2), 234–250

Robertson, Peter E (1999) 'Economic growth and the return to capital in developing economies.' *Oxford Economic Papers* 51(4), 577–594

Rodrik, Dani (2010) 'Making room for china in the world economy.' *The American Economic Review* pp. 89–93

Roe, Terry L, D Şirin Saracoğlu, and Rodney BW Smith (2010) 'The two sector Ramsey model.' In 'Multisector Growth Models' (Springer) pp. 45–77

Song, Yang (2014) 'What should economists know about the current chinese hukou system?' *China Economic Review* 29, 200–212

Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti (2011) 'Growing like china.' *The American Economic Review* 101(1), 196–233

Summers, Lawrence H (1981) 'Taxation and corporate investment: A q-theory approach.' *Brookings Papers on Economic Activity* 12(1), 67–140

Syrquin, Moshe (1998) 'Patterns of structural change.' In *Handbook of development economics,* ed. Chenery? Hollis and T. N. Srinivasan, vol. 1 (Elsevier)

The Economist (2013) 'A bubble in pessimism china's economy is inefficient, but it is not unstable.' *Available at http://www.economist.com/news/china/21583691-chinas-economy-inefficient-it-not-unstable-bubble-pessimism*

Trimborn, Timo, Karl-Josef Koch, and Thomas M Steger (2008) 'Multidimensional transitional dynamics: A simple numerical procedure.' *Macroeconomic Dynamics* 12(03), 301–319

Vollrath, Dietrich (2009) 'How important are dual economy effects for aggregate productivity?' *Journal of Development Economics* 88(2), 325–334

Weil, Philippe (1989) 'The equity premium puzzle and the risk-free rate puzzle.' *Journal of Monetary Economics* 24(3), 401–421

Whalley, John, and Shunming Zhang (2007) 'A numerical simulation analysis of (hukou) labour mobility restrictions in china.' *Journal of Development Economics* 83(2), 392–410

Woo, Wing Thye (1998) 'Chinese economic growth: Sources and prospects.' In *The Chinese Economy,* ed. Michel Fouquin and Francoise Lemoine (London: Economica)

Yao, Yang (2011) 'The relationship between china's export-led growth and its double transition of demographic change and industrialization?' *Asian Economic Papers* 10(2), 52–76

Ye, Longfeng, and Peter E Robertson (2016) 'How important was labor reallocation for china's growth? a sceptical review.' *The Review of Income and Weath (forthcomming)*

Young, Alwyn (1995) 'The tyranny of numbers: Confronting the statistical realities of the east asian growth experience.' *The Quarterly Journal of Economics*

_ (2003) 'Gold into base metals: Productivity growth in the people's republic of china during the reform period.' *Journal of Political Economy* 111(1), 1220–1261

_ (2013) 'Inequality, the urban-rural gap and migration.' *The Quarterly Journal of Economics* p. qjt025

Zhang, Li, and Li Tao (2012) 'Barriers to the acquisition of urban hukou in chinese cities.' *Environment and Planning A* 44(12), 2883–2900

Zheng, Jinghai, Arne Bigsten, and Angang Hu (2009) 'Can chinas growth be sustained? a productivity perspective.' *World Development* 37(4), 874–888

Zhu, Xiaodong (2012) 'Understanding china's growth: Past, present, and future.' *Journal of Economic Perspectives* 26(4), 103–24

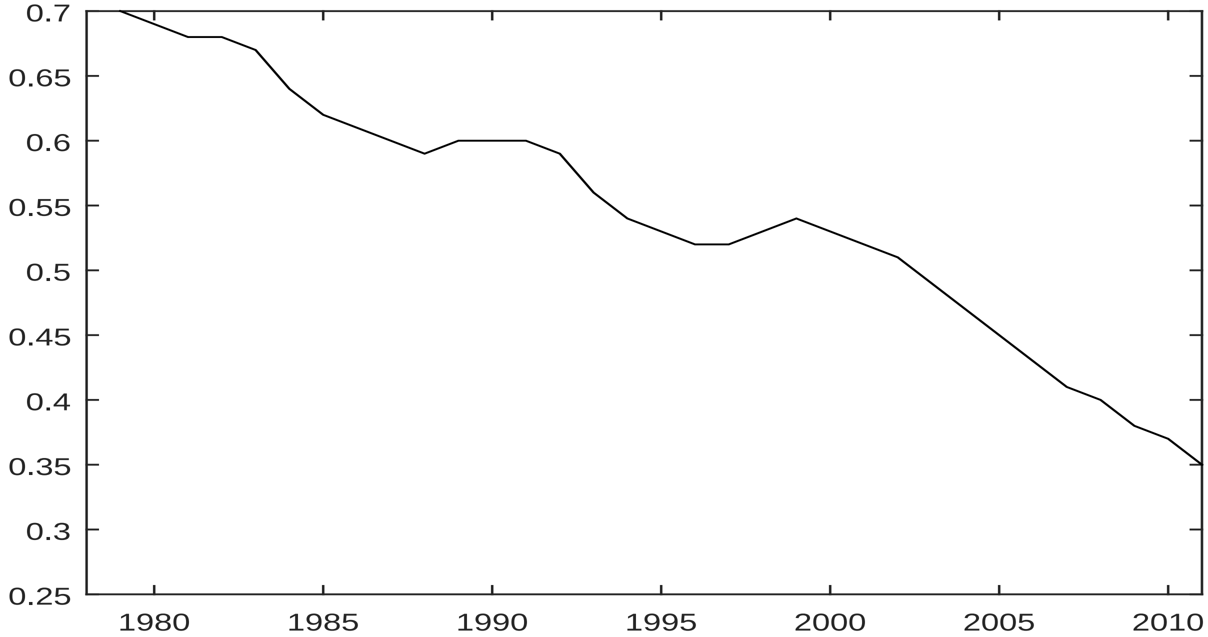

Figure 1: Employment Share of Agriculture

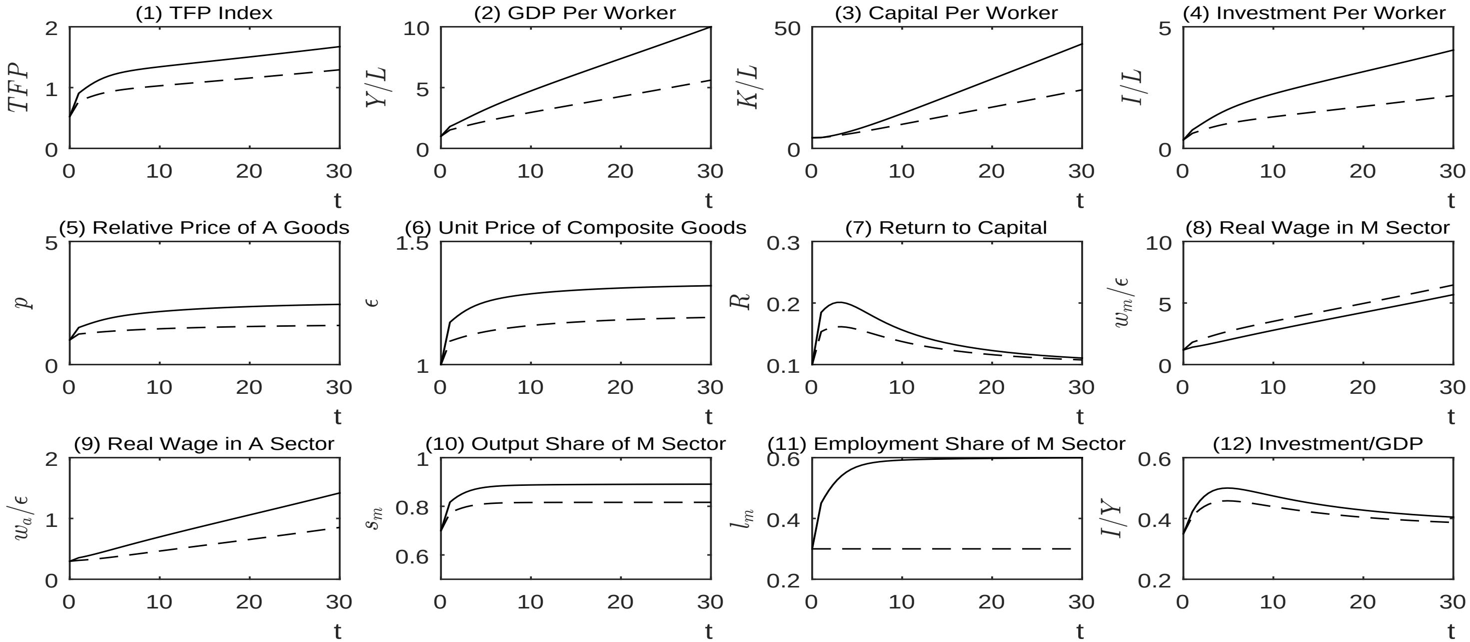

Figure 2: Key Variables in Baseline and Counterfactual C1

Notes: "M" and "A" denote the nonagricultural sector and the agricultural sector respectively. The solid and dotted lines indicate the baseline and the counterfactual C1 respectively.

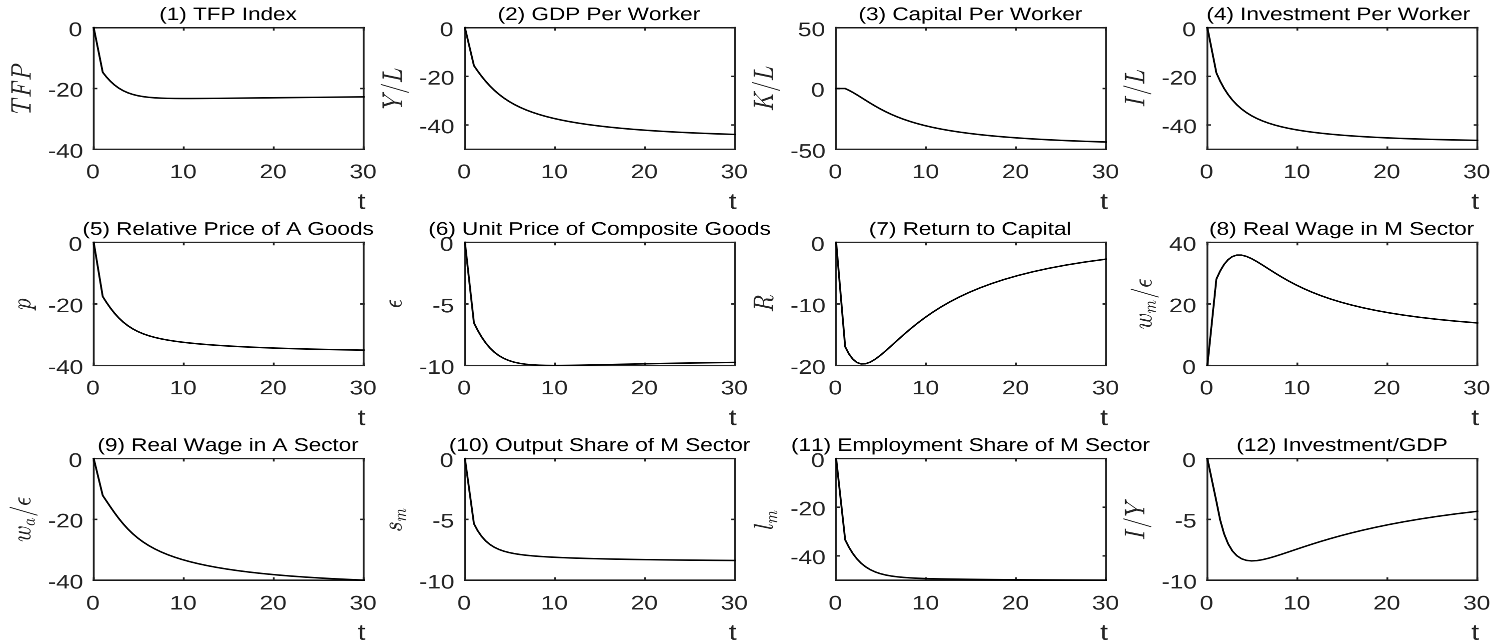

Figure 3: Percentage Change in Key Variables in Baseline Relative to Counterfactual C1

Notes: "M" and "A" denote the nonagricultural sector and the agricultural sector respectively.

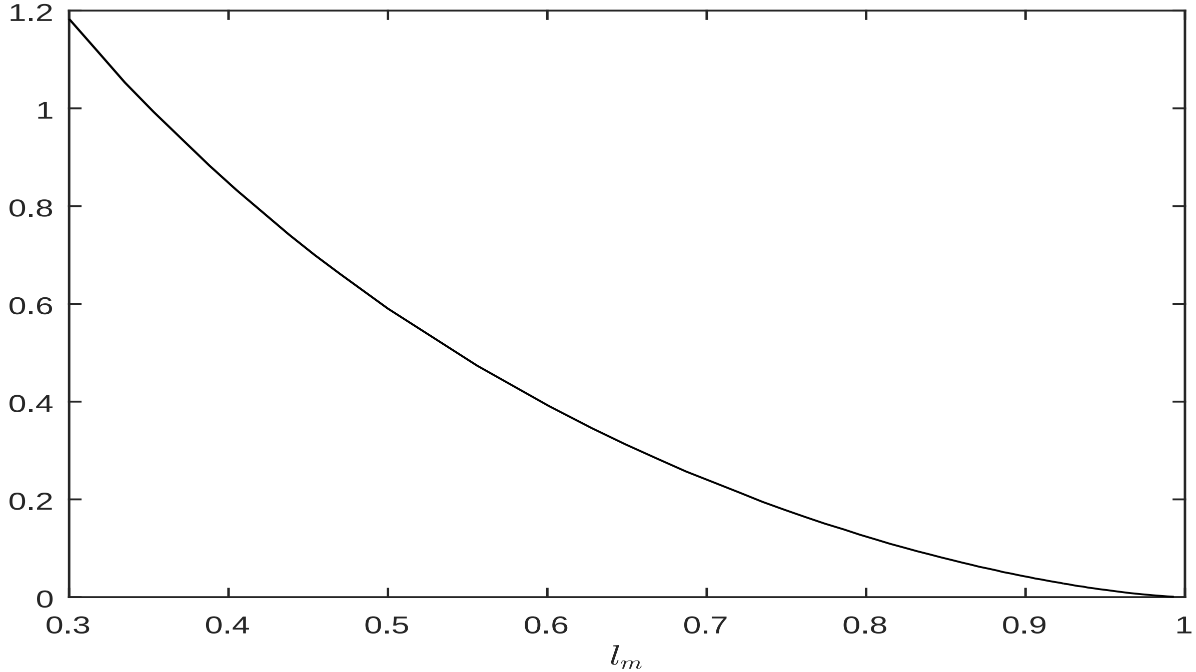

Figure 4: Elasticity of l_m with Respect to Nonagricultural Sector Productivity A_m

Table 1: Parameters

Parameter	Value	Description	Target
θ	1.1	inverse of inter-temporal elasticity of substitution	assumed
n	0.01	population growth	assumed
x	0.02	labor augmenting productivity growth	assumed
δ	0.05	depreciation	assumed
ρ	0.028	time discount rate	real return to capital $R^* = 0.1$
τ	0.75	mobility friction	wage gap data
α	0.31	capital income share in A sector	sectoral output & employment shares and investment-output ratio
β	0.49	capital income share in M sector	sectoral output & employment shares and investment-output ratio
ϕ_a	4.7	constant of unit cost function in A sector	zero profits
ϕ_m	2.8	constant of unit cost function in M sector	zero profits
σ_a	1.0	substitution elasticity between capital and labor in A sector	assumed
σ_m	1.0	substitution elasticity between capital and labor in M sector	assumed
σ_u	2.5	substitution elasticity between goods in utility function	change in sectoral employment share

Notes: "M" and "A" denote the nonagricultural sector and the agricultural sector respectively.

Table 2: Baseline

Variable	Baseline
shares:	
employment share of M sector, $l_m(1978)$	0.30
employment share of M sector, $l_m(2008)$	0.60
output share of M sector, $s_m(1978)$	0.70
output share of M sector, $s_m(2008)$	0.89
annual growth:	
GDP per worker, Y/L	8.0%
GDP per worker in A sector, pY_a/L_a	6.3%
GDP per worker in M sector, Y_m/L_m	6.4%
capital per worker, K/L	7.9%

Notes: "M" and "A" denote the nonagricultural sector and the agricultural sector respectively.

Table 3: Historical Labor Reallocation Effect (1978-2008)

Variable	Initial (1978) (1)	Baseline (2008) (2)	C1 (2008) (3)	% Change (2008) (4)	Growth Baseline (%) (5)	Growth C1 (%) (6)	Growth Difference (%) (7) = (5) - (6)
TFP	0.52	1.67	1.29	-22.75	3.94	3.05	0.89
Y/L	1.00	10.00	5.61	-43.88	7.98	5.92	2.06
K/L	4.37	42.96	24.07	-43.99	7.91	5.85	2.06
Y_m/L_m	2.33	14.86	15.27	2.77	6.36	6.46	-0.10
Y_a/L_a	0.43	1.11	0.93	-16.80	3.23	2.60	0.63
Q/L	0.65	4.51	2.89	-35.98	6.67	5.10	1.57
I/L	0.35	4.04	2.17	-46.31	8.50	6.27	2.23
p	1.00	2.45	1.59	-35.00	3.03	1.56	1.47
ϵ	1.00	1.32	1.19	-9.75	0.93	0.59	0.34
R	0.10	0.11	0.11	-2.72	0.34	0.24	0.09
w_m	1.18	7.50	7.70	2.74	6.34	6.44	-0.10
w_a	0.30	1.87	1.02	-45.82	6.34	4.19	2.15
w_m/ϵ	1.18	5.68	6.46	13.84	5.36	5.82	-0.46
w_a/ϵ	0.30	1.42	0.85	-39.97	5.36	3.59	1.78
w_m/w_a	4.00	4.00	7.59	89.64	0.00	2.16	-2.16
s_m	0.70	0.89	0.82	-8.38	0.81	0.51	0.29
l_m	0.30	0.60	0.30	-49.96	2.33	0.00	2.33
I/Y	0.35	0.40	0.39	-4.34	0.48	0.33	0.15
γ	0.44	0.48	0.46	-2.91	0.28	0.18	0.10

Notes: Columns (1)-(3) summarize the values of variables at the end of the three-decade transition period (year 2008) across simulations. Column (4) shows the percentage change of variables in the counterfactual C1 relative to the baseline. Columns (5)-(6) present annual growths of variables in the baseline and the counterfactual C1, respectively. Column (7) gives the difference in values between column (5) and column (6).

Table 4: Labor Reallocation Effect under China's Growth Slowdown (2015-2025)

	Baseline	No Migration (C2)
Low Growth		
$l_m(2025)$	0.70	0.70
$g_y(\%)$	2.00	2.00
migration prohibited		0.00
growth diff(%)		0.00
Medium Growth		
$l_m(2025)$	0.75	0.70
$g_y(\%)$	4.03	3.64
migration prohibited		0.05
growth diff(%)		0.39
High Growth		
$l_m(2025)$	0.79	0.70
$g_y(\%)$	6.02	5.25
migration prohibited		0.09
growth diff(%)		0.77

Notes: $l_m(2025)$ is the labor share of the nonagricultural sector in year 2025. g_y indicates the growth rate of GDP per worker over 2015-2025.

Table 5: Growth Gains from Hukou Reform (2015-2025)

	Baseline	Hukou Reform (C3)
Low Growth		
$l_m(2025)$	0.70	0.90
$g_y(\%)$	2.00	3.45
migration due to reform		0.20
migration in total		0.20
growth diff(%)		1.45
Medium Growth		
$l_m(2025)$	0.75	0.93
$g_y(\%)$	4.03	5.35
migration due to reform		0.18
migration in total		0.23
growth diff(%)		1.32
High Growth		
$l_m(2025)$	0.79	0.94
$g_y(\%)$	6.02	7.12
migration due to reform		0.15
migration in total		0.24
growth diff(%)		1.10

Notes: $l_m(2025)$ is the labor share of the nonagricultural sector in year 2025. g_y indicates the growth rate of GDP per worker over 2015-2025.

Table A1: Historical Labor Reallocation Effect (1978-2008) – Alternative σ_a and σ_m

		$\sigma_m = 1$			$\sigma_m = 0.8$			$\sigma_m = 0.6$		
		Baseline	C1	Diff	Baseline	C1	Diff	Baseline	C1	Diff
$\sigma = 1$	g_k(%)	7.91	5.85		7.55	5.44		7.09	4.98	
	g_y(%)	7.98	5.92	2.06	7.98	5.88	2.10	8.04	5.93	2.11
	TFP(%)	3.94	3.05	0.89	4.90	3.82	1.08	5.99	4.68	1.31
	l_m(2008)	0.30	0.60		0.30	0.60		0.30	0.60	
	shock(%)	98			115			140		
	σ_u	2.50			2.38			2.25		
$\sigma = 1.2$	g_k(%)	7.96	5.89		7.62	5.50		7.16	4.99	
	g_y(%)	8.00	5.93	2.07	8.01	5.90	2.11	8.00	5.85	2.15
	TFP(%)	3.89	3.01	0.88	4.81	3.76	1.05	5.78	4.50	1.28
	l_m(2008)	0.30	0.60		0.30	0.60		0.30	0.61	
	shock(%)	98			115			135		
	σ_u	2.45			2.32			2.25		
$\sigma = 1.4$	g_k(%)	8.00	5.94		7.71	5.57		7.25	5.07	
	g_y(%)	8.01	5.95	2.06	8.04	5.93	2.11	7.99	5.85	2.14
	TFP(%)	3.81	2.97	0.84	4.70	3.70	1.00	5.58	4.39	1.19
	l_m(2008)	0.30	0.60		0.30	0.60		0.30	0.60	
	shock(%)	98			115			133		
	σ_u	2.35			2.22			2.14		
$\sigma = 1.6$	g_k(%)	8.07	5.99		7.76	5.53		7.32	5.09	
	g_y(%)	8.04	5.98	2.07	8.03	5.83	2.20	7.95	5.79	2.16
	TFP(%)	3.73	2.92	0.80	4.53	3.55	0.99	5.31	4.21	1.09
	l_m(2008)	0.30	0.60		0.30	0.60		0.30	0.60	
	shock(%)	98			113			128		
	σ_u	2.25			2.15			2.05		

Notes: g_k and g_y denote the growth rate of capital per worker and GDP per worker respectively. l_m(2008) is the employment share of the nonagricultural sector in year 2008. "shock" denotes a productivity shock to the nonagricultural sector. σ_a and σ_m are the substitution elasticities between labor and capital in the sectoral production functions, and σ_u is the substitution elasticity between two goods in the utility function.

Table A2: Labor Reallocation Effect under China's Growth Slowdown (2015-2025) – Alternative σ_a and σ_m

		$\sigma_m = 1$		$\sigma_m = 0.8$		$\sigma_m = 0.6$	
		baseline	no migration (C2)	baseline	no migration (C2)	baseline	no migration (C2)
$\sigma_a = 1$	$l_m(2025)$	0.75	0.70	0.75	0.70	0.75	0.70
	$g_y(\%)$	4.03	3.64	4.00	3.59	4.00	3.58
	shock(%)	12.80		13.00		13.50	
	migration prohibited	0.05		0.05		0.05	
	growth diff(%)	0.39		0.41		0.42	
$\sigma_a = 1.2$	$l_m(2025)$	0.75	0.70	0.75	0.70	0.75	0.70
	$g_y(\%)$	4.02	3.62	3.99	3.58	4.01	3.58
	shock(%)	12.70		12.90		13.50	
	migration prohibited	0.05		0.05		0.05	
	growth diff(%)	0.40		0.41		0.43	
$\sigma_a = 1.4$	$l_m(2025)$	0.75	0.70	0.75	0.70	0.75	0.70
	$g_y(\%)$	4.01	3.61	3.98	3.57	4.01	3.58
	shock(%)	12.60		12.80		13.50	
	migration prohibited	0.05		0.05		0.05	
	growth diff(%)	0.40		0.41		0.43	
$\sigma_a = 1.6$	$l_m(2025)$	0.75	0.70	0.75	0.70	0.75	0.70
	$g_y(\%)$	4.00	3.60	3.97	3.56	4.02	3.58
	shock(%)	12.50		12.70		13.50	
	migration prohibited	0.05		0.05		0.05	
	growth diff(%)	0.40		0.41		0.44	

Notes: $l_m(2025)$ is the labor share of the nonagricultural sector in year 2025. g_y indicates the growth rate of GDP per worker over 2015-2025. "shock" denotes a productivity shock to the nonagricultural sector. σ_a and σ_m are the substitution elasticity between labor and capital in the sectoral production function.

Table A3: Growth Gains from Hukou Reform (2015-2025) – Alternative σ_a and σ_m

		$\sigma_m = 1$		$\sigma_m = 0.8$		$\sigma_m = 0.6$	
		baseline	reform (C3)	baseline	reform (C3)	baseline	reform (C3)
$\sigma_a = 1$	$l_m(2025)$	0.75	0.93	0.75	0.92	0.75	0.92
	$g_y(\%)$	4.03	5.35	4.00	5.31	4.00	5.36
	shock(%)	12.80		13.00		13.50	
	migration added	0.18		0.18		0.17	
	growth diff(%)	1.32		1.31		1.36	
$\sigma_a = 1.2$	$l_m(2025)$	0.75	0.92	0.75	0.92	0.75	0.92
	$g_y(\%)$	4.02	5.30	3.99	5.31	4.01	5.37
	shock(%)	12.70		12.90		13.50	
	migration added	0.18		0.18		0.17	
	growth diff(%)	1.28		1.32		1.36	
$\sigma_a = 1.4$	$l_m(2025)$	0.75	0.93	0.75	0.92	0.75	0.92
	$g_y(\%)$	4.01	5.30	3.98	5.31	4.01	5.39
	shock(%)	12.60		12.80		13.50	
	migration added	0.18		0.18		0.18	
	growth diff(%)	1.29		1.33		1.38	
$\sigma_a = 1.6$	$l_m(2025)$	0.75	0.93	0.75	0.93	0.75	0.93
	$g_y(\%)$	4.00	5.31	3.97	5.32	4.02	5.41
	shock(%)	12.50		12.70		13.50	
	migration added	0.18		0.18		0.18	
	growth diff(%)	1.31		1.35		1.39	

Notes: $l_m(2025)$ is the labor share of the nonagricultural sector in year 2025. g_y indicates the growth rate of GDP per worker over 2015-2025. "shock" denotes a productivity shock to the nonagricultural sector. σ_a and σ_m are the substitution elasticities between labor and capital in the sectoral production functions.

Editor, UWA Economics Discussion Papers:
Sam Hak Kan Tang
University of Western Australia
35 Sterling Hwy
Crawley WA 6009
Australia

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