China's mobility barriers and employment allocations[*]

L Rachel Ngai
London School of Economics

Christopher A Pissarides
London School of Economics and Institute for Advanced Study,
the Hong Kong University of Science and Technology

Jin Wang
Hong Kong University of Science and Technology

Abstract

China's hukou system imposes two main barriers to population movements. Agricultural workers get land to cultivate but are unable to trade it in a frictionless market. Social transfers (education, health, etc.) are conditional on holding a local hukou. We show that the land policy leads to over-employment in agriculture and it is the more important barrier to industrialization. Effective land tenure guarantees and a perfect competitive rental market would correct this inefficiency. The local restrictions on social transfers favour rural enterprises over urban employment with a relatively smaller impact on industrialization.

Keywords. Chinese immigration, Chinese land policy, imperfect rental market, mobility barriers, *hukou* registration, social transfers

JEL classification. J61, O18, R23

1 Introduction

Barriers to labour mobility delay the transition of labour from traditional to new sectors of economic activity and are an important reason for the failure of developing countries to catch up with richer ones. Simon Kuznets noted the importance of such barriers in his influential 1966 book on economic growth when he wrote, "a high rate of modern economic growth is attainable only if the required marked shifts in industrial structure are not too impeded by resistance - of labour and of capital, of people and their resources in the old and accustomed grooves." (Kuznets, 1966, 157). This paper is about the role of a particular policy barrier in China, the *hukou* system of household registration. It will argue that despite the large transitions that took place in China over the last three decades, the *hukou* registration system has led to lower levels of both industrialization and urbanization, and consequently to a bigger share of employment in less productive agricultural jobs than would have been the case in a more open labour market.

Fast industrialization began in China following Deng Xiaoping's market reforms that started in 1978 and has been accompanied by a structural transformation that saw labour move from agricultural employment in rural areas to industry and services in predominantly urban areas. Agricultural employment fell from 68% of total employment in 1978 to 26% in 2010. Many Chinese scholars attribute a large part of the rise in labour productivity in China over this period to the shift from low productivity agricultural employment to higher productivity manufacturing jobs (Brandt and Zhu, 2010, Dekle and Vandenbroucke, 2012). And yet, it could have gone further. Alwyn Young (2003), who does not include agriculture in his analysis of productivity growth in China, makes a strong point for the study of policies that "kept the peasantry tied up in agriculture," instead of releasing labour to work in higher productivity activities. Similar conclusions were reached by others; in a 2005 survey of 17 provinces that account for the vast majority of Chinese farmers, Zhu et al. (2006) find that after the initial growth of agricultural incomes in the 1980s, China's land policies have been largely responsible for a widening of the income gap between rural and urban households.[1] The policies responsible for these disparities are the subject of this paper.

The large movements of labour from agricultural to non-agricultural activities (industrialization) and the related movement from rural to urban locations (urbanization) are documented in Figure 1.[2] Most of the employment growth that

---

[1] A summary of results with policy recommendations is available in Zhu and Prosterman (2007).

[2] The data in Figure 1 were constructed by Brandt and Zhu (2010). They made two adjustments to the employment data of the National Bureau of Statistics (NBS). First, following Holz (2006), they fixed a major discontinuity in the NBS employment data beginning in 1990. Second, they made use of detailed labour supply data for rural households collected by the Research

attracted agricultural labour was in the urban sector but the rural non-agricultural sector also expanded, a point that we address in this paper. Despite this transformation, however, large productivity differences across sectors remain. Productivity in agriculture is still much lower than it is in non-agricultural jobs, something that indicates barriers to labour mobility (e.g. Brandt and Zhu, 2010). This kind of productivity gap between agriculture and non-agriculture is a common feature of developing countries (Gollin, Lagakos and Waugh, 2014); Vollrath (2009) finds that the employment misallocation that gives rise to the productivity gap accounts for a substantial fraction of cross country income differences.[3]

In this paper we describe the mobility barriers that are embedded in the *hukou* household registration system and then formally derive their implications for employment allocations in a sectoral model of the economy. The *hukou* registration, introduced in 1958, initially tied people to their area and job and did not allow any labour migration at all. Restrictions have been relaxed piecemeal and not uniformly across the country, but the registration system is still in place and it is still an impediment to labour mobility. Barriers to mobility from the *hukou* registration system arise mainly along two dimensions. First in the use of land, which is provided free by the state to rural families but tenure rights are not sufficiently secured to enable the growth of an efficient rental market; and second in the provision of social services such as education and health, which are conditional on people's *hukou* registration and in particular the area in which they are registered.

The analysis of the impact of China's land policy on migration decisions can be done in a two-sector model of industrialization, with an agricultural sector that uses both land and labour and a non-agricultural sector that uses only labour. The key to our analysis is that land tenures are not guaranteed, so land allocated to farmers for cultivation may not be renewed when their lease expires or even taken away by the authorities before it expires. Although a succession of new laws since the 1980s have aimed to establish more secure tenures, we cite a large number of studies that find that in practice there is still substantial risk that village authorities might take land away for reallocation to other farmers. Farmers and potential migrants are aware of this risk (90% or more say so, even in recent times; see for example Kimura et al., 2011) so they take it into account when negotiating rents for the land vacated by migrants. The result, as we show, is that the rental market clears at a rate below the marginal product of land. In our model the ratio of the market-clearing rental to the marginal product of land is equal to the

---

Centre for the Rural Economy to reestimate primary sector employment, in order to address concerns that the NBS data underestimated the rate of employment decline in this sector.

[3]Ngai (2004) and Gollin, Parente and Rogerson (2007) reach similar conclusions by showing that the delay in the transition out of agriculture contributes to cross-country income differences because it delays the start of modern economic growth.

probability that the farmer will not lose the land to a reallocation after migration.[4] The lower rent leads farmers to underestimate the true opportunity cost of land in their decision whether to migrate out of agriculture or not and consequently it leads to over-employment in agriculture. A reform that gives security of tenure to farmers enables the development of an efficient rental market for agricultural land and so induces farmers to fully take into account the opportunity cost of land.[5]

Social subsidies also work against migration but for different reasons. Subsidies are given to local *hukou* holders only and they include support for education, health, pensions and other less important forms of income supplements. In the early years of industrialization the Chinese authorities encouraged the development of "township and village enterprises" in rural areas, so that rural residents could move from agricultural to non-agricultural jobs without leaving the area and so still be eligible for the local subsidies. In order to deal with the impact of this policy we extend our model to three-sectors, by introducing a rural non-agricultural sector, and model the impact of the *hukou* restrictions on the eligibility for social subsidies. We show that in contrast to the land policy which affects industrialization, the main impact of the social transfer policy is to reduce the urbanization of employment; i.e., it leads to over-employment in rural non-agriculture and under-employment in urban locations.

We illustrate our results with recent Chinese data and find support for our claims. Both the land and social subsidization policies contribute to over-employment in agriculture and under-employment in the urban sector, with much smaller effects on employment in the rural non-agricultural sector. This over-employment in agriculture contributes a substantial portion of the observed productivity gap between agriculture and non-agriculture in China.

In a developing country like China, there are many different reasons that contribute to mobility barriers and to lower productivity in agriculture. Our main focus in this paper is the household registration system, although in a later section of the paper we also consider the implications of an exogenous labour market wedge, of the kind generally analyzed in the development literature. We find that although the exogenous wedge has an impact on migration decisions, our analysis of the impact of the *hukou* registration on mobility remains as important.

Our analysis parallels that of several other studies that analyse sources of mobility barriers in institutional features of different countries. Caselli and Coleman (2001) attribute barriers to mobility out of agriculture in the early years of industrialization in the United States to different educational levels in urban and rural locations. Hayashi and Prescott (2008) show that the prewar Japanese so-

---

[4]In the commonly cited "use it or lose it" case this ratio is zero, as the migrant loses the land with probability 1.

[5]Policies that secure land tenure effectively have been advocated by the World Bank (2014), Zhu and Prosterman (2007) and Tao and Xu (2007), among others.

cial custom of requiring a son to inherit the land from his father and remain in agriculture can account for the delay in Japan's catch-up with the United States. Beegle, De Weerdt and Dercon (2011) propose home community networks as exit barriers preventing migration in Tanzania and Munshi and Rosenzweig (2016) investigate the role of rural caste insurance and social networks as barriers in rural India. For China, Brandt, Hsieh and Zhu (2008) and Cao and Birchenall (2013) discuss the implications of the *hukou* system for the existence of a labour market wedge, whereas Tombe and Zhu (2017) model the overall economic impact of trade liberalization and the labour wedge, due partly to assumed land communes. Land policy as a mobility barrier also plays a role in Adamopoulos et al. (2017), who focus on workers' selection effects in a heterogeneous labour model as the explanation for China's sectoral productivity differences. None of these papers models explicitly both land policy in the context of an inefficient rental market and social subsidies in the context of a sectoral model, which is our main contribution in this paper.[6]

Section 2 outlines the household registration system and describes its history and impacts, paying particular attention to land policy and the role of social subsidies. Section 3 develops the two-sector model that is used to study the role of the land policy in the agricultural - non-agricultural labour allocation. In section 4 the model is extended to social subsidies and to three sectors, agricultural and rural and urban non-agricultural. In section 5 we derive the efficient allocation and quantify the likely distortions caused by the *hukou* restrictions, both in the context of an otherwise efficient equilibrium and in the context of a second-best world characterized by an exogenous labour market wedge.

2 China's mobility barriers

2.1 The *hukou* system of registration and its impact

The *hukou*, or household registration system, assigns a *hukou* certificate to each citizen of the People's Republic and on that basis the person becomes eligible for some state benefits, in the form of either use of land or social transfers and services. The system was institutionalized in 1958, when each local area in the country (a city or a region, depending on population size) issued a *hukou* to every

---

[6]Au and Henderson (2006) also use a three-sector model (agriculture, township and village non-agriculture and city non-agriculture) which broadly corresponds to our three-sector model. They employ the techniques of new economic geography to show that both city size and the township and village enterprise sectors are too small, which is indication of the existence of mobility barriers out of agriculture. Our results show that the big distortion is in the too small urban sector, whereas the non-agricultural rural sector is less distorted because of offsetting impacts of the two policies that we model.

resident, which classified the resident as either an agricultural worker or a non-agricultural worker. This became a kind of "passport" for internal use, which indicates the region of origin of the person and entitles the holder to claim certain state benefits in their origin region. The objective of the policy was to promote a Communist ideology connected to the use of land (which belonged entirely to the state) and the provision of social services. Agricultural workers were given land to cultivate and were given access to some social services provided by their rural location (usually social communes), whereas urban workers were expected to work in factory or office jobs and had access to social benefits, many of them job-related, which included subsidized medical care, education for their children and social assistance, funded by the city that issued their *hukou*.

Initially the *hukou* registration system was strictly enforced and practically eliminated all possibilities for industrial or geographical labour mobility. As a result, before 1980, practically all people living in an area had a local *hukou* and all workers working in industry or services had a non-agricultural *hukou* (Li, Gu and Zhang, 2015).[7]

Naturally, this situation was not compatible with a market economy with industrializing ambitions, as China became after Deng's reforms. Agriculture was too big to be productive and industrialization needed labour. In response to this need, the *hukou* system was gradually softened and reformed, eventually (by the late 1990s) allowing free migration across jobs and areas, albeit with registration never abolished and rarely allowed to change during one's lifetime. There have been too many reforms of varying degrees to enable a manageable narrative or the description of a system that currently applies to everyone. To make things worse, the strictness with which the system is now applied and the ease with which one could change one's registration is left to local authorities, and different local authorities apply different rules. The more prosperous large cities (especially the big three, Beijing, Shanghai and Guangzhou) generally follow stricter policies than towns or smaller cities.[8]

For modelling purposes, however, we can cut through this complex situation by focusing on the following four types of agents: agricultural *hukou* holders working in one of three locations, agriculture in their rural area of registration, non-

---

[7]Up to 1998, offspring inherited their mothers' *hukou* status and changes were not allowed. In 1998 the law was changed and children were permitted to inherit either parent's *hukou* status, so there was a little more flexibility, but permissions to change status from that of either parent were still very rare.

[8]See Fan (2008), Meng (2014), Chan (2009) and Chan and Buckingham (2008). As an example of how standards vary, whereas many smaller provinces encourage migration to achieve more industrial growth, Shandong province, one of the most industrialized in China, recently required registration of migrants with the police and fines employers who do not report how many migrant workers they employ (reported in the *Financial Times*, December 8, 2016; https://www.ft.com/content/7c55b30c-bd14-11e6-8b45-b8b81dd5d080)

agriculture in their rural area of registration and non-agriculture in an urban location (the migrants); and non-agricultural *hukou* holders working in their urban area of registration. Most of the migration literature ignores the non-agricultural workers in rural areas, who hold an agricultural *hukou.* We bring it into the analysis in our full model of section 4 because in the early years of industrialization the authorities encouraged the growth of "township and village enterprises" which employed mainly unskilled workers producing labour-intensive goods. Although this form of employment is now given less emphasis, non-agricultural rural employment remains a substantial fraction of employment (see again Figure 1). Omitting it altogether from the analysis misses an important aspect of the industrialization process in China and an important element of China's social assistance policies.

We ignore two other types of *hukou,* the non-agricultural *hukou* issued in rural areas and the agricultural *hukou* issued in urban areas. In rural areas virtually all residents were originally registered as agricultural workers, except for a small numbers of government employees who carried non-agricultural *hukou* (Chan, 2012, Table 3). The agricultural *hukou* issued in urban areas can be ignored because with increased industrialization and urbanization beginning in the 1990s, agriculture has become too small in urban areas to matter.[9]

With regard to social services, the condition that only local *hukou* holders qualify for them was embedded in the original design of the *hukou* system and it still pervades today. Agricultural *hukou* holders get access to social services in their rural locality but not to social services in the urban locality after they move. Because of this, many rural migrants leave their families behind when they migrate to the city; women may go back to their village when they have a child, to take advantage of available social services; and many men return to their rural locations after a few years in the city, especially if they have children of school age and they want to take advantage of free education in their origin state.

These movements undoubtedly cause social problems for families but the economic cost is less important. Formally taking into account return migration due to changing family circumstances would complicate our model and we do not pursue it.[10] The feature of the system that we emphasize is the ambiguous security of tenure and the possible loss of access to land once the farmer leaves agricultural employment, an issue that we describe in more detail in the next subsection. With

---

[9]Another reason for ignoring the issuing of different types of *hukou* by the same authorities is that many provinces gave up on distinguishing between agricultural and non-agricultural *hukou,* beginning around the turn of the millennium. (Chan, 2012, p. 73, Fan, 2008, p.69). Rural areas issue agricultural *hukou* and urban areas non-agricultural ones.

[10]We also do not pursue the modelling of changing *hukou* type, which some localities offer after a certain period of work in their area and subject to the qualifications of the worker. Such changes were rare until recently, although more recently the granting of urban *hukou* became more common, especially in smaller cities (Chan, 2009).

regard to social services we assume that all urban *hukou* holders have access to urban social benefits, and all agricultural workers have access to both land and social services provided by their rural authorities. Migrants (agricultural *hukou* holders in urban areas) have no access to any services but non-agricultural workers in rural areas have access to rural social benefits. More details of these allocations are given in the sections that follow.

2.2   China's land policies

Agricultural land is distributed among the rural population on the basis of family size and other needs, in an attempt to achieve more equality in the village. The property rights do not pass on to the villager but he and his family can cultivate the land and the income is all theirs. Two issues are particularly important to farmers (see Kung, 1995; Mullan, Grosjean and Kontoleon, 2011): security of tenure and the possibility of renting out the land to other farmers for an income.

Rural land is managed under the Household Responsibility System, originally enacted in 1978. When the system was first set up no renting of land was allowed and although land was allocated for 15-year periods, periodically the village leader would reallocate land on the basis of household changes, which included more involvement in non-farm work (Kung and Liu, 1997). It was also possible that agricultural land was taken over by the government for infrastructure projects (e.g., road building) or construction. So there was no security of tenure and it was not possible to take advantage of the land to earn an income, other than self-production. Relaxation of the law with respect to land rentals started early but village leaders retained some reallocation discretion which, as we elaborate later in this section, did not help remove the reallocation risk faced by farmers.

With respect to appropriations by the government for infrastructure or urban development, we make the reasonable assumption that the affected farmers are given access to new land if they remain in the village and wish to continue in agricultural production. Although this risk may be important with respect to issues such as long-term investments in land, it does not play a role in our analysis. The more important issue for our analysis is the existence of a rental market and the reallocation risk when a farmer migrates, in view of the absence of property rights. In particular, whether the migrant farmer can keep his land and rent it out for an income or whether migrants lose their allocated land when they migrate.[11]

A reform to the 1978 Household Responsibility System came in 1984, when

_____

[11]Tao and Xu (2007) argue that farmers worry about land acquisitions because their compensation from the local authorities, whatever its form, is not up to the level of the yield from their previously allocated land. We do not address this issue but focus on the other two (and more important) issues that they raise, land reallocations and the migrants' accessibility to social benefits.

8

central document no. 1 allowed rentals subject to permission by the village leader (Lin, 1989). This right, however, was rarely used, at least in the beginning. Survey evidence in 1995 reveals that only about 3% of agricultural land was rented out despite the fact that the agriculture employment share fell from 62% to 48% during the 1984-1995 period (Brandt et al., 2002). The low rental rate is associated with the perceived "use it or lose it" rule: renting out land could lead the village leader to believe that the land was no longer needed by the farmer so it was taken away and given to someone else in the village in the next reallocation (Yang, 1997; Brandt, Rozelle and Turner, 2004; Adamopoulos et al., 2017).

A second major reform came in 1998 with the Land Management Law, which introduced some formal documentation for the land tenure right. Although the Act did not have the full intended effect, the rental market did show some growth, with about 10% of farmers renting out their land by 2000, with large variations across regions (Deininger and Jin, 2005; Wang, Riedinger and Jin, 2015).

A more important development in land law came in 2003, with the passing of the Rural Land Contracting Law, which was designed to strengthen tenure rights. It offered more secure tenure by limiting reallocations and permitting transfer of lands between households (see Li, 2003, Jin and Deininger, 2009 and Wang, Riedinger and Jin, 2015). This reform, combined with increased rural-urban migration, led to a further growth in the rental market, with 19% of farmers renting out their land by 2008 (see the survey by Wang, Riedinger and Jin, 2015). Reallocations, however, were frequent before the passing of the law (Brandt et al., 2002) and continued after 2003, albeit at a lower rate (Deininger and Jin, 2009; Deininger et al., 2014; Liao et al., 2016). In a five-wave survey taken in 1999-2010 and covering 17 provinces that accounted for 77% of the rural population, Feng, Bao and Jiang (2014) report that after the first round of land contracting in 1984, 80% of villages experienced reallocation by 1999 and 82% by 2001. After the second-round of contracting beginning in 1993, 40% of villages experienced reallocation by 2010. These numbers are consistent with other evidence. For example, Wang, Riedinger and Jin (2015) in their survey of six provinces report that the percentage of villages experiencing some kind of reallocation in the five-year period prior to the year in question, declined from 66% in 2000 to 16% in 2008. The former figure is consistent with the evidence of Brandt et al. (2002) in their survey of 215 villages across eight provinces (72% reallocations in 1983-1995).

The decline of reallocation incidence, however, did not necessarily lead to the emergence of an efficient rental market. The evidence of Wang, Riedinger and Jin (2015) shows that about half of land transfers were still to relatives throughout the period 2000-08, most rental agreements were verbal and not very well specified and rent was paid in only 31% of transfers in 2000 and in 41% in 2008, on average at a lower rate in 2008 than in 2000. Moreover, in a 2011 pilot survey of Shaanxi and

9

Jiangsu provinces, Brandt et al. (2017) show that in nearly half of the transfers arranged by the village, payments to households were in arrears. With the absence of written contracts in most cases, households renting out their land did not have much say over the matter.[12] Consistent with this, the World Bank (2014, chapter 4) reported that land transfers were taking place at low rental rates, they were unrecorded, and they were subject to a lot of uncertainties which reduced the real value of the land to farmers.

In the formal modelling that follows we deal with the complex issue of land transfers by allowing for an imperfect rental market that functions between two extremes, the "use it or lose it" extreme whereby if a farmer does not cultivate his land it is taken away by the village leader and is reallocated to other farmers, and the "guaranteed tenure" extreme according to which the farmer is guaranteed a tenure on the land and he can deal with it as he likes during the period of the guarantee.[13] On the basis of the discussion of this section we consider the former to be a much closer description of the situation in China at least up to the passing of the 1998 and 2003 Acts, whereas the latter corresponds to a policy reform that involves either the privatization of land or equivalently the granting of full security of tenure, something not yet implemented.[14] Besides the two extremes we model the intermediate case where a land rental market exists but rents are below competitive market rates. This is evidenced by the fact that the vast majority of transfers (up to 90%) are still to relatives or villagers known to the farmer, in the majority of cases with no rent payments (but presumably with some payment in kind in the form of product gifts) and the majority rely on oral contracts. As the World Bank reports, such contractual arrangements lead on average to rents or payments in kind that are below competitive rates, with migrating farmers compromising for such low rates in the absence of formal tenure certificates and to avoid stimulating the attention of the village authorities which can still exercise

---

[12]Wang, Riedinger and Jin (2015) report that about half of respondents in their survey had full certification of their land tenure, as enacted in the 2003 law, whereas Prosterman et al. (2011) in their survey of seventeen provinces claim that the fraction of farmers who had properly enforceable contracts was closer to a quarter.

[13]We say "he" because there is some uncertainty about women's right to the land. See http://www.chinadaily.com.cn/china/2017-11/04/content_34098958.htm

[14]In light of the remaining uncertainties about reallocations, Liao et al. (2016) and Tombe and Zhu (2017) adopt the former simplification (whereby the farmer loses the land when he migrates) in their modelling of migration and the same extreme case was modelled in an earlier version of our paper that circulated as CEPR Discussion Paper no.11657 (24 November 2016). Law changes are still taking place with a view to strengthening tenure guarantees. In April 2017 *China Daily* reported a proposed law designed to make migrants "feel more secure holding the land contracts," and drawing a distinction between the owner of the land, which is the state, the contractor, who is the local resident allocated the land, and the manager, who is cultivating it. See http://www.chinadaily.com.cn/china/2017-11/04/content_34098958.htm

an arbitrary reallocation in favour of farmers who remain in the village. One of the contributions of our paper is to show how the reallocation risk leads to an equilibrium rent that is below the competitive rate, as postulated by the World Bank and others.

3 China's land policy in a model of migration

The state makes available at zero rent land plots to local agricultural *hukou* holders. The land remains the property of the state but the agricultural *hukou* holder can "manage" the land, namely cultivate it for a return. If he is unable or unwilling to cultivate the land he may be able to rent it out for some return or lose it altogether to an administrative reallocation. We assume the absence of real or financial assets, so we can work with a one-period model. Land is allocated from the state on a per-period basis for cultivation and cannot be used to make intertemporal transfers (e.g., through mortgages). All output is consumed in the period that is produced and consumers are price-takers.

In order to focus the analysis on labour distortions we assume that goods markets are frictionless and all consumers face the same prices. For this to hold all goods must be transferable without cost across space, an assumption that we make. The distortions introduced by the *hukou* type alter only the incomes received by different groups of workers. We further assume that there are only two regions, a rural one that produces agricultural goods and an urban one that produces non-agricultural goods. We ignore the non-agricultural production in rural areas in this section. We denote all rural/agricultural production by subscript a and all urban/non-agricultural production by subscript u. With these assumptions urbanization and industrialization are one and the same.[15]

3.1 Consumer allocations and production functions

The utility function of an agent i is defined by

$$
\begin{aligned}
U^i &= \log c^i, \\
c^i &= \left(c_a^i - \bar{c}_a\right)^\omega \left(c_u^i\right)^{1-\omega}
\end{aligned}
\tag{1}
$$

where $\omega \in [0,1]$ and $\bar{c}_a$ is a subsistence level for agricultural goods (which delivers a lower and more realistic income elasticity for agricultural goods than for non-agricultural ones), c^i is the consumption aggregate for each person and c_a^i and

---

[15] Strictly speaking, our analysis in this section is about the allocation of labour between agricultural production and all other activities. We refer to the latter as urban for notational and linguistic simplicity.

c_u^i respectively denote consumption of the agricultural and the non-agricultural goods. Throughout the paper we use superscript i for individual and subscript j for types of goods. Individuals can be of different types due to the *hukou* they hold or the sector in which they are employed.

The budget constraint facing each person is

$$p_a c_a^i + p_u c_u^i \leq I^i. \tag{2}$$

where p_a is the price of the agricultural good, p_u the price of the non-agricultural good and I^i is the income of individual i.

Maximization of the utility function subject to the budget constraint gives the usual marginal rate of substitution (MRS) equation:

$$\frac{c_a^i - \bar{c}_a}{c_u^i} = \frac{\omega}{1 - \omega} \frac{p_u}{p_a}. \tag{3}$$

The value-added production function for the non-agricultural good is,

$$y_u = A_u n_u \tag{4}$$

where y_u denotes output, n_u is the fraction of the labour force employed in non-agriculture and A_u is a technology parameter. With linear production function and competitive equilibrium all revenue is passed on to labour, so wages are:

$$w_u = p_u A_u. \tag{5}$$

Given the important role of land in our analysis, the agricultural production function has to take it into account explicitly, noting that all agricultural land is officially owned by the state. We let h_a be the measure of agricultural *hukou* holders (and $h_u = 1 - h_a$ the measure of urban *hukou* holders), n_a the fraction of employment in agriculture, with $n_a \leq h_a$ to reflect the direction of migration movements, and l be the total area of land made available for agricultural use (a policy constant). Let l_a^i be the land cultivated by a single farmer i. The farmer's production function is given by,

$$y_a^i = A_a \left(l_a^i \right)^{1-\beta} \qquad 0 \leq \beta < 1, \tag{6}$$

where A_a is agricultural technology.

The village leader allocates a plot of size l/h_a to every local *hukou* holder. Those who stay on the land cultivate their allocation plus any land that they rent from the migrants. In light of our discussion in section 2.2, we assume that the rental market is subject to the uncertainties of reallocation. Of course, there could be other reasons for market failures but we believe that the reallocation risk is the main one in China.

Consider the following sequence of events within the single period. They take place simultaneously but the motivation is clearer if we describe them as a sequence of actions. The village leader moves first to allocate l/h_a land to all local *hukou* holders. Next the *hukou* holders decide whether to stay and cultivate the land or migrate; a measure $n_a \leq h_a$ stay. Next a rental market opens for migrants' land. Let the rental that clears the market be ρ. A remaining (non-migrating) farmer i rents ϕ^i units of land and pays the rent $\rho\phi^i$. Migrants take the rents and leave the area. Before production begins, the village leader makes a move. He decides whether to enter the market for a second allocation round or stay away and allow the farmers to cultivate the land that they rented. The village leader's action is uncertain *ex ante*; farmers attach a probability λ to *non*-reallocation. Under a *guaranteed tenure* regime $\lambda = 1$; the village leader takes no further action and production begins on the rented land. If tenure is not guaranteed he might take the land of the migrant and reallocate it for free. Under a *use it or lose it* regime $\lambda = 0$; the village leader reallocates the land of the migrants with probability 1. Once reallocations take place production begins. In intermediate cases $\lambda \in (0, 1)$; there is a probability $(1-\lambda)$ between 0 and 1 that the village leader will reallocate.

Under this arrangement farmer i with probability λ gets to cultivate his initial allocation l/h_a plus the land he rented, ϕ^i; with probability $1 - \lambda$ he loses the land that he rented in a reallocation but being resident in the village he is reallocated a share of the land that the village leader expropriated. In an egalitarian regime, in the second-round allocation each farmer receives an equal share of the land left behind by migrants which, when added to the initial egalitarian allocation, results in a land plot of size l/n_a for each remaining farmer. Formally, when farmer i enters the rental market the land that he will be able to cultivate satisfies,

$$l_a^i = \begin{array}{ll} l/h_a + \phi^i & \text{with probability } \lambda \\ l/n_a & \text{with probability } 1 - \lambda \end{array} \tag{7}$$

The farmer's expected income from cultivation is,

$$I^a = \lambda p_a A_a \left(l/h_a + \phi^i\right)^{1-\beta} + (1 - \lambda)p_a A_a \left(l/n_a\right)^{1-\beta} - \rho\phi^i. \tag{8}$$

Maximization with respect to ϕ^i gives,[16]

$$\lambda(1 - \beta)p_a A_a \left(l/h_a + \phi^i\right)^{-\beta} = \rho. \tag{9}$$

Since all farmers are identical they all choose the same ϕ, which under market clearing must be equal to $l/n_a - l/h_a$. Therefore $l_a^i = l/n_a$; the farmer gets to

---

[16]Note that condition (9) and all subsequent ones hold even if the farmer maximized expected utility instead of expected income because it applies to only one state of nature, the one of no reallocation.

cultivate the same plot of land in both states of nature and the equilibrium rental is,

$$\rho = \lambda(1 - \beta)p_a A_a (l/n_a)^{-\beta} = \lambda r, \tag{10}$$

where r denotes the marginal product of land. We have established:

Proposition 1 *An* ex ante *reallocation probability* $(1 - \lambda)$ *of land that is not cultivated by contracted farmers implies a rental market for land that clears at rent* λr, *where* $\lambda \in [0, 1]$ *and* r *is the marginal product of land in agriculture.*

The reallocation probability $(1 - \lambda)$ introduces a discount on rents that plays the role of a risk premium borne by migrating farmers. In a risk-free market (the guaranteed tenure one) they collect rents r for their land. But because in reality they run the risk of reallocation, the market clears at a lower rent λr, so $(1 - \lambda)r$ is a discount on their rent due to the reallocation risk. Ex-post, remaining farmers do not face any risks because they cultivate the same land plot l/n_a whatever happens, so the entire cost of the reallocation risk is borne by the migrants.

Under these conditions, the farmers' net return is the value of output of his farm, $p_a y_a^i$, *less* the cost of the rents $\rho\phi^i = \lambda r(l/n_a - l/h_a)$, which is,

$$I^a = [1 - \lambda(1 - \beta)] p_a A_a (l/n_a)^{1-\beta} + \lambda r l/h_a. \tag{11}$$

Note that in the guaranteed tenure case of $\lambda = 1$, the first part on the right side of (11) is labour's return from the farm (the marginal product of labour) and the second term the (competitive) rent from the land gifted by the state to agricultural *hukou* holders. In the more relevant range of $\lambda < 1$, the labour component is higher and the rent component lower. In the reallocation extreme of "use it or lose" it $\lambda = 0$, and the farmer's income is the entire output of the farm (the average product of labour).

Aggregate food production is given by the summation of y_a^i over i, i.e. $n_a y_a^i$, which in view of the symmetric solution $l_a^i = l/n_a$, becomes the output of a conventional Cobb-Douglas production function in the non-migrating farmers and the exogenous land allocation:

$$y_a = A_a n_a^\beta l^{1-\beta}. \tag{12}$$

3.2 Worker's migration decision

The migration condition equates wages in the urban location *plus* any rents that the migrant can collect from the initial land allocation, to the net return from cultivation had the migrant remained in agricultural production. The income of the agricultural worker is given by I^a in (11) and the income of the migrant by I^m, defined by:

$$I^m = p_u A_u + \lambda r l/h_a, \tag{13}$$

which is the sum of the wage from non-agricultural production w_u, obtained in (5), and the rental income on the initial land allocation, $\lambda rl/h_a$. The migration condition equates the two income levels, $I^a = I^m$ and can now be stated:

$$[1 - \lambda(1 - \beta)]\, p_a A_a \,(l/n_a)^{1-\beta} = p_u A_u. \tag{14}$$

In the case $\lambda = 1$, where there is a risk-free secondary market for land rentals, the migration condition (14) equates the value of marginal product of labour in each sector, despite the initial rent-free allocation by the state. But if $\lambda < 1$, the migrating farmer gets less than marginal revenue product from his land when he leaves, and pays below-market rates for a portion of his land if he stays, and so migration is lower.

Formally, this can also be seen by rewriting the migration condition (14) as,

$$\underset{(\mathbf{VMPL}_a)}{\beta p_a A_a \,(l/n_a)^{1-\beta}} = \underset{(\boldsymbol{\pi}\mathbf{VMPL}_u)}{\pi p_u A_u} \; ; \quad \pi \equiv \frac{\beta}{1 - \lambda(1 - \beta)} \leq 1 \tag{15}$$

Migration equates the value of marginal product of labour in agriculture to a fraction $\pi < 1$ of that in the non-agricultural sector, a typical feature of the misallocation of resources. The term π can be interpreted as a form of "labour market wedge", which has the same impact as an income loss by rural migrants in the non-agricultural destination, compared with local *hukou* holders who receive the full wage $p_u A_u$. This wedge is an endogenous outcome of the model due to the land policy. In the extreme case when $\lambda = 0$, i.e. those who leave the farm receive no rental income, the model implies that the endogenous wedge is equal to β, i.e. the implicit income loss is equal to the share of land $(1 - \beta)$ in the production function. The estimates of factor shares in China imply a β of about 0.5 (see Cao and Birchenall, 2013, Fuglie and Rada, 2015), giving a substantial endogenous implicit income loss in the new state of about 50%.

The migration condition (14) depends on the endogenous relative price of the two goods which needs to be solved out in a general equilibrium but its properties and sources of inefficiency (when compared to a perfect rental market) can be illustrated in a simple diagram, as follows (see figure 2). The vertical axis measures the returns from labour in each sector (for given relative prices) and the horizontal measures agricultural employment from left to right (and since $n_u = 1 - n_a$, non-agricultural employment from right to left, with 1 as origin). Because of the linear production function, the returns from urban employment are independent of employment, as in the right side of (14), and shown by the horizontal line at $p_u A_u$. The returns from rural employment slope down in employment left to right because of diminishing returns. The probability λ is a shift variable in this relationship. For $\lambda = 1$ the curve takes its lowest position and $\lambda = 0$ gives the highest position. The equilibrium for a perfect rental market is given by the intersection at n_a^*. For

an imperfect market with rents below the marginal product of land, equilibrium is at an intersection between n_a^* and n_a^0, the latter denoting the intersection in the "use it or lose it" extreme ($\lambda = 0$). Clearly, a $\lambda < 1$ yields too much employment in agriculture, because farmers do not take into account the full cost of the land in their decisions; they behave as if the cost of land is λr instead of r.

3.3   Market clearing conditions

The migration results shown in figure 2 are partial but deriving the equilibrium ones by solving out for prices does not alter the intuition or properties that they illustrate. We solve for prices by equating demand and supply for the aggregate economy, consisting of three types of consumers: the h_u urban (non-agricultural) *hukou* holders who work in the urban sector, the n_a rural (agricultural) *hukou* holders who work in agriculture and the $m = (h_a - n_a)$ migrants who work in the urban economy and hold agricultural *hukou*. Let c_j^u and c_j^i, $i = a, m$ be the corresponding consumption levels for the three types of agents. The market clearing condition for non-agricultural goods is:

$$A_u \left(1 - n_a\right) = h_u c_u^u + n_a c_u^a + \left(h_a - n_a\right) c_u^m \tag{16}$$

and for agricultural goods, making use of (12):

$$A_a l^{1-\beta} n_a^\beta = h_u c_a^u + n_a c_a^a + \left(h_a - n_a\right) c_a^m. \tag{17}$$

Definition 2 *The land policy equilibrium is defined by the rental market in Proposition 1, policy parameters (h_a, h_u, λ) and a sequence of prices $\{p_a, p_u\}$, consumption allocations $\{c_a^i, c_u^i\}_{i=a,m,u}$ and labour allocations $\{n_a, 1 - n_a\}$ such that: given prices, the consumption allocations maximize the utility functions subject to the respective budget constraint; the employment allocation satisfies the migration condition that equates labour income in the two sectors; and prices satisfy the market clearing conditions.*

With this definition we establish,

Proposition 3 *If land is an essential input into production, $\beta < 1$, a land policy that keeps rents below the value of marginal product of land is a non-trivial barrier to labour mobility, inducing a bigger labour allocation in agriculture and less in non-agricultural production. These allocations coexist with a lower relative productivity in agriculture.*

The proof is straightforward and we sketch it here. Aggregating the MRS condition (3) with the weight of each type of consumer and making use of the

market clearing conditions (16) and (17) yields,

$$A_a l^{1-\beta} n_a^\beta - \bar{c}_a = \frac{\omega}{1-\omega} \left(\frac{p_u}{p_a} \right) A_u \left(1 - n_a \right). \tag{18}$$

Substituting the relative prices p_u/p_a from (14) and making use of (4), yields the equilibrium condition for agricultural employment, which we write for better intuition as,

$$\frac{1-n_a}{n_a} = \frac{1-\omega}{\omega\beta} \left(1 - \frac{\bar{c}_a}{A_a n_a^\beta l^{1-\beta}} \right) \pi, \tag{19}$$

where π is the "wedge" measure in (15), $\pi = \beta/[1-\lambda(1-\beta)] \in [\beta, 1]$. We note that the wedge is due entirely to the land policy and if $\pi = 1$ it is zero, so the implicit income loss from migration, compared to the efficient rental market is $(1-\pi)$. The highest value of $\pi = 1$ corresponding to the perfect rental market case of $\lambda = 1$, and the lowest value of $\pi = \beta$, corresponds to the "use it of lose it" case of $\lambda = 0$. The former yields a migration condition that equates the marginal product of labour across sectors, whereas the lowest value $\pi = \beta$ equates the *average* product of labour in agriculture to the marginal product in urban production (which is equal to the average product but only because of the linearity of the production function).

The results stated in Proposition 3 follow from equation (19). First, we note that the left side slopes down in n_a and the right side slopes up, giving a unique solution for agricultural employment. Second, the left-side ratio is the ratio of urban to rural employment, which depends positively on λ, through its impact on the wedge π. This establishes the main property of the labour allocation highlighted in the Proposition. The guaranteed tenure regime with $\lambda = 1$ delivers the highest urban to rural employment ratio whereas the "use it or lose it" alternative gives the lowest. The intuition is the same as the one that we gave in the preceding section about migration; the more distant the rental market from its efficient level, the bigger the wedge between rural and urban labour returns. Other properties of the labour allocation are equally intuitive. The ratio of urban to rural employment depends positively on the relative preference for non-agricultural goods, on the flexibility in agricultural consumption as measured by the discretionary (non-subsistence) component of consumption, and negatively on the income share of labour in agriculture. Finally, labour productivity in agriculture is below that in non-agriculture. As (15) shows, the marginal product of labour in agriculture is a fraction π of the marginal product in non-agriculture, and yet workers do not reallocate from rural to urban areas. By extension, this misallocation of labour contributes to a lower aggregate productivity in the economy as a whole.

17

4 Government subsidies

We now introduce the second main policy tool associated with the *hukou* system – government subsidies. The local authorities in all areas of the country subsidize part of the consumption of local *hukou* holders by supplying free of charge some locally-produced social services, such as education and health. They do not subsidize the consumption of migrant workers, who are commonly referred to as "floating workers". The subsidies are financed through local taxation and the implication that we emphasize here is that migrants have to pay taxes but receive no benefits, a feature of the system that acts as a migration disincentive.

As we pointed out in section 2, the system was originally introduced to prohibit migration. In the first stages of reform, beginning in 1978, the Chinese authorities relaxed some of the migration restrictions but rather than encouraging migration to the cities from the start, they encouraged the formation of small "township and village enterprises", so agricultural workers could move to industrial jobs within their area of registration. The aim of the policy was partly in line with the more general political objective of gradual relaxation of the restrictions of the Mao era, and partly to preserve the access of local residents to subsidized services. Figure 1 shows a bulge in rural non-agricultural employment in the 1980s, an indication that the policy was successful. Later the *hukou* restrictions were relaxed further, leading to growth in industrial employment in urban areas, but the rural non-agricultural sector remained an important source of non-agricultural employment in predominantly agricultural areas.

We take this fact into account by generalizing the model of the preceding section by introducing a second non-agricultural sector, located in the rural area. The good produced in the urban areas is still distinguished by subscript u and the non-agricultural good produced in rural areas by subscript r. Workers who move out of agriculture are modelled as in the preceding section but their access to social subsidies depends on their destination: if they move to the rural non-agricultural sector they retain their local subsidies but if they move to the urban area they lose them and they are not entitled to draw urban subsidies.[17] Our distinction between rural and urban non-agricultural jobs enables us to discuss separately the processes of industrialization and urbanization, which have been a feature of Chinese economic development since the reforms of the 1980s.

To proceed, we assume that the authorities buy a fraction s_j $(j = r, u)$ of local

---

[17]We maintain the same assumptions about land as in the preceding section for all workers who move out of agriculture. There is some evidence in the literature that workers who move to the rural non-agricultural sector, especially if they are located within commuting distance of their village, have a better chance of retaining access to their land than workers who move to urban areas. Modelling this case requires a model of family allocations or of dual jobs and we do not pursue it in this paper.

non-agricultural output and give it to local *hukou* holders for free and raise lump sum taxes T_j $(j = r, u)$ to finance them locally. To avoid pathological situations where consumers might want to sell government services we assume that s_j is sufficiently small so that $s_j y_j < c_j^i$ in all equilibria. The policy parameters with government subsidies are (h_a, h_u, s_r, s_u), which are taken as given, and where, as before, h_a is the fraction of the population with agricultural *hukou* and $h_u = 1 - h_a$ is the fraction with non-agricultural *hukou*.

We define the following equilibrium allocation with government policy.

Definition 4 *The full-policy equilibrium is defined by the rental market in Proposition 1, policy parameters $(h_a, h_u, s_r, s_u, \lambda)$, lump sum taxes (T_r, T_u) and prices $\{p_r, p_u, p_a\}$, consumption allocations $\{c_a^i, c_r^i, c_u^i\}_{i=a,r,u,m}$ and labour allocations (n_a, n_r, n_u) such that: given prices, the consumption allocations maximize utility functions subject to their respective budget constraints; the labour allocations satisfy the migration conditions that set incomes in all sectors equal to each other. Prices $\{p_r, p_u, p_a\}$ satisfy market clearing conditions and equilibrium lump-sum taxes satisfy government budget constraints separately in each region.*

The rest of this section is devoted to characterizing this equilibrium.

4.1 Consumer's and worker's allocations

The utility function is the same as (1) except that now there is a second non-agricultural good c_r :

$$
\begin{aligned}
U^i &= \log c^i, \\
c^i &= \left(c_a^i - \bar{c}_a\right)^\omega \left[\psi c_r^{i\,\frac{\eta-1}{\eta}} + (1-\psi)c_u^{i\,\frac{\eta-1}{\eta}}\right]^{\frac{(1-\omega)\eta}{\eta-1}}
\end{aligned}
\tag{20}
$$

with $\omega, \psi \in (0, 1)$ and η is the elasticity of substitution between rural and urban non-agricultural good. The production functions for the two types of non-agricultural goods are:[18]

$$
y_j = A_j n_j; \quad i = r, u.
\tag{21}
$$

With government subsidies and taxes, consumer's budget constraints are affected differently across different types of consumers. In rural areas, there are

---

[18]We retain the linear structure of production for simplicity and for direct comparison with the model of the preceding sections, and differentiate between the two non-agricultural goods in the utility function. An alternative with similar results would be to differentiate the two goods in production, treating them as intermediary goods aggregating up to the final consumption good. Qualitative results would be identical.

agricultural and non-agricultural workers. Given that they are all rural *hukou* holders, they face the same subsidies and taxes, so their budget constraints are:

$$p_a c_a^i + p_r(c_r^i - s_r y_r) + p_u c_u^i = I^i - T_r, \quad i = a, r \tag{22}$$

where I^a is the same as in the land policy equilibrium (11) and

$$I^r = p_r A_r + \lambda r l / h_a, \tag{23}$$

which is similar to (13).

In urban areas there are migrant workers who are not entitled to government subsidies but pay local taxes.[19] The budget constraint for these workers is different from the one in rural areas:

$$p_a c_a^m + p_r c_r^m + p_u c_u^m = I^m - T_u, \tag{24}$$

and the migrant's income is as in (13). In contrast, urban *hukou* holders benefit from government subsidies:

$$p_a c_a^u + p_r c_r^u + p_u(c_u^u - s_u y_u) = I^u - T_u. \tag{25}$$

The income of urban hukou holders is simply the wage income in (5).

The consumer utility maximization is similar to before except that there is an optimal consumption choice across rural and urban non-agricultural goods. Condition (3) is modified to

$$\frac{c_a^i - \bar{c}_a}{\left[\psi c_r^{i\,\frac{\eta-1}{\eta}} + (1-\psi)c_u^{i\,\frac{\eta-1}{\eta}}\right](c_u^i)^{1/\eta}} = \frac{\omega}{(1-\omega)(1-\psi)}\frac{p_u}{p_a} \tag{26}$$

and there is a new condition for the marginal rate of substitution across rural and urban non-agricultural goods:

$$\frac{c_r^i}{c_u^i} = \left(\frac{\psi}{1-\psi}\frac{p_u}{p_r}\right)^{\eta}. \tag{27}$$

4.2   Workers' migration conditions

Since rural workers do not lose their right to social subsidies if they remain in the rural areas, the mobility condition across agriculture and the non-agricultural

---

[19]Pan and Wei (2013) write, "Unfortunately, children of migrant workers in China are deprived of the right to compulsory education despite the fact that these workers pay taxes in their host cities and their employers pay the so-called "city construction fees" and "educational surcharge"".

sector in rural areas is similar to (14) in the land policy equilibrium without subsidies, as illustrated in figure 2:

$$[1 - \lambda (1 - \beta)] \, p_a A_a \, (l/n_a)^{1-\beta} = p_r A_r. \tag{28}$$

Using budget constraints (22) and (24), the migration condition for an agricultural worker moving to an urban location is:

$$[1 - \lambda (1 - \beta)] \, p_a A_a \, (l/n_a)^{1-\beta} + p_r s_r y_r - T_r = p_u A_u - T_u \tag{29}$$

Turning now to government, budget balance in rural locations requires,

$$p_r s_r y_r = T_r, \tag{30}$$

because all rural residents are also rural *hukou* holders. In urban locations the recipients of subsidies are the h_u urban *hukou* holders whereas the tax payers are the same h_u workers plus the m migrants with agricultural *hukou:*

$$h_u p_u s_u y_u = (h_u + m) \, T_u. \tag{31}$$

Substitution of the government's financing constraints and the urban production function into the migration condition (29), in view of the employment share in urban production being, as before, $n_u = h_u + m$, simplifies the migration condition between agriculture and urban production to:

$$[1 - \lambda (1 - \beta)] \, p_a A_a \, (l/n_a)^{1-\beta} = p_u A_u \, (1 - h_u s_u) \,. \tag{32}$$

Comparison with (14) makes clear the role of government subsidies in migration decisions. They act as a disincentive to urban migration because of the tax that migrants have to pay without matching social subsidies, reducing the net income that migrants receive after migration. In figure 2, the impact of subsidies is to shift down the horizontal line for the labour return in the urban location, the shift factor being $(1 - h_u s_u)$. The downward shift moves the intersection point further to the right, away from the efficient point n_a^*, so the intersection between the downward sloping line with the relevant λ and the new urban line can now be to the right of the "use it or lose it" intersection n_a^0.

The migration conditions (28) and (32) can also be re-written to mirror (15):

$$\beta p_a A_a \, (l/n_a)^{1-\beta} = \pi p_r A_r = \pi \sigma p_u A_u, \tag{33}$$

with the same definition for π and where we defined a new wedge related to urban subsidies as $\sigma \equiv (1 - h_u s_u) \,$; the shift factor in figure 2. Like π, σ attains its maximum value when there is no distortion, in which case $s_u = 0$ and $\sigma = 1$.

Given the restriction $s_u < 1$, and by definition $h_u < 1$, σ has a strictly positive minimum, reached in the limit as s_u rises.

The presence of $\sigma < 1$ on the right-hand side of (33) is an additional source of implicit income loss in the urban state relative to the land-policy equilibrium in equation (15). It generates a larger labour market wedge, so social subsidies act as an additional type of barrier against the movement from rural to urban locations.

The interaction of the two policies generates a rather complex picture of migration barriers. Agricultural workers' main barrier is the land, because they could go to a non-agricultural job in their locality without affecting the taxes and social subsidies they face; this makes land policy the main barrier to *industrialization*. Rural non-agricultural workers can migrate to urban areas but they then have to pay taxes without receiving subsidized services; the urban tax and subsidy policy is mainly a barrier to *urbanization*. Of course, in equilibrium both policies affect both industrialization and urbanization. These results are derived more formally in the next section, which endogenizes relative prices.

4.3   Employment allocations under the full *hukou* system

As in the case of the two-sector model, solving for prices does not alter the key intuition and qualitative results discussed in the preceding section. These results are summarized in the following Proposition:

Proposition 5 *Social subsidies given to urban hukou holders and the land reallocation risk when land is rented reduce both the urbanization and industrialization rates; subsidies work by introducing disincentives to urbanization whereas the land policy works by introducing disincentives to industrialization.*

Appendix 7.1 derives the equilibrium employment shares step by step. The two equations that give the non-agricultural employment shares are,

$$\frac{n_r}{1 - n_a} = \frac{X\sigma^{-\eta}}{1 + X\sigma^{-\eta}}; \quad \frac{n_u}{1 - n_a} = \frac{1}{1 + X\sigma^{-\eta}}. \tag{34}$$

where X is a function of parameters and defined by,

$$X \equiv \left(\frac{\psi}{1 - \psi}\right)^{\eta} \left(\frac{A_r}{A_u}\right)^{\eta - 1}, \tag{35}$$

and the equation for agricultural employment is,

$$\frac{1 - n_a}{n_a} = \frac{1 - \omega}{\omega\beta} \left(1 - \frac{\bar{c}_a}{A_a n_a^{\beta} l^{1-\beta}}\right) \pi \frac{\sigma + X\sigma^{1-\eta}}{1 + X\sigma^{1-\eta}}. \tag{36}$$

22

Equations (34) replace the single equation $n_u = 1 - n_a$ of the two-sector model and equation (36) replaces the important equation (19) of the two-sector model. Note that for $\sigma = 1$ (no subsidies), (36) collapses to (19).

Prices are given by the equality of demand and supply for each good, noting that there are now four types of consumers instead of the previous three: the h_u urban *hukou* holders who work in the urban sector, the agricultural *hukou* holders who work in agriculture, n_a, and non-agriculture, n_r, and the m migrants in the urban sector. Refer to the Appendix for more details.

That subsidies work mainly against urbanization in the equilibrium allocation follows immediately from (34): Higher subsidy rate lowers σ and the ratio of urban to rural non-agricultural employment, n_u/n_r. From equation (36), urban social transfers also lower overall industrialization, by reducing non-agricultural employment relative to agricultural.[20] It follows that urban employment is a smaller fraction of a reduced overall industrialization incidence, whereas rural non-agricultural employment is a relatively bigger fraction of the reduced industrialization. Urban subsidies reduce both industrialization and urbanization but their main disincentive is on urbanization. The other properties of the solution for agricultural employment are the same as in the two-sector model without subsidies.

Social transfers in rural areas, s_r, do not play a role in the employment allocation. The intuition is twofold: first, movements between agricultural and non-agricultural jobs in rural areas do not affect the social subsidies received and taxes paid by rural workers, so they do not distort the rural allocation decisions. Second, once agricultural *hukou* holders decide to move to urban locations, they lose the rural benefits but also do not have to pay rural taxes, and these balance each other out by the assumption of regional budget balance.

5 Policy distortions

5.1 Efficient allocations

We now lay down the efficient allocations by solving the planner's problem. The social planner chooses labour and land allocations to maximize the utility of the representative agent as in (20), subject to the production technologies (6) and (21),

---

[20]For very high values of η this condition may not hold. When η is very high, rural and urban non-agricultural goods are virtually identical and when subsidies are raised by a small amount large numbers of agricultural *hukou* holders might move back from urban to rural non-agriculture and agriculture. We exclude this pathological situation by imposing the required restriction on η, which is $\eta \leq [1 + X\sigma^{-\eta}]/X\sigma^{-\eta}(1 - \sigma)$. Clearly, this is always satisfied for $\sigma = 1$ but as σ takes lower values the upper limit on η is a finite number. In section 5.2 we show that $X\sigma^{-\eta}$ and σ can be quantified and applying the numbers for 2010 we get, $\eta \leq 103$.

and the land and labour resource constraints. The planner's problem is formally derived in Appendix 7.2 and stated here:

Proposition 6 *In the optimal allocation, the value of the marginal product of labour is equalized in all production sectors:*

$$\frac{\partial U}{\partial c_j}\left(\frac{\partial c_j}{\partial n_j}\right) = \xi \quad j = a, r, u, \tag{37}$$

where ξ is the corresponding multiplier for the labour resource constraint. There are equal land allocations across farmers. The optimal employment allocations satisfy:

$$\frac{n_r^*}{1 - n_a^*} = \frac{X}{1+X}; \quad \frac{n_u^*}{1 - n_a^*} = \frac{1}{1+X}, \tag{38}$$

and

$$\frac{1 - n_a^*}{n_a^*} = \frac{1 - \omega}{\omega \beta}\left(1 - \frac{\bar{c}_a}{A_a\left(n_a^*\right)^\beta l^{1-\beta}}\right). \tag{39}$$

Comparing the efficient allocation in (39) with that in the *hukou* equilibrium in (36) implies that agricultural employment is higher in the *hukou* equilibrium given $0 < \sigma \le 1$ and $0 < \pi \le 1$, both because of the subsidies and the imperfect rental market for migrant land. The intuition for these results is the same as the one given in connection to figure 2. The subsidies also raise n_r/n_u so it follows from (34) that urban employment is inefficiently low in the *hukou* equilibrium because of both policies. Non-agricultural rural employment is pushed up above the efficient level by the subsidization policy and pushed down by the land policy, potentially giving an ambiguous result. The results of this section are summarized in the following proposition:

Proposition 7 *The hukou equilibrium with $0 < h_u s_u < 1$ and $0 < \lambda < 1$ (equivalently, $0 < \sigma < 1$ and $0 < \pi < 1$) implies an inefficiently high agricultural employment share and an inefficiently low urban employment share, with ambiguous results on the rural non-agricultural employment share.*

The *hukou* equilibrium yields the efficient allocation when there is a risk-free rental market for agricultural land ($\lambda = 1$) and either no subsidies or (because of our non-distortionary modelling of both transfers and taxes) universal subsidization covering migrants as well. This holds independently of the specific ownership structure for land; the important property required is that farmers have guaranteed tenure during the period of their contract.

Proposition 8 *The decentralized equilibrium is efficient if there is guaranteed tenure with a perfect rental market for land ($\lambda = 1$) and there are either no region specific urban subsidies ($s_u = 0$) or no exclusion of migrants from the urban subsidies.*

Dividing (36) by (39), we can compare more explicitly the agricultural employment share in the policy equilibrium n_a with the efficient allocation, n_a^* :

$$\frac{(1 - n_a)/n_a}{(1 - n_a^*)/n_a^*} = \left(\frac{1 - \bar{c}_a/y_a}{1 - \bar{c}_a/y_a^*} \right) \pi \frac{\sigma + X\sigma^{1-\eta}}{1 + X\sigma^{1-\eta}}, \tag{40}$$

where the agricultural production function $A_a n_a^\beta l^{1-\beta}$ has been replaced by y_a for notational simplicity and

$$\frac{1 - \bar{c}_a/y_a}{1 - \bar{c}_a/y_a^*} = \frac{1 - \bar{c}_a/y_a}{1 - (n_a/n_a^*)^\beta (\bar{c}_a/y_a)}. \tag{41}$$

A higher labour wedge (lower π) increases the inefficiency in the labour allocation as it acts as a policy-induced disincentive to migration. A similar argument applies for lower σ, the subsidy wedge. From the definition of π we find that for $\lambda < 1$, π increases in β, so a higher labour share in agriculture reduces the wedge and the distortion caused by the imperfect rental market. The intuition follows from our solution: in the case with perfect rental market, $\lambda = 1$, labour gets a share β of agricultural output whereas in the policy equilibrium it gets share $(1 - \lambda (1 - \beta))$, so the higher is β the closer the two equilibrium outcomes will be.

Another important parameter that influences the gap between the policy outcome and the efficient one is the value of subsistence consumption, $\bar{c}_a$. A higher value for $\bar{c}_a$ implies that substitution possibilities between agricultural and non-agricultural consumption are more limited so removing some of the incentives that farmers have to migrate does not have as much impact on their decisions as in cases where consumers are more likely to switch between agricultural and non-agricultural goods. The ratio in (41) increases in the subsistence ratio $\bar{c}_a/y_a$ given the over-employment in agriculture $(n_a > n_a^*)$ that we have already established.

A final property of the policy equilibrium to note is that there are interactions in the impact of policy on outcomes. Higher subsidies reduce σ and the ratio $(\sigma + X\sigma^{1-\eta}) / (1 + X\sigma^{1-\eta})$, so, if the distortion from land increases and π falls, its marginal impact is reduced when subsidies are higher. The same applies to the marginal impact of subsidies; it is maximized in the case of an efficient land policy.

5.2   Quantitative impacts of policy distortions

We conclude with some measures of the quantitative importance of the sources of inefficiency that we have identified in this paper. These are the land reallocation

risk and the consequent absence of an unencumbered rental market for land and the *hukou*-linked entitlement to social subsidies. We are not doing a full calibration of the Chinese employment allocation but we are merely looking for ways that enable us to put an approximate value on the inefficiencies caused by the two policies. We measure inefficiency by the deviation of observed employment from the model's efficient allocation. We make use of some parameter estimates in the literature and statistical information from China.

Our assertion is that the observed employment allocation in the three sectors, agriculture and rural and urban non–agriculture, corresponds to the one obtained in the model with both a land and a subsidy policy, which we denoted (n_a, n_r, n_u) and obtained in section 4. We then use (40) to compare the policy equilibrium with the efficient allocation and we also study the impact when only the land policy is in operation, by setting $s_u = 0$.

Starting with parameters in (40), we get an estimate of $\beta = 0.51$ from the work of Cao and Birchenall (2013);[21] from (34) we obtain $X\sigma^{-\eta} = n_r/n_u$ using observed employment allocations; the measure of urban *hukou* holders h_u is given by Chan (2012); and the subsidy s_u was computed by us from several Chinese statistical sources and includes spending on education, health care services, pensions, and other social assistance programmes (e.g., basic living subsidies). Full details of the data are reported in Appendix 7.3 and 7.6.

The final parameter required to derive the distortion in industrialization is $\bar{c}_a$. We treat $\bar{c}_a$ as a constant, as is commonly assumed in the development literature, and start from an initial year in which almost all consumption is at subsistence level. We take this year to be 1978, before the big migrations started and when agriculture was still employing 68% of the labour force; we choose $\bar{c}_a$ such that $\bar{c}_a/y_a = 0.9$ for that year.[22] Given the value of $\bar{c}_a$, equilibrium condition (36) implies a time series of $\bar{c}_a/y_a$. (see Appendix 7.4). Together with (41), we can use (40) to compute n_a^* for any observed agricultural employment share n_a and a given value of λ. Finally, to derive the distortion in urbanization, we compute n_u^* using (38) which requires a value for η to separate X from $\sigma^{-\eta}$. We assume that η is equal to 2. Small variations in this number do not change the results given that $h_u s_u$ is small and so $\sigma \equiv (1 - h_u s_u)$ is very close to unity.[23]

Results depend crucially on the value of λ, as one would expect, since $\lambda = 1$

---

[21] They estimate for Chinese agriculture a share of capital of 0.25, land 0.37 and labour 0.38, which implies $\beta = 0.38/0.75 = 0.51$. This value is in line with the estimates of Fuglie and Rada (2015) and Adamopoulos et al. (2017). The small differences in the three estimated values make only marginal differences to our results.

[22] Lower subsistence would increase the distortion.

[23] We note that although η appears in the equation for agricultural employment, (36), a value is not required to compute n_a^*, because by (34) the whole expression $X\sigma^{-\eta}$ is equal to n_r/n_u and we can use data from the employment series to calibrate it.

yields efficiency. What is a reasonable value? As explained in section 2.2, before 1984 land was always appropriated and despite the issuing of a new document in 1984, the same can be assumed up to the passing of the 1998 Act. In this period $\lambda = 0$. Although the 1998 Act improved property rights, the market did not pick up until after property rights were strengthened in the 2003 Act. For 2004 we use $\lambda = 0.2$, based on the Feng, Bao and Jiang (2014) finding that 80% of villages were experiencing reallocations at this time. From 2004 onwards the rental market started improving gradually but never reached maturity. Feng, Bao and Jiang (2014) report that by 2010, 40% of villages were experiencing reallocations, so we use $\lambda = 0.6$ for this year.[24]

We derive results both for $s_u = 0$ and for the full policy model with the computed value of s_u, to shed light on the relative importance of each distortionary policy. Table 1 shows the results for three years, 1998, 2004 and 2010, the first two being landmark policy-change years and the third the last year of our sample. The table shows the year and the percentage of urban *hukou* holders in that year in column 1, the type of model with values for λ and the computed s_u in the next three columns, next a column for "income loss" and finally in the final three columns the computed results, with the first row of each year showing the computed efficient equilibrium employment share and in the other two rows the percentage-point distortion due to the policy. The column for income loss is the implicit loss of income to the migrant that we used in our formulas (e.g., equation (33)), measured as a percentage of the wage rate in urban areas. It is clear from the results in the table that the land policy causes a much bigger distortion to implicit incomes than the subsidies, even in the final year when both λ and s_u increased due to new legislation that strengthened tenure rights and increased urban subsidies.[25]

Our results show that the distortions in the allocation of employment to agriculture and non-agriculture (industrialization) are substantial, especially in the early years. In 1998 agricultural employment is 8 percentage points higher than in the efficient allocation and in 2004 this number remains high, at 7 percentage points.

---

[24]We reiterate that these numbers are not meant to be accurate measures of the *ex ante* reallocation probability but numbers that are reasonable approximations to the observed reallocation rates in the rural locations of the migrants. Our objective is to use plausible numbers to get ball-park figures for the policy distortions.

[25]Two caveats that can be stated with respect to the impact of subsidies are as follows (both pointed out by anonymous referees). First, our computed subsidy rates are derived from government spending but if migrants buy services such as education and health in urban areas at higher prices than the cost of these to the government (which is very likely), then the disincentive to migrants from their exclusion from these services is higher than computed. Second, and working in the opposite direction, migrants may continue using the services provided in their home area, e.g., by sending their children to school there or going back for health treatment if the need arises, and this reduces the income loss from migration.

Social subsidies do not affect these numbers by much. By 2010, when agricultural employment is almost half of what it was in 2004, the distortion from the land policy is down to 3.8 percentage points and that of subsidies to 0.2 points. In all these cases, the land policy distortion is equivalent to about 18-22% over-employment in agriculture.

The impact of subsidies is relatively more important in the urbanization of production. In 2010, the 0.2 percentage points of under-industrialization generated by subsidies is distributed as 1.0 percentage points less employment in urban areas and 0.8 percentage points more employment in rural non-agriculture. The overall 4.0 percentage points of under-industrialization is distributed as 3.4 percentage points under-urbanization and 0.6 percentage points under-employment in rural non-agriculture. This illustrates the ambiguity in the net distortion of the rural non-agricultural employment that we discussed in section 4. Overall, the distortions due to the land policy dominate the allocations but social subsidies still play an important role. Their main contribution is to generate more employment in rural non-agriculture, which slows down the process of urbanization.

5.3   Other labour market wedges

Some authors have argued that migrants are either discriminated against or have skills that are not suited to the ones required in urban locations, so insufficient earnings is a major barrier to migration from rural to urban areas. It is not possible with the data available for China to identify the source of lower earnings for migrants, whether it is due to discrimination or heterogeneity, but lower earnings on average is frequently documented in the empirical literature (see for example Meng and Zhang, 2001; Frijters, Kong and Meng, 2011; Démurger et al., 2009). This is an immigration barrier that we did not take into account in our model, in which the migration condition guarantees earnings equality. In this section we recalculate the impact of the land and social subsidy policies on immigration when there is an exogenous labour market wedge for immigrants that contributes to the observed productivity differences between agricultural and non-agricultural labour. The purpose is to check the robustness of our findings to the existence of this wedge, which leads to a constrained-efficient outcome in the absence of the *hukou* restrictions.

We follow the standard approach in the development literature by introducing an exogenous labour market wedge that lowers the non-agricultural wages earned by agricultural *hukou* holders to μw_i, $i = r, u$, with $\mu \in (0, 1)$. In other words, a migrant receives only a fraction μ of the urban wages received by workers with urban *hukou*. We show in Appendix 7.5 that this generalizes the mobility condition

28

(33) in an intuitive way, to:

$$\beta p_a A_a \left(l/n_a\right)^{1-\beta} = \mu\pi p_r A_r = \mu\pi \left(1 - \frac{1-\sigma}{\mu}\right) p_u A_u, \tag{42}$$

where $\pi = \beta/\left(1 - \lambda\left(1 - \beta\right)\right)$ and $\sigma = 1 - h_u s_u$ as before. Employment allocations satisfy:

$$\frac{n_r}{1 - n_a} = \frac{X\left(1 - \frac{1-\sigma}{\mu}\right)^{-\eta}}{1 + X\left(1 - \frac{1-\sigma}{\mu}\right)^{-\eta}}; \frac{n_u}{1 - n_a} = \frac{1}{1 + X\left(1 - \frac{1-\sigma}{\mu}\right)^{-\eta}}, \tag{43}$$

and

$$\frac{1 - n_a}{n_a} = \frac{1-\omega}{\omega\beta}\left(1 - \frac{\bar{c}_a}{A_a n_a^\beta l^{1-\beta}}\right)\mu\pi \frac{\left(1 - \frac{1-\sigma}{\mu}\right) + X\left(1 - \frac{1-\sigma}{\mu}\right)^{1-\eta}}{1 + X\left(1 - \frac{1-\sigma}{\mu}\right)^{1-\eta}}. \tag{44}$$

These conditions collapse to (33)-(36) when $\mu = 1$. In the absence of land and subsidy policy ($\pi = \sigma = 1$), the migration condition (33) implies that the exogenous μ is a labour market wedge that prevents equality of the value of marginal product of labour across sectors.

We assume the observed employment allocations are those that come out of the model with $\mu \in (0, 1)$ and the two policies. All parameters are calibrated as before and the new parameter μ is set to match the productivity gap between agriculture and non-agriculture when λ and σ take the values reported in Table 1 for each year (see Appendix 7.5 for more details). The productivity gap is defined as the ratio of nominal labour productivity in non-agriculture to agriculture. This ratio is obtained from combining nominal GDP for agriculture and non-agriculture from the *Chinese Statistic Yearbook* with the sectoral employment shares in Figure 1. The computed ratio increased from 3.9 in 1998 to 4.1 in 2004 and fell to 3.1 in 2010. The implied μ values are 0.26, 0.23 and 0.24, respectively, for each of the three years.

Given the computed parameter values, we then use equations (44) and (43) to calculate (with μ taking its computed values) the employment allocations when the rental market for land is efficient ($\pi = 1$) and there is no *hukou*-based discrimination in subsidies ($\sigma = 1$). This delivers the "second-best," or "constrained-efficient" employment allocations. We then derive the impact of the land policy and the social subsidization by comparing the predicted employment allocations to the second best allocation. Table 2 shows that our results about the over-employment in agriculture and the under-employment in urban production, relative to the second-best allocations, are similar to those in Table 1, except that social subsidies have a

larger effect on urbanization. The reason for this change follows from the way the wedge μ changes the migration condition, from (33) to (42): since migrants care about the cost of the social subsidies, which comes out of their income, they care about the ratio of this cost to their wage income, so the parameter that picks up the impact of the subsidies changes from $1 - (1 - \sigma)$ when they earn as much as local *hukou* holders to $1 - (1 - \sigma)/\mu$ when they earn only μ as much. Looking also at the column that shows the implicit policy income loss shows that social subsidies cause a much larger implicit income loss (as a percentage of their earnings) than was the case in Table 1.

By construction, the three barriers together, μ, λ, and s_u, account for the entire productivity gap between agriculture and non-agriculture. It is possible to use our results to decompose the gap into the contribution of each barrier, following the same methodology as in the employment allocations. This is shown in the last column of Table 2. The computed ratios show that the over-employment in agriculture induced by the land policy and the social subsidies can account for about half $(3.9 - 1.9)/3.9$ of the productivity ratio in 1998, with most of it due to the land policy. By 2010, the land policy still accounts for about a quarter $(2.9 - 2.1)/3.1$ of the productivity ratio, with an additional 7 percent $(0.2/3.1)$ due to social subsidies. These results show that the *hukou*-based land policy and social services contribute a substantial part of the productivity gap due to the misallocation of employment.

6   Conclusion

We have shown that the two main components of the *hukou* household registration system, the allocation of land cultivation rights to rural residents and the entitlement to social subsidies in the area of registration, lead to over-employment in agriculture and under-employment in the urban non-agricultural sector, whereas the rural non-agricultural sector is subject to a negative influence from the land policy and positive from the social subsidies, which might offset each other. The land distortions arise from the fact that the absence of tenure guarantees, which in its extreme form is summarized by the statement "use it or lose it", lead (endogenously in our paper) to imperfect rental markets, with a market-clearing rental rate below the marginal product of land. In the comparison of migrant incomes from rural and urban activities this leads to a discount on the effective income in urban activities by up to 50% (when compared to an efficient rental market), which is the reason that migrants under-estimate the social benefits from migration.[26] This inefficiency can be corrected by guaranteeing the security of tenure

---

[26]Of course, this claim has a dual, as summarized in our introduction, according to which farmers under-estimate the opportunity cost of land.

to farmers. Extending full entitlement to social services to migrants (the "floating workers") corrects the distortions due to the local entitlement restrictions of social transfers.

Our results are derived from a model that has strong qualitative implications and quantitative properties that depend on a small number of parameters. We show that land policy is the main channel through which the *hukou* system distorts both urbanization and industrialization. The social subsidies are small by comparison, and although they have an impact on urbanization and the growth of rural enterprises, their impact on industrialization is less. Generalizing from our findings, we would argue that the absence of efficient rental markets discourages the growth of large agricultural enterprises and reduces the incentives to mechanize agriculture, which is a current problem in China (World Bank, 2014).

References

[1] Adamopoulos, Tasso, Loren Brandt, Jessica Leight, and Diego Restuccia (2017). "Misallocation, Selection, and Productivity: A Quantitative Analysis with Panel Data from China." Working Paper, University of Toronto.

[2] Au, Chun-Chung and J. Vernon Henderson (2006). "How Migration Restrictions Limit Agglomeration and Productivity in China." *Journal of Development Economics*, 80(2), 350–388.

[3] Beegle, Kathleen, Joachim De Weerdt, and Stefan Dercon (2011). "Migration and Economic Mobility in Tanzania: Evidence from a Tracking Survey." *The Review of Economics and Statistics*, 93(3), 1010–1033.

[4] Brandt, Loren, Jikun Huang, Li Guo, and Scott Rozelle (2002). "Land Rights in China: Facts, Fictions, and Issues." *The China Journal*, 47(1), 67–97.

[5] Brandt, L., S. Rozelle, and M. A. Turner (2004). "Local Government Behavior and Property Right Formation in Rural China." *Journal of Institutional and Theoretical Economics*, 160(4), 627–662.

[6] Brandt, Loren, Chang-tai Hsieh, and Xiaodong Zhu (2008). "Growth and Structural Transformation in China." In *China's Great Economic Transformation*, edited by Loren Brandt and Thomas G. Rawski. Cambridge University Press.

[7] Brandt, Loren and Xiaodong Zhu (2010). "Accounting for China's Growth." Working Papers tecipa-394, University of Toronto.

[8] Brandt, Loren, Susan H. Whiting, Linxiu Zhang, and Tonglong Zhang (2017). "Changing Property-Rights Regimes: A Study of Rural Land Tenure in China." *The China Quarterly*, 1–24.

[9] 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.

[10] Caselli, Francesco and Wilbur John Coleman (2001). "The U.S. Structural Transformation and Regional Convergence: A Reinterpretation." *Journal of Political Economy*, 109(3), 584–616.

[11] Chan, Kam Wing and Will Buckingham (2008). "Is China Abolishing the *Hukou* System?" *The China Quarterly*, 195, 582–606.

[12] Chan, Kam Wing (2009). "The Chinese *Hukou* System at 50." *Eurasian Geography and Economics*, 50(2), 197–221.

[13] Chan, Kam Wing (2012). "Crossing the 50 Percent Population Rubicon: Can China Urbanize to Prosperity?" *Eurasian Geography and Economics*, 53(1), 63–86.

[14] Deininger, Klaus and Songqing Jin (2005). "The Potential of Land Markets in the Process of Economic Development: Evidence from China." *Journal of Development Economics*, 78(1), 241–270.

[15] Deininger, Klaus and Songqing Jin (2009). "Securing Property Rights in Transition: Lessons from Implementation of China's Rural Land Contracting Law." *Journal of Economic Behavior and Organization*, 70(1-2), 22–38.

[16] Deininger, Klaus, Songqing Jin, Fang Xia, and Jikun Huang (2014). "Moving Off the Farm: Land Institutions to Facilitate Structural Transformation and Agricultural Productivity Growth in China." *World Development*, 59, 505–520.

[17] Dekle, Robert and Guillaume Vandenbroucke (2012). "A Quantitative Analysis of China's Structural Transformation." *Journal of Economic Dynamics and Control*, 36, 119–135.

[18] Démurger, Sylvie, Marc Gurgand, Shi Li and Yue Ximing (2009). "Migrants as second-class workers in urban China? A decomposition analysis." *Journal of Comparative Economics*, 37(4), 610–628.

[19] Fan, C. Cindy (2008). "Migration, Hukou, and the Chinese City." In *China Urbanizes: Consequences, Strategies, and Policies*, edited by Shahid Yusuf and Anthony Saich. Washington, D.C.: World Bank.

[20] Feng, Lei, Helen X.H. Bao, and Y. Jiang (2014). "Land Reallocation Reform in Rural China: A Behavioral Economics Perspective." *Land Use Policy*, 41, 246–259.

[21] Frijters, Paul, Sherry Tao Kong, and Xin Meng (2011). "Migrant Entrepreneurs and Credit Constraints under Labour Market Discrimination." IZA Discussion Papers 5967.

[22] Fuglie, K. and N. Rada (2015) ERS Data Product: International Agricultural Productivity. Economic Research Service, U.S. Department of Agriculture, Washington, DC.

[23] Gollin, Douglas, Stephen Parente, and Richard Rogerson (2007). "The Food Problem and the Evolution of International Income Levels." *Journal of Monetary Economics*, 54, 1230–1255.

[24] Gollin, Douglas, David Lagakos, and Michael E. Waugh (2014). "The Agricultural Productivity Gap." *Quarterly Journal of Economics*, 129(2), 939–993.

[25] Hayashi, Fumio and Edward C. Prescott (2008). "The Depressing Effect of Agricultural Institutions on the Prewar Japanese Economy." *Journal of Political Economy*, 116(4), 573–632.

[26] Holz, Carsten (2006). "Measuring Chinese Productivity Growth, 1952–2005." Mimeo. Hong Kong University of Science and Technology.

[27] Jin, Songqing and Klaus Deininger (2009). "Land Rental Markets in the Process of Rural Structural Transformation: Productivity and Equity Impacts from China." *Journal of Comparative Economics*, 37(4), 629–646.

[28] Kimura, Shingo, Keijiro Otsuka, Tetushi Sonobe, and Scott Rozelle (2011). "Efficiency of Land Allocation through Tenancy Markets: Evidence from China." *Economic Development and Cultural Change,* 59(3), 485–510.

[29] Kung, James K.S. (1995). "Equal Entitlement versus Tenure Security under a Regime of Collective Property Rights: Peasants' Preference for Institutions in Post-Reform Chinese Agriculture." *Journal of Comparative Economics,* 21(2), 82–111.

[30] Kung, James K.S. and Shouying Liu (1997). "Farmers' Preference Regarding Ownership and Land Tenure in Post-Mao China: Unexpected Evidence from Eight Counties." *The China Journal*, 38(2): 33–63.

[31] Kuznets, Simon (1966). *Modern Economic Growth, Rate, Structure and Spread.* New Haven: Yale University Press.

[32] Li, Jun, Yanfeng Gu, and Chuncen Zhang (2015). "*Hukou*-based Stratification in Urban China's Segmented Economy." *Chinese Sociological Review*, 47(2), 154–176.

[33] Li, Ping J.D. (2003). "Rural Land Tenure Reforms in China: Issues, Regulations and Prospects for Additional Reform." *Journal of Land Reform, Land Settlement and Cooperatives*, special edition (3), 59–72.

[34] Liao, Pei-Ju, Ping Wang, Yin-Chi Wang, and Chong Kee Yip (2016). "To Stay or to Migrate? The One-child Policy, Land Tenure Arrangement and Work-based Migration in China." Mimeo, The Chinese University of Hong Kong.

[35] Lin, Justin Yifu (1989). "Rural Factors Markets in China after the Household Responsibility System Reform." In *Chinese Economic Policy: Economic Reform at Midstream*, edited by Bruce Reynolds, New York: Paragon.

[36] Meng, Xin (2014). "Rural-Urban Migration in China." In *The Oxford Companion to the Economics of China*, edited by Shenggen Fan, Ravi Kanbur, Shang-Jin Wei, and Xiaobo Zhang. Oxford University Press.

[37] 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.

[38] Mullan, Katrina, Pauline Grosjean, and Andreas Kontoleon (2011). "Land Tenure Arrangements and Rural–Urban Migration in China." *World Development*, 39(1), 123–133.

[39] Munshi, Kaivan and Mark Rosenzweig (2016). "Networks and Misallocation: Insurance, Migration, and the Rural-Urban Wage Gap." *American Economic Review*, 106(1), 46–98.

[40] Ngai, L. Rachel (2004). "Barriers and the Transition to Modern Growth." *Journal of Monetary Economics*, 51(7), 1353–1383.

[41] Pan, Jiahua and Houkai Wei (2013). *Annual Report on Urban Development in China.* Berlin: Springer-Verlag.

[42] Prosterman, Roy, Keliang Zhu, Jianping Ye, and Jeffery Riedinger (2011). "Farmers' Land Rights in Today's China: From a Seventeen-Province Survey." In *Annual Report on China's Rule of Law*, edited by Li Lin, China Academy of Social Sciences, Beijing: China Social Academic Press.

[43] Tao, Ran and Zhigang Xu (2007). "Urbanization, Rural Land System and Social Security for Migrants in China." *The Journal of Development Studies*, 43(7), 1301–1320.

[44] Tombe, Trevor and Xiaodong Zhu (2017). "Trade, Migration and Productivity: A Quantitative Analysis of China." Working Papers tecipa-542, University of Toronto.

[45] Vollrath, Dietrich (2009). "How Important are Dual Economy Effects for Aggregate Productivity?" *Journal of Development Economics*, 88(2), 325–334.

[46] Wang, Hui, Jeffrey Riedinger, and Songqing Jin (2015). "Land Documents, Tenure Security and Land Rental Development: Panel Evidence from China." *China Economic Review*, 36, 220-235.

[47] World Bank (2014). *Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization.* Washington, D.C.: World Bank.

[48] Yang, D. T. (1997). "China's Land Arrangements and Rural Labor Mobility." *China Economic Review*, 8(2), 101–15.

[49] Young, Alwyn (2003). "Gold into Base Metal: Productivity Growth in the People's Republic of China during the Reform Period." *Journal of Political Economy,* 101(6), 1220–1261.

[50] Zhu, Keliang, Roy Prosterman, Jianping Ye, Ping Li, Jeffery Riedinger, and Yiwen Ouyang (2006). "The Rural Land Question in China: Analysis and Recommendations Based on a Seventeen-Province Survey." *New York University Journal of International Law and Politics*, 38(4), 761–839.

[51] Zhu, Keliang and Roy Prosterman (2007). "Securing Land Rights for Chinese Farmers: A Leap Forward for Stability and Growth." Cato Development Policy Analysis Series, No. 3.

7 Appendix

7.1 Equilibrium in three sectors with government subsidies

The market clearing condition for non-agricultural goods is:

$$A_j n_j = h_u c_j^u + n_a c_j^a + n_r c_j^r + m c_j^m; \quad j = r, u \tag{45}$$

and for agricultural goods, using (12):

$$A_a l^{1-\beta} n_a^\beta = h_u c_a^u + n_a c_a^a + n_r c_j^r + m c_a^m. \tag{46}$$

We first derive the employment allocation across rural and urban non-agriculture. Aggregating the MRS condition (27) with the weight of each type of consumer and making use of the market clearing condition (45) for $j = r, u$, we obtain:

$$A_r n_r = \left(\frac{\psi}{1-\psi} \frac{p_u}{p_r} \right)^\eta A_u n_u, \tag{47}$$

Substituting the relative price of the two goods from (33) into the aggregate MRS condition (47), we obtain the relative size of the rural to the urban non-agricultural employment share:

$$\frac{n_r}{n_u} = \left(\frac{\psi}{1-\psi} \right)^\eta \left(\frac{A_r}{A_u} \right)^{\eta-1} (1 - h_u s_u)^{-\eta} \equiv X \sigma^{-\eta}. \tag{48}$$

By definition, $n_r + n_u = 1 - n_a$, which yields the rural and urban non-agricultural employment shares in (34).

Turning now to the allocations across agriculture and non-agriculture, we can rearrange (26) to:

$$\frac{c_a^i - \bar{c}_a}{c_u^i} = \frac{\omega}{1-\omega} \frac{p_u}{p_a} \left(1 + \frac{\psi}{1-\psi} \left(\frac{c_r^i}{c_u^i} \right)^{\frac{\eta-1}{\eta}} \right), \tag{49}$$

substituting (27),

$$c_a^i - \bar{c}_a = \frac{\omega}{1-\omega} \frac{p_u}{p_a} \left(1 + \left(\frac{\psi}{1-\psi} \right)^\eta \left(\frac{p_u}{p_r} \right)^{(\eta-1)} \right) c_u^i. \tag{50}$$

Aggregating it with the weight of each type of consumer and making use of the market clearing conditions (46) and (45):

$$A_a l^{1-\beta} n_a^\beta - \bar{c}_a = \frac{\omega}{1-\omega} \frac{p_u}{p_a} \left(1 + \left(\frac{\psi}{1-\psi} \right)^\eta \left(\frac{p_u}{p_r} \right)^{(\eta-1)} \right) A_u n_u. \tag{51}$$

Substituting relative prices from (32), we obtain,

$$A_a l^{1-\beta} n_a^{\beta} - \bar{c}_a = \frac{\omega}{1-\omega} \left(\frac{\beta A_a (l/n_a)^{1-\beta}}{\pi \sigma} \right) \left(1 + \left(\frac{\psi}{1-\psi} \right)^{\eta} \left(\frac{A_r}{\sigma A_u} \right)^{(\eta-1)} \right) n_u. \quad (52)$$

substituting n_u from (34) and using definition of X in (48):

$$n_a \left(1 - \frac{\bar{c}_a}{A_a l^{1-\beta} n_a^{\beta}} \right) = \frac{\omega}{1-\omega} \left(\frac{\beta}{\pi \sigma} \right) \left(1 + X \sigma^{1-\eta} \right) \frac{1 - n_a}{1 + X \sigma^{-\eta}}. \quad (53)$$

Rearrange to obtain the equilibrium condition for the agriculture employment share in (36).

7.2 Planner's problem

The planner's problem is to choose labour and land allocation to maximize the utility of a representative agent subject to the production technologies

$$\max_{n_a, n_r, n_u, l_a} U = (c_a - \bar{c}_a)^{\omega} \left[\psi c_r^{\frac{\eta-1}{\eta}} + (1-\psi) c_u^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta(1-\omega)}{\eta-1}}; \quad s.t.$$

$$c_a = n_a \left(A_a l_a^{1-\beta} \right); \quad c_j = A_j n_j; \quad j = r, n$$

$$n_a l_a \leq l$$

$$n_a + n_r + n_u \leq 1$$

As land is only used in agriculture, it must be that $l_a = l/n_a$. Thus the problem is transformed to choosing labour allocation to solve:

$$\max_{n_a, n_r, n_u, l_a} U = (c_a - \bar{c}_a)^{\omega} \left[\psi c_r^{\frac{\eta-1}{\eta}} + (1-\psi) c_u^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta(1-\omega)}{\eta-1}}; \quad s.t.$$

$$c_a = A_a n_a^{\beta} l^{1-\beta}; \quad c_j = A_j n_j; \quad j = r, u$$

$$n_a + n_r + n_u \leq 1$$

Let ξ be the corresponding multiplier for the labour resource constraint. The optimality conditions imply:

$$\frac{\partial U}{\partial c_j} \left(\frac{\partial c_j}{\partial n_j} \right) = \xi \quad j = a, r, u, \quad (54)$$

which states that the value of marginal product of labour must be equalized across all sectors. Equation (54) together with the production functions can be used to derive the optimal employment allocations.

Across sectors r and u,

$$\frac{c_r}{c_u} = \left(\frac{\psi}{1-\psi}\right)^{\eta}\left(\frac{A_r}{A_u}\right)^{\eta}. \tag{55}$$

Substituting the production technologies, we derive,

$$\frac{n_r}{n_u} = \left(\frac{\psi}{1-\psi}\right)^{\eta}\left(\frac{A_u}{A_r}\right)^{1-\eta} \equiv X, \tag{56}$$

which together with the labour resource constraint imply the employment allocations in (38).

Across sectors a and u,

$$\frac{\omega}{c_a - \bar{c}_a}\left(\frac{\beta c_a}{n_a}\right) = \frac{(1-\omega)(1-\psi)\left[\psi\left(\frac{c_r}{c_u}\right)^{\frac{\eta-1}{\eta}} + (1-\psi)\right]^{\frac{1}{\eta-1}}}{\left[\psi c_r^{\frac{\eta-1}{\eta}} + (1-\psi)c_u^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}}A_u, \tag{57}$$

which simplifies to

$$\frac{\omega}{c_a - \bar{c}_a}\left(\frac{\beta c_a}{n_a}\right) = \frac{(1-\omega)(1-\psi)}{c_u\left[\psi\left(\frac{c_r}{c_u}\right)^{\frac{\eta-1}{\eta}} + (1-\psi)\right]}A_u, \tag{58}$$

together with (55) and the production function for c_u, we obtain:

$$\frac{\omega}{1-\omega}\frac{\beta}{n_a} = \left(1 - \frac{\bar{c}_a}{c_a}\right)\left(\frac{1}{n_u(1+X)}\right). \tag{59}$$

Finally substituting the production function for c_a and equilibrium n_u in (38) we obtain the equilibrium condition for agriculture employment share in (39).

7.3 Constructing s_u

We obtained data for social spending in urban areas as a percentage of non-agricultural value added (denoted Z_u below). The model requires s_u, social spending as a percentage of urban value added, and we explain here how it can be computed in the model's equilibrium.

Social spending as a percentage of non-agricultural value added is defined by

$$\begin{aligned}
Z_u &\equiv \frac{s_u p_u y_u}{p_u y_u + p_r y_r} \\
&= \frac{s_u}{1 + p_r y_r / p_u y_u}. \tag{60}
\end{aligned}$$

From (33), we get,

$$
\begin{aligned}
p_r A_r &= (1 - h_u s_u) p_u A_u \\
\frac{p_r y_r}{n_r} &= (1 - h_u s_u) \frac{p_u y_u}{n_u} \\
\frac{p_r y_r}{p_u y_u} &= (1 - h_u s_u) \frac{n_r}{n_u}.
\end{aligned}
\tag{61}
$$

Substitution from (61) into (60) yields,

$$
Z_u = \frac{s_u}{1 + (1 - h_u s_u) n_r / n_u}
\tag{62}
$$

Formula (62) contains observables except for the unknown s_u and we use it to compute the time series for s_u.

7.4   Computing the efficient allocation

Given a value for $\bar{c}_a / y_a$ in a given year, we use (36) to compute the implied preference parameter ω for that year, from the rearranged equation:

$$
\frac{\omega}{1 - \omega} = \left(1 - \frac{\bar{c}_a}{y_a} \right) \left(\frac{n_a}{1 - n_a} \right) \left(\frac{\pi}{\beta} \right) \frac{\sigma + X \sigma^{1-\eta}}{1 + X \sigma^{1-\eta}}.
\tag{63}
$$

The parameter ω derived from this is assumed to hold in all years in the sample, being a fixed preference parameter. Given ω, rearranging (63) once again and using subscript t for a year in our sample, we obtain a time series for $\bar{c}_a / y_a$:

$$
\left(\frac{\bar{c}_a}{y_a} \right)_t = 1 - \left(\frac{\omega}{1 - \omega} \right) \frac{1 - n_{at}}{n_{at}} \left(\frac{\beta}{\pi} \right) \frac{1 + X \sigma^{1-\eta}}{\sigma + X \sigma^{1-\eta}}.
\tag{64}
$$

Together with (41), we can use (40) to compute n_{at}^* for any observed agriculture employment share n_{at} and a given value of λ.

7.5   Model with other labour market wedges

Wages in non-agricultural sectors are $w_j = \mu p_j A_j$, $j = r, u$, so the migration conditions across agriculture and rural non-agriculture in (28) become,

$$
\left[1 - \lambda \left(1 - \beta \right) \right] p_a A_a \left(l / n_a \right)^{1-\beta} = \mu p_r A_r,
\tag{65}
$$

which, making use of the π notation, immediately gives the first equality of (42).

The mobility condition across rural non-agriculture and urban non-agriculture is

$$
\mu p_r A_r + p_r s_r y_r - T_r = \mu p_u A_u - T_u.
\tag{66}
$$

The urban employment share is still $(h_u + m)$ so the government budget constraints are the same as in (30) and (31). Substitution of those into (66) gives the second equality in (42). Finally, employment shares (43) and (44) follow from substituting the mobility condition (42) into the aggregate MRS conditions (47) and (51).

The non-agricultural labour productivity implied by the model is

$$NAP = \frac{p_r A_r n_r + p_u A_u n_u}{n_r + n_u} = \frac{n_r/n_u + (1 - h_u s_u/\mu)^{-1}}{n_r/n_u + 1} p_r A_r, \qquad (67)$$

where the last equality follows from the migration condition across sectors r and u in (42). Thus, the ratio of labour productivity across agricultural and non-agricultural production, making use of the mobility condition (42), becomes:

$$\frac{NAP}{AP} = \frac{n_r/n_u + (1 - h_u s_u/\mu)^{-1}}{n_r/n_u + 1} \left(\frac{\beta}{\mu \pi} \right), \qquad (68)$$

which implies an unique value of μ given data on $(NAP/AP, n_r/n_u)$ and parameters $(\beta, \lambda, h_u s_u)$, all of which are observable.

7.6 Data

The employment shares (n_a, n_r, n_u) are from Brandt and Zhu (2010). The nominal value-added of non-agriculture $(p_n y_n)$ is the sum of secondary and tertiary nominal value-added reported by the NBS. The share of urban *hukou* h_u is from Chan (2012), who compiled the number from *Chinese Statistical Yearbooks* and *China Population Statistical yearbooks*. It is available from 1970 to 2000 at five-year intervals, then annually from 2001 to 2010.

The social spending data are constructed using a large number of official sources including *Educational Statistical Yearbook of China*, *China Health Statistical Yearbook*, Ministry of Finance (MOF) webpage, *Finance Yearbook of China*, *China Civil Affairs' Statistical Yearbook* and *China Statistical Yearbook*. We include all social service costs related to *hukou* (World Bank 2014, chapter 3) including education, health care services, pensions, and other social assistance programs (e.g., basic living subsidies). We collected detailed data of government spending for urban and rural areas respectively. The main components are:

Education – This corresponds to the category "Government Appropriation for Education" from the *Educational Statistical Yearbook of China*. For the rural education we included only the spending for 9 years of compulsory education and we derived the urban education spending by subtracting the rural spending from the total government spending on education.

Health – The data are from the *China Health Statistical Yearbook*. The total government spending on health is the fiscal budget appropriation for health from governments at all levels. However, we only have separate data for rural and urban areas on total health spending, which includes altogether the spending from the government, social entities and individuals. We therefore assume that the distribution of rural and urban spending is the same in total health spending and in government health spending.

Pensions – For rural areas, this variable denotes the government subsidies on the New Rural Pension System (for rural residents) from the MOF webpage. For urban areas, it denotes the government subsidies on the Urban Enterprise Basic Pension Insurance (for workers with urban *hukou*) and Urban Residents Social Pension Insurance (for non-employed residents with urban *hukou*), from the *Finance yearbook of China* and *MOF Webpage*.

Other Urban Welfare – This is government spending on Unemployment Insurance, Work Injury Insurance and Maternity Insurance, which local urban *hukou* employees are eligible for. The data are extracted from the *Finance yearbook of China* and MOF webpage.

Basic Living Subsidies – This variable includes basic living standard subsidies for urban and rural areas, from the *China Civil Affairs' Statistical Yearbook*.

Figure 1. Employment Allocations in China

Figure 1. Employment allocations
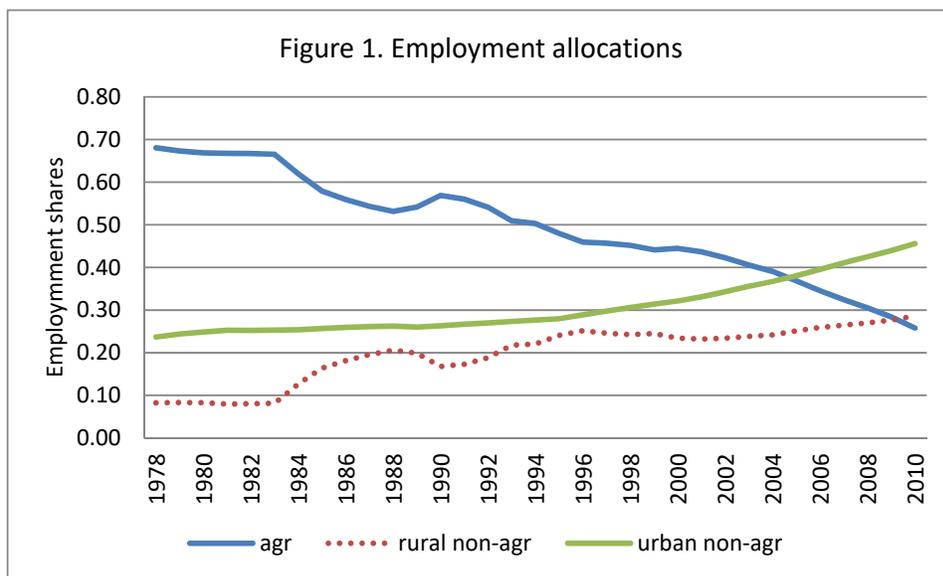
Source: Brandt and Zhu (2010).

Notes: Figure 1 presents employment shares of the agricultural sector and the non-agricultural sector, with the non-agricultural sector divided into rural non-agricultural and the urban non-agricultural sectors.

Figure 2 Agricultural employment with migration and an imperfect rental market
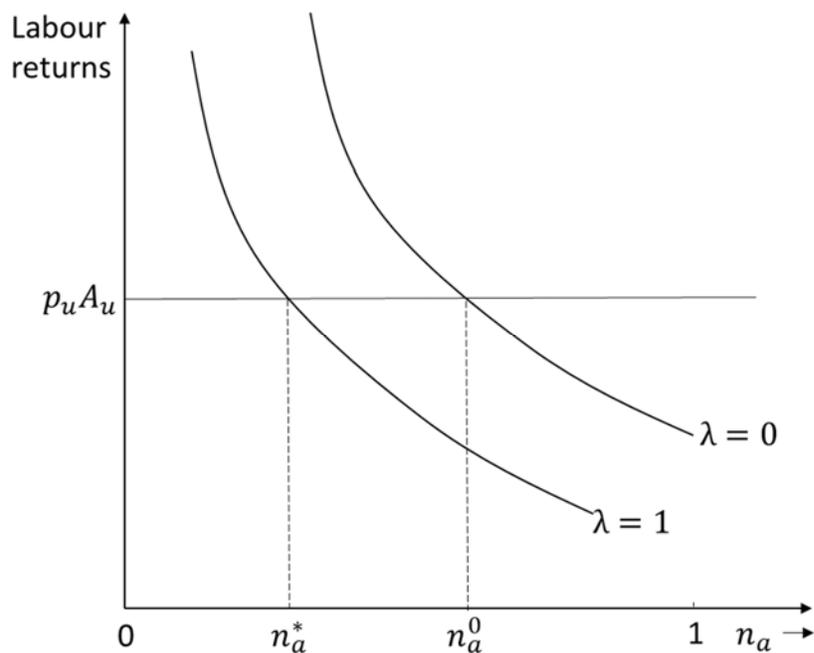
Table 1: Impact of Policy on Industrialization and Urbanization

year		Land policy λ	Subsidy (%) s_u	Income loss (%) $1-\pi\sigma$	Agriculture (%) n_a	Urban non-agriculture (%) n_u	Rural non-agriculture (%) n_r
1998	efficient	1	0	0.0	37.1	35.4	27.5
	land policy	0	0	49.0	+7.9	-4.5	-3.4
h_u=25%	full policy	0	4.5	49.6	+8.0	-4.8	-3.2
2004	efficient	1	0	0.0	32.1	41.5	26.4
	land policy	0.2	0	43.5	+6.9	-4.2	-2.7
h_u =30%	full policy	0.2	5.5	44.4	+7.0	-4.8	-2.2
2010	efficient	1	0	0.0	21.8	49.0	29.2
	land policy	0.6	0	27.8	+3.8	-2.4	-1.4
h_u=34%	full policy	0.6	7.4	29.6	+4.0	-3.4	-0.6

Table 2: Impact of Policy in the presence of other labour market distortions

year		Policy income loss (%) $1-\pi(1-\frac{1-\sigma}{\mu})$	Agriculture (%) n_a	Urban non-agriculture (%) n_u	Rural non-agriculture (%) n_r	Productivity Ratio NAP/AP
1998	constrained-efficient	0.0	38.6	35.5	25.9	1.9
μ=0.26	land policy	49.0	+6.2	-3.6	-2.6	3.8
	full policy	51.2	+6.5	-4.9	-1.6	3.9
2004	constrained-efficient	0.0	32.4	43.2	24.4	2.2
μ=0.23	land policy	43.5	+6.1	-3.9	-2.2	4.0
	full policy	47.5	+6.7	-6.4	-0.3	4.1
2010	constrained-efficient	0.0	21.8	52.0	26.2	2.1
μ=0.24	land policy	27.8	+3.3	-2.2	-1.1	2.9
	full policy	35.3	+4.0	-6.5	+2.5	3.1

Note: λ, h_u and s_u take the same values as in Table 1. Policy income loss is the percentage of implicit income loss relative to the second-best. Productivity ratio is the ratio of nominal labour productivity in non-agriculture (NAP) to agriculture (AP).