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Harnessing the Forces of Urban Expansion - The Public Economics of Farmland Development Allowance

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Abstract

For decades, rapid urban expansion has led to concerns over the loss of cultivated land in rural China. This contrasts sharply with another salient feature of the Chinese land policy reform landscape that has gone on largely unnoticed - the addition of newly cultivated land in China through land development has consistently exceeded land conversion. In a model featuring fiscal decentralization, local governments as custodians of land use and development, along with a land development allowance policy instituted in 1998, we show that a land development allowance policy can harness the forces of urban expansion to encourage agricultural land development.

JEL Classification: H11, H77, P35, R5, R14, O18

Keywords: land development allowance, fiscal decentralization, inter-jurisdictional competition, agricultural development.

"[The Ministry of Land and Resources] figures show China added 2.4 million hectares of arable land between 1999 and 2006. Over the past seven years, the area of newly added arable land has proved to be greater than the land made available for construction projects, benefiting more than 12 million farmers." (China Daily, June 22, 2007)

1 Introduction

In both developed and developing economies, the preservation and development of arable land resources is a policy issue of prime importance. The debate brings together diverse interests going from the driving forces of urban expansion on one hand, to proponents of the need for self sufficiency in food production for example. The need for government policy interventions is typically justified on the grounds of market failure, where market price of land fail to reflect collective benefits associated with arable land preservation and development, including both market and non-market services provided (Coase 1960, Gardner 1977, Lopez et al 1994). This earlier literature presumes that property rights over land is privately held, and the need for market-based government policies through taxes and subsidies, or explicit zoning legislations, for example, have been extensively studied based on this critical assumption.

An altogether different system of land resource stewardship applies in economies where land is public property. The case of China is a prime example where urban land ownership resides with the state,[1] while rural and suburban land areas are owned by collectives (Lin and Ho 2005). Subsequent to governance reforms in the 1990's and the devolution of fiscal responsibility and authorities (Qian and Roland 1998, Zhang and Zhou 1998 Lin and Liu 2001, Jin, Qian and Weingast 2005), local governments have increasingly taken on the role of land developers (Lichtenberg and Ding 2009), responsible both for the allocation and development of arable land, as well as land conversion decisions (Bao et al. 2004). In terms of agency and incentives, therefore, the analytics of the Chinese case requires a shift in focus from private individuals and enterprises to local governments, and from market prices to the fiscal pressures facing local governments.[2]

Importantly, the transfer of land allocation and land development authority to local governments has the potential of introducing a brand new set of inter-jurisdictional strategic considerations, hitherto under-appreciated in two areas of active research: fiscal federalism, and land policy reforms in the face of forces driving urban expansion.[3] Specifically, incentives that guide inter-jurisdictional competition for mobile inputs made possible by fiscal decentralization (Tiebout 1956, Stigler 1957) can spill over to affect

land conversion and development decisions at the jurisdictional level,[4] as land resources are of course key to urban development and to attract mobile capital (Zhang 2007). Meanwhile, centrally mandated land policy reforms can impact the fiscal capabilities of local governments, by framing their incentives to allocate existing land between agriculture or non-agriculture, and to invest in the enrichment of existing land resources.

At least as first pass, the importance of these strategic considerations will depend largely on two sets of issues. To start, in the face of footloose industries, how salient really is the relationship between capital inflow and land conversion to non-agricultural uses? To this end, evidence in Zhang, Mount and Boisvert (2004) reveals that upon controlling for other relevant factors, arable area is indeed inversely related to the degree of industrialization in China at the provincial level. Second, to what extent are local governments in fact incentivized to channel socially excessive levels of local resources to favor non-agricultural as opposed to agricultural production? In this regard, Huang, Lin and Rozelle (2002) shows that through government procurement and a system of centrally mandated implicit taxes on agriculture and rebates particularly for export industries, a total of 563 billion yuan was extracted from the agricultural sector to support the nation's development process in the period between 1978 - 1996. These evidence point to the intimate relationship between urban land use and industrialization at the local level, and the potential (local-level) perceived bias against agriculture that arise due to a centrally mandated system of taxes and transfers.

Taken together, these observations make it all the more striking that between 1999 and 2006, the addition of new cultivated land in China reached a total of 3.5 million hectares – an amount *greater* than land approved for use in construction projects, while during the same time period, the total stock of arable land has declined from 129 million to 122 million hectares. Table 1 illustrates. As shown, while land conversion has indeed contributed to the net decline in the total stock of cultivated land in China, this contribution relative to total land loss has been relatively minor, and never higher than 25% for each year between 1999 - 2006. Other sources of land loss include ecological preservation, natural hazards, and agricultural reorganization. An overwhelming majority of the additions to cultivated land due to land consolidation originate from local government projects. Between 2003 - 2006, for example, cultivated land addition due to central government projects constituted only 15% (0.19 out of 1.27 million hectares) of the total (China Land and Resources Yearbook 2004-2008).

Furthermore, it bears emphasis that land development entails real resource cost.[5] In Table 2, we

present provincial data on land consolidation, reclamation and rehabilitation in the year 2000, as well as the investment cost of these activities. Against the cost of land development, Wu, Liu and Davis (2005) employed a production function approach to empirically estimate the productivity impact of land consolidation projects in China. Based on data from 227 Chinese farm households in the context of the Comprehensive Agricultural Development Program, the study confirms the cost effectiveness of land consolidation projects via a significant increase in crop output.

Without a deeper understanding of the Chinese farmland preservation policy landscape, these observations on the volume and effectiveness of land development activities may appear to run contrary to expectations, particularly in view of the competition for mobile capital unleashed subsequent to fiscal decentralization, and the aforementioned bias in favor of non-agricultural production implicit in China's system of procurement, taxes and rebates. In this paper, we explore the economic rationale of Chinese farmland protection policies, in the context of a generalized policy of land development allowance (*tudi zhengli zhedi zhibiao*) that has so far received very little attention in economic analysis of farmland preservation and land development.[6] In doing so, we bring together three sets of contributing factors: (i) local government as custodian of land allocation and the importance of land revenue as a source of fiscal revenue at the local level, (ii) inter-jurisdictional competition for mobile capital inputs, and (iii) incomplete fiscal decentralization characterized by imperfect revenue retention and an implicit tax on agriculture.

2 Law of Land Administration and Farmland Protection in China

We begin with a discussion of two central issues surrounding the incentives that govern farmland protection in China: (i) national legislation governing land use allocation, and (ii) the role of land revenue in local public finance.

The Law of Land Administration is the first piece of comprehensive land legislation enacted in China in 1986, and amended in 1998 with specific emphasis on farmland protection. In compliance with the Constitution, the legislation is founded on the public ownership of land either by the state or by collectives, a comprehensive system of land use control through centrally mandated annual quotas that restricts the rate of land conversion, and the establishment of a Department of Land Administration responsible for monitoring and investigation.

At the national level, land use allocation is governed by a comprehensive system of land use planning quota authorized by the State Council. For the period 1997 - 2010, these national level quotas are shown in Table 3. In principle, from mandates at the national level to actual allocation at the township level, national quotas are supposed to translate to use restrictions linked to specific plots and land use zones. However, a comparison between Tables 1 and 3 quickly reveals that already by 2002, the actual stock of cultivated land (126.85 million hectares) is below the national quota of at least 128 million hectares of reserved cultivated land mandated for 2010.

In order to provide targeted measures to encourage the protection of cultivated land, the legislation requires that the occupation of cultivated land for non-agricultural purposes should be replaced by the addition of new cultivated land through land development via reclamation, consolidation / rehabilitation. In addition, Article 18 of The Regulations on the Implementation of the Land Administration Law provided for the first time an official land development allowance policy, by stipulating that:[7]

> "People's governments at all local levels should, pursuant to the comprehensive land use planning, take measures to press ahead with land consolidation. Sixty percent of the area of the newly-added cultivated land through land consolidation can be used as compensation quotas for cultivated land occupied for construction."

At the provincial level, similar policies have been put in place. In Zhejiang province, for example, the 1998 Notice on Encouraging Rural Land Consolidation stipulates that 72% of the total areas of added effective cultivation can be used for approved infrastructure, core village, small town and industrial district.

This land development allowance policy specifically aligns the amount of newly added land for cultivation with the size of the land conversion quota applicable for any local level government.[8] As such, rather than traditional monetary incentives through taxes and subsidies, the land development allowance policy provide in-kind benefits in the form of land conversion quotas to reward farmland preservation activities at the local level.

The legislation also lays out clearly the terms under which local government can requisition, transfer, or assign land use right. The expropriation of cultivated land over 35 hectares for construction is subject to State Council review. Local governments are required to pay compensation to former occupants at a rate 6 to 10 times the average annual output of the expropriated land, in addition to a resettlement subsidy linked also to the value of output.[9] Land use right can be transferred for

commercial uses, and assignments should be subject to market forces through bid tendering, auctions, or listings.

For a quantitative picture of the importance of land administration policy on provincial public finance, we compiled a collection of basic statistics from the China Land and Resources Yearbook for the period 1999 - 2006. We note first and foremost that land revenue is a sizeable contributor to local extra-budgetary fiscal revenue. Revenue that local governments collect from the leasing and the transfer of land use rights for non-agricultural purposes is fully retained within the local government by law (Beijing Local Taxation Bureau 2003) as part of extra-budgetary revenue.[10] In Table 4, the importance respectively of extra-budgetary revenue as a share of total local financial revenue, and the net revenue from land lease as a share of total extra-budgetary revenue at the provincial level are shown. These shares vary widely across provinces, but on average, net revenue from land leases makes up almost a third of local extra-budgetary revenue at the provincial level. Meanwhile, extra-budgetary revenue constitutes a substantial part of total provincial revenue, at close to 50% averaged across year and province.

Importantly, despite the absence of a land market, the net unit revenue from government land lease, calculated as the per hectare net revenue collected from land lease at the provincial level, show signs that market forces are indeed in play in the assignment of land use right by local governments. To this end, Table 5 summarizes the average revenue from of land lease in 31 provinces of China over the period 1998 - 2006. The same information is plotted in Figure 1. As should be expected when market forces are in play, the price of land lease is positively associated with the relative size of the secondary and tertiary sectors. To control for other time varying factors that may have also contributed to the net unit revenue of land lease at the provincial level, Table 6 shows the estimates from a random effect regression that additionally controls for the share of the primary sector in GDP, the lagged value of GDP, population density and a time trend. As shown, these estimates are statistically significant and in accordance with expectation – the net unit revenue from of land lease rises with demand side factors such as industrialization and population density, after controlling for a time trend that is likewise positive and significant.[11]

These salient features of land resource governance and preservation in China will form the building blocks of the model of land development allowance policy in what follows.

3 The Model

We begin with a familiar two-tiered (center-local) structure of governance that features two characteristics (Oates 1972, Keen and Maurice 1996, Qian and Roland 1998): fiscal decentralization with imperfect tax revenue retention, and inter-jurisdictional competition for mobile capital. With incomplete fiscal decentralization, tax collected locally is only partially retained within the province, and otherwise repatriated to the central government to finance the provision of a national public good. With inter-jurisdictional competition, production capacity in each province depends critically on whether local governments can institute policies that attract mobile capital.

To this setup, our model introduces three additional features: (i) a dualistic structure of production activities including both agriculture and non-agriculture in each province, (ii) the possibility of costly conversion of agricultural land to augment non-agricultural production capacities and to attract capital inflow; and furthermore (iii) the possibility of costly addition of agricultural land through reclamation, consolidation and rehabilitation to augment agricultural production capacities.

The model will be examined in light of three distinctive policy regimes: (i) the first best regime representing the land development and land conversion choices of a benevolent central government, (ii) a decentralized regime where land development and land conversion decisions are made by local governments in the face of incomplete fiscal decentralization and competition for capital, and finally (iii) a land development allowance policy regime in which the central government set explicit guidelines linking land conversion quota to land development efforts at the provincial level.

The Composition of Provincial Production Activities

Consider M otherwise identical provinces, $i = 1, ..., M$. Each province is comprised of two types of production activities, referred to henceforth as agriculture (a) and non-agriculture (n). Accounting for all other inputs and costs of production, land use in agriculture $T_a^i \geq 0$ measured in efficiency units generates value added $A(T_a^i)$.[12] $A(T_a^i)$ is taken to satisfy standard properties, with $A(0) = 0$, and $A_T(T_a^i) > 0$ and $A_{TT}(T_a^i) < 0$. Non-agricultural land T_n^i and capital input jointly enable non-agricultural production activities, generating value added $N(K^i, T_n^i)$. $N(K^i, T_n^i)$ is strictly increasing and concave in both arguments, and $N_{KT}(K^i, T_n^i) > 0$.

All local governmental efforts (inclusive of land reclamation, land consolidation, and land rehabilitation) in amassing new and enriching existing land resources for agricultural use will be collectively

referred to in what follows as land development t_d^i. Let t_c^i denote the extent of the conversion of agricultural land to support non-agricultural production. Furthermore, let $\bar{T}_a$ and $\bar{T}_n$ be the initial stocks respectively of agricultural and non-agricultural land. We have therefore

$$\begin{aligned} T_n^i &= \bar{T}_n + t_c^i \\ T_a^i &= \bar{T}_a - t_c^i + t_d^i \end{aligned}$$

Thus, t_c^i reflects the net increase in non-agricultural land use, while $t_d^i - t_c^i$ reflects the net increase in agricultural land use. Rearranging terms,

$$t_c^i = T_n^i - \bar{T}_n \tag{1}$$

$$\begin{aligned} t_d^i &= T_a^i - \bar{T}_a + t_c^i \\ &= T_a^i + T_n^i - \bar{T}_a - \bar{T}_n \end{aligned} \tag{2}$$

It follows that in order for total land use $T_a^i + T_n^i$ to exceed the baseline level $\bar{T}_a + \bar{T}_n$ regardless of how the allocation is split between agriculture and non-agriculture, land development is indispensable $t_d^i \geq 0$.

We assume that the minimum cost schedule of land conversion $\gamma = \gamma(t_c^i)$ is strictly increasing and convex in the scale of land conversion with $\gamma(0)$.[13] Similarly, assume that the minimal cost schedule of land development $\delta = \delta(t_d^i)$ is strictly increasing and convex in the scale of land development with $\delta(0) = 0$. [14]

Fiscal Decentralization, Local Revenue and Expenditure

Both local and central governments balance their own budgets. At the local level, sources of revenue include (i) (distortionary) taxation of value added generated from production activities, (ii) land lease fees on non-agricultural enterprises that obtain land use rights, and (iii) all other sources of non-distortionary taxation levied in the province $\bar{r}^i$, or net transfers from the central government $\bar{R}^i$, both of which will be taken henceforth as given exogenously.

With two sectors (agriculture and non-agriculture) generating value added, total tax take at the local and the central levels depend on a variety of factors. First, the tax rate τ on value added is mandated by the central government. For the case of China, since the Provisional Regulation of the People's Republic of China on Value Added Tax in 1994, τ stood at 13% for agricultural products, while

export producing private enterprises receive full rebate on the value added tax so that τ is effectively zero (Su and Zhao 2004, Beijing Local Taxation Bureau 2003). Furthermore, as emphasized in Qian and Roland (1998), foreign firms are able to evade taxes in host countries by transfer pricing schemes. To highlight this dichotomy in the tax treatment and tax take on agricultural and non-agricultural production activities, we assume henceforth that the value added tax τ is strictly positive in agriculture and zero in non-agriculture.[15]

As a second source of revenue, local government levies land lease fees on the transfer of land use rights to non-agricultural enterprises.[16] As discussed, the Law of Land Administration of 1998 stipulates that these fees are expected to be market determined via bid tendering, auctions or listing, and the evidence shown in Section 2 also concurs. Accordingly, we let land lease fee per land unit be given by the marginal product $N_T(K^i, T_n^i)$ in each province i. Total revenue from the land lease in province i is thus $N_T(K^i, T_n^i)T_n^i$.

The assignment of tax revenue between the central government and the local governments is taken to follow a simple guiding principle (Su and Zhao 2004, Beijing Local Taxation Bureau 2003) – taxes that involve national interest or the macro economy are assigned to the central government (e.g. import tax); taxes pertaining to local economic activities come under the full control of sub-national governments (e.g. local level land lease fees), while value added tax is shared at a given rate determined by the central government. Accordingly, let ν be the share of local value added tax revenue retained by the province, and $1-\nu$ the share repatriated to the central government. ν parameterizes the extent of fiscal decentralization with $\nu = 1$ reflecting full fiscal decentralization and full tax revenue retention within each province. According to Beijing Local Taxation Bureau (2003), value added taxation revenue follows the sharing rule of 75% for the central government and 25% for local governments, or $\nu = 0.25$.

The revenue that a local government collects in province i is thus

$$B^i \equiv \tau\nu A(T_a^i) + N_T(K^i, T_n^i)T_n^i + \bar{r}^i + \bar{R}^i$$

while tax revenue of the central government include collections from all M provinces,

$$B \equiv \sum_{i=1}^{M} \tau(1-\nu)A(T_a^i) - \sum_{i}^{M} \bar{R}^i.$$

Budget balance at the local level requires:

$$B^i = \gamma(t_c^i) + \delta(t_d^i). \tag{3}$$

Budget balance at the central government level requires:

$$B = Z \tag{4}$$

where Z is a public good at the national level.

Inter-regional Competition for Capital

Capital is mobile across provinces. The marginal returns to capital in province i is given competitively by:

$$r^i = N_K(K^i, T_n^i).$$

The nation-wide aggregate stock of capital is $\bar{K}$. Arbitrage made possible by capital mobility implies that returns to capital are equalized across provinces, and thus for all i,

$$r^i = N_K(K^i, T_n^i) = r. \tag{5}$$

Assume henceforth that each province takes the nation-wide returns to capital, r, as given. Equation (5) illustrates the tight link between land allocated to non-agricultural uses in province i, and the ability of province i to attract foreign capital. In particular, let

$$K^i(T_n^i, r) = \{K^i | N_K(K^i, T_n^i) = r\}.$$

It is straightforward to check that an increase in T_n^i encourages capital inflow since $N_{KT}(K^i, T_n^i) > 0$, with elasticity

$$\eta = \frac{\partial \log K^i(T_n^i, r)}{\partial \log T_n^i}|_{rconst.} = -\frac{T_n^i N_{KT}(K^i, T_n^i)}{K^i N_{KK}(K^i, T_n^i)} > 0.$$

Finally, the economy-wide returns to capital r implicitly solves the following equality, which requires that the sum total $\sum_{i=1}^{M} K^i$ adds up to equal the size of the aggregate stock $\bar{K}$,

$$\sum_{i=1}^{M} K^i(T_n^i, r) = \bar{K}.$$

Each local government takes the structure of production, the fiscal contract between the provinces and the center, as well as the presence of inter-jurisdictional competition for capital as given. The objective of each local government in i is to maximize the welfare function W^i in i,[17] where

$$W^i(t_c^i, t_d^i) = \left[N(K^i(T_n^i, r), T_n^i) + (1-\tau)A(T_a^i) - N_T(K^i, T_n^i)T_n^i - \bar{r}^i\right] + U(Z) \tag{6}$$

subject to the budget constraint in (3). The first expression in square brackets indicates provincial level economic well-being, as given by the value added generated in i, $A(T_a^i) + N(K^i, T_n^i)$, net of taxes and land lease fees $\tau A(T_a^i) + N_T(K^i, T_n^i)T_n^i + \bar{r}^i$. $U(Z)$ denotes citizen benefits from a national level public good Z that the central government finances through central government tax revenue. The objective function of the central government is $W = \sum_{i=1}^{M} W^i$.

3.1 Nation-wide First Best Allocation

We begin our analysis by setting out a first-best baseline. From (4), the central government chooses capital allocation K^i, land use T_n^i and T_a^i in each i, along with public good provision Z to maximize W:

$$\max_{K^i, T_n^i, T_a^i, Z} \sum_{i=1}^{M} \left[N(K^i, T_n^i) + (1-\tau)A(T_a^i) - N_T(K^i, T_n^i)T_n^i - \bar{r}^i \right] + U(Z) \tag{7}$$

subject to the budget constraint that total (local plus central) government tax revenue equals total expenditure:

$$\sum_{i=1}^{M} B_i + B = \sum_{i=1}^{M} [\gamma(t_c^i) + \delta(t_d^i)] + Z \tag{8}$$

and $\sum_{i=1}^{M} K_i = \bar{K}$. Let a superscript "$o$" denote these first-best outcomes. (7) and (8) together implies that the central government's maximization problem is simply:

$$\max_{K^i, T_n^i, T_a^i, Z} \sum_{i=1}^{M} \left[N(K^i, T_n^i) + A(T_a^i) - \gamma(t_c^i) - \delta(t_d^i) + U(Z) \right] - Z. \tag{9}$$

With M otherwise identical provinces,

$$K^o = \bar{K}/M \tag{10}$$

with symmetric allocation of $\bar{K}$ across the M provinces. Public good provision equalizes the marginal cost with marginal benefits aggregated across provinces:

$$1 = MU'(Z^o).$$

In addition, land development in each province equalizes the marginal gains in agricultural value added and the marginal cost of land development:

$$\frac{\partial W}{\partial T_a^i} \equiv W_a^o(T_a^o, T_n^o) = A_T(T_a^o) - \delta_t(t_d^o) = 0. \tag{11}$$

Land conversion in a first-best equilibrium yields marginal gains in non-agricultural value added at $N_T(K^o, T_n^o)$. In terms of marginal costs, two forms are incurred, including first the direct marginal cost

of land conversion $\gamma_t(t_c^o)$, in addition to the marginal cost of land development $\delta_t(t_d^o)$ to replenish an otherwise declining usage of agricultural land T_a^i:

$$\frac{\partial W}{\partial T_n^i} \equiv W_n^o(T_a^o, T_n^o) = N_T(K^o, T_n^o) - \gamma_t(t_c^o) - \delta_t(t_d^o) = 0. \tag{12}$$

(11) and (12) jointly determine the first-best levels of land use respectively in a and in n. Figure 2 illustrates. Schedule D^oD^o in Figure 2 traces the combinations of T_a^i and T_n^i that equate the marginal benefits of land development to the corresponding marginal cost. Note first of all that D^oD^o slopes downwards. Intuitively, an increase in land use in non-agricultural production, all else constant, raises the marginal cost of additional land development for agricultural uses by convexity of δ. This discourages land use in agriculture.

Schedule C^oC^o in Figure 2 in turn traces the combinations of T_a^i and T_n^i that equate the marginal benefits of land conversion to the corresponding marginal cost. Note that C^oC^o also slopes downwards. Intuitively, an increase in land use in agriculture, all else constant, raises the marginal cost of additional land development for non-agricultural uses by convexity of δ from (12). This discourages land use in non-agriculture.

The equilibrium land use allocation in the two sectors is given by the intersection of the D^oD^o and the C^oC^o schedules.[18] These findings establish a set of benchmarks, based on which we will evaluate three additional policies regimes.

3.2 Incomplete Fiscal Decentralization and Inter-regional Competition for Capital

Contrary to the first best outcome, Chinese provinces confront decentralized decision making with incomplete revenue retention $\nu < 1$, and inter-regional competition for capital ($K^i(T_n^i, r)$). As noted, each provincial government maximize the post-tax income generated in the province, subject to a budget constraint in (3), taking as given the nation-wide returns to capital r. Using (3) and (6), the problem of each provincial government i simplifies to:

$$\max_{T_n^i, T_a^i} N(K^i(T_n^i, r), T_n^i) + (1 - \tau(1-\nu))A(T_a^i) - \gamma(t_c^i) - \delta(t_d^i) + \bar{R}^i + U(Z) \tag{13}$$

In a symmetric equilibrium, K^i, T_n^i, T_c^i, and z^i are identical across regions. Let a superscript "c" denote these outcomes with inter-regional competition for capital. We have

$$K^i = K^c = \bar{K}/M \tag{14}$$

so that the aggregate stock of capital $\bar{K}$ is equally allocated once again across the M otherwise identical provinces. Thus,

$$K^c = K^o.$$

Land development in each province equalizes the marginal gains in agricultural value added and the marginal cost:

$$\frac{\partial W^i}{\partial T_a^i} \equiv W_a^i(T_a^c, T_n^c) = (1 - \tau(1-\nu))A_T(T_a^c) - \delta_t(t_d^c) = 0 \tag{15}$$

Comparing (11) with (15), where the latter exhibits incomplete revenue retention parameterized by $\nu < 1$, provincial government underestimates the marginal benefits of land development relative to the first best regime. In Figure 3, the D^iD^i schedule reflects this difference by once again tracing out the combinations of land use in a and n that maximizes provincial welfare, indicating a scaling back of agricultural land use relative to the first best regime for all T_n^i.

Now in sharp contrast to the case of agricultural land development, local government overestimates the marginal benefits net of marginal costs of land conversion:

$$\frac{\partial W}{\partial T_n^i} \equiv W_n^i(T_a^c, T_n^c) = (1+\theta)N_T(K^c, T_n^c) - \gamma_t(t_c^c) - \delta_t(t_d^c) = 0. \tag{16}$$

where

$$\theta = \frac{N_K K^c}{N_T T_n^c} \frac{\partial \log K^i(T_n^i, r)}{\partial \log T_n^i}|_{rconst.} = \frac{\sigma_K}{\sigma_T}\eta > 0.$$

and $\sigma_K = N_K(K^c, T_n^c)K^c/N(K^c, T_n^c)$ and $\sigma_T = N_T(K^c, T_n^c)T_n^c/N(K^c, T_n^c)$ are the shares of capital and land in non-agricultural production. θ thus captures both the sensitivity of capital inflow K^i to land use in non-agriculture and the impact of capital inflow on non-agricultural production. θ accordingly reflects the strength of the impact of inter-jurisdictional competition for capital on land conversion incentives.

Now compare (12) and (16), competition for mobile capital effectively shifts the CC curve outwards. As shown in Figure 3, the revised C^iC^i schedule along with the D^iD^i schedule jointly determine the equilibrium land allocation decision of local governments. Incomplete fiscal decentralization and competition for capital thus reinforce one another in augmenting local officials' incentives to increase land use in non-agriculture, at the expense of agricultural production. We have:[19]

Proposition 1 *With incomplete fiscal decentralization and inter-regional competition for capital, there is over-provision of non-agricultural land by local governments and underprovision of agricultural land*

relative to the first best:

$$T_n^i > T_n^o, \;\; T_a^i < T_a^o.$$

This is made possible by an increase in land conversion effort, but a decrease in overall land development effort relative to the first best regime if local tax revenue retention is sufficiently poor, or, with $(1-\nu)$ *is sufficiently large:*

$$t_c^i > t_c^o, \;\; t_d^i < t_d^o.$$

Since $T_n^i = \bar{T}_n + t_c^i$ by definition, non-agricultural land use greater than the first best level necessitates land conversion effort greater than the first best. Now, $t_a^i = T_a^i + T_n^i - \bar{T}_a - \bar{T}_n$ and as such overall land development effort depends jointly on land allocation in both a and n, which move in opposite direction relative to the first best allocation due respectively to incomplete tax revenue retention, and competition for capital. If the former (tax retention) effect dominate, agriculture suffers doubly due to land conversion, and an overall reduction in land development effort.

3.3 Land Development Allowance

In order to prevent unchecked urban expansion and the decline in agricultural production due to land conversion, there is a variety of policy options. At one extreme, a ban on land conversion sets $t_c^i = 0$. Meanwhile, a comprehensive system of agricultural land use quotas with a ban on *uncompensated* land conversion requires that agricultural land use must never be fall below a given quota, and as such every unit of land conversion must be compensated by land development of at least the same scale. The Circular of Further Strengthening Land Management and Cultivated Land Protection, jointly issued by the Chinese Communist Party Central Committee and the State Council on April 15, 1997, is one such policy which specifies a target of dynamic balance of total cultivated land. Yet another alternative policy puts checks on land conversion by a policy of land development allowance, whereby expansion in non-agricultural land use is allowable only as a fraction of newly added agricultural land. The Law of Land Administration enacted in 1998 (Chapter 4, Article 18) officially sanctions the use of land development allowance, where 60% of newly added agricultural land through land consolidation can be used as compensation quotas for cultivated land occupied for construction.[20]

Each of these policy options are special cases of the following general formulation of a land development allowance policy, which links allowable land conversion to land development efforts. Formally, a land development allowance policy is a pair (ρ, Δ), which requires that land conversion in each province

i be no greater than:[21]

$$t_c^i \leq \max\{0, \rho(t_d^i - \Delta)\} \tag{17}$$

where $\rho \in [0,1]$ gives the size of land development allowance permitted as a fraction of total land development. Δ is a minimal land development quota, and land conversion is permitted under this policy when land development exceeds Δ. This policy imposes a constraint on the feasible land use choices in a and n facing each provincial government. The constraint is shown in Figure 4 as the upward sloping schedule $\Delta\Delta$. Anywhere along the schedule, the constraint is just binding with $t_c^i = \rho(t_d^i - \Delta)$, or equivalently, $T_n^i \leq \bar{T}_n + \rho(T_a^i - \bar{T}_a - \Delta)/(1-\rho)$. A ban on land conversion is thus the simplest case where $\rho = \Delta = 0$, and $\Delta\Delta$ is thus a horizontal schedule at $\bar{T}_n$.

Alternatively, a law that stipulates a dynamic balance in the stock of agricultural land at no less than $\hat{T}_a^i$ requires that $\rho = 1$ and $\Delta = \hat{T}_a^i - \bar{T}_a \geq \bar{T}_a \geq 0$ whenever $\Delta \geq 0$. Once the quota Δ is reached, land conversion is now permissible so long as a "dynamic balance" in T_a^i at the specified level $\hat{T}_a^i$ is maintained by compensating each unit of agricultural land loss through land conversion by the the same degree of land development ($\rho = 1$).

More generally, varying $\rho \in (0,1)$ and $\Delta \leq 0$ allows the central government to fine-tune the land allowance policy. The question remains as to whether the policy can be designed to exploit local government's incentive for urban spatial expansion to benefit agricultural land development more generally. To see this, consider once again the local government' problem, now augmented with a centrally mandated policy of land development allowance:

$$\max_{T_n^i, T_a^i} N(K^i(T_n^i, r), T_n^i) + (1 - \tau(1-\nu))A(T_a^i) - \gamma(t_c^i) - \delta(t_d^i) + \bar{R}^i + U(Z) \tag{18}$$

subject to (17), or equivalently

$$T_n^i \leq \bar{T}_n + \frac{\rho}{1-\rho}(T_a^i - \bar{T}_a - \Delta),$$

and

$$T_a^i + T_n^i \geq \bar{T}_n + \bar{T}_a.$$

In a symmetric equilibrium, K^i, T_a^i and thus T_n^i continues to be identical across regions. Let a superscript "r" denote these outcomes with land development allowance, fiscal decentralization, and inter-regional competition for capital. We have

$$K^i = K^r = \bar{K}/M. \tag{19}$$

With land development allowance as given by (17), an increase in agricultural land use made possible by land development additionally impact the ability of the local government to expand non-agricultural land use, given ρ and Δ. At an interior equilibrium, we have

$$\begin{aligned}\frac{\partial W^i}{\partial T_a^i} &\equiv W_a^r(T_a^i) = 0 \qquad (20)\\ &\Leftrightarrow (1-\rho)[(1-\tau(1-\nu))A_T(T_a^r) - \delta_t(t_a^r)] + \rho[(1+\theta)N_T(K^r, T_n^r) - \delta_t(t_a^r) - \gamma(t_c^r)] = 0\\ &\Leftrightarrow (1-\rho)W_a^i(T_a^r, T_n^r) + \rho W_n^i(T_a^r, T_n^r) = 0\end{aligned}$$

It follows that the marginal welfare impact of an increase in land use in agriculture is now a weighted average of (i) the marginal welfare impact of an increase in T_n^i, $W_n^i(T_a^r, T_n^r)$ (ii) the marginal welfare impact of an increase in T_a^i in the absence of the allowance policy, $W_a^i(T_a^r, T_n^r)$. Furthermore, as long as the land development allowance policy is binding ($T_n^r < T_n^c$), the combinations of land use in a and n that satisfies (20) lies between C^iC^i and D^iD^i, as shown in Figure 4 as R^iR^i.[22] Note that R^iR^i tends to the C^iC^i schedule as ρ tends to 1, and D^iD^i otherwise as ρ tends to 0. The intersection of the upward sloping land development allowance constraint $\Delta\Delta$, and the R^iR^i schedule gives the local government choice of land use in a and n.

We now show that an appropriately designed land development allowance scheme can replicate the first best outcome:

Proposition 2 *A land development allowance policy (ρ^r, Δ^r) that replicates the first best land allocation T_a^o and T_n^o takes the form:*

$$\frac{\rho^r}{1-\rho^r} = \frac{\tau(1-\nu)A_T(T_a^o)}{\theta N_T(\bar{K}/M, T_n^o)} \qquad (21)$$

and

$$\Delta^r = T_a^o - \bar{T}_a - \frac{\theta N_T(\bar{K}/M), T_n^o}{\tau(1-\nu)A_T(T_a^o)}(T_n^o - \bar{T}_n). \qquad (22)$$

The result is intriguing for it shows that a land development allowance policy can re-invigorate rural land development efforts while reducing urban land use. From (21), and (22), the intuition behind this result is as follows. Note that land development allowance ρ^r as displayed in (21) essentially eliminates the disincentive for agricultural land development due to incomplete fiscal decentralization $\tau(1-\nu)A_T$ by pairing it with the heightened incentive for urban spatial expansion in the presence of mobile capital θN_T. Next, by accordingly calibrating Δ^r based on the first best land allocation and ρ^r,[23] a appropriately designed land development allowance policy can indeed replicate the first

best outcome. Doing so increases land use in agriculture, and tames excessive urban spatial expansion in each province. Furthermore, relative to the decentralized outcomes (t_c^c, t_d^c), the land development allowance policy strictly increases the total land development for $t_d^o > t_d^c$ as shown in Proposition 1 as long as local tax revenue retention is sufficiently poor. Jointly these findings are consistent with the experience of land policy reform and the massive increase in land consolidation efforts in China as discussed earlier.

Proposition 1 also provides clear guidance on the determinants of the size of the land development allowance ρ^r, and the size of the quota Δ^r. Specifically, upon an increase in the extent of inter-jurisdictional competition for capital, due to an increase in the elasticity θ for example, the land development allowance policy should be stricter requiring a reduction in ρ, but simultaneously a relaxation of the agricultural land development quota through a reduction in Δ. Meanwhile, a change in the fiscal contract, such as a reduction in ν that worsens local tax revenue retention even more, should call for a increase in ρ to encourage local governments to take advantage of the land development allowance policy, while at the same time increasing the quota Δ^r to ensure that the first best allocation can be reached.

Note furthermore that the land development allowance policy (ρ^r, Δ^r) is feasible only if the land development quota $\Delta^r = T_a^o - \bar{T}_a - \frac{\theta N_T(\bar{K}/M), T_n^o}{\tau(1-\nu)A_T(T_a^o)}(T_n^r - \bar{T}_n)$ is positive. A priori, the expression in (22) can be positive or negative depending on the relative magnitude of the first best allocations, and the marginal value added impact of land in the two sectors N_T and A_T. Alternatively, therefore, consider a subsidized land development allowance policy (ρ, s). Specifically, let s denote a subsidy transfer from the central government to province i for each unit of land development carried out. The cost of land development in province i is thus $\delta(t_d^i) - st_d^i$. With a earmarked subsidy replacing the role of the land development quota, the land development allowance policy restricts land conversion via the constraint: $t_c^i \leq \rho t_d^i$, or $T_n^i \leq \bar{T}_n + \rho(T_a^i - \bar{T}_a)/(1-\rho)$.

It can be shown that first best land allocation can be replicated here as well. Consider once more the local government' problem, now augmented with a centrally mandated policy of land development allowance with earmarked subsidy:

$$\max_{T_n^i, T_a^i} N(K^i(T_n^i, r), T_n^i) + (1 - \tau(1-\nu))A(T_a^i) - \gamma(t_c^i) - \delta(t_d^i) + st_d^i + \bar{R}^i + U(Z) \tag{23}$$

subject to

$$T_n^i \leq \bar{T}_n + \frac{\rho}{1-\rho}(T_a^i - \bar{T}_a),$$

and

$$T_a^i + T_n^i \geq \bar{T}_n + \bar{T}_a.$$

Let a superscript "s" denote these outcomes with subsidized land development allowance, fiscal decentralization, and inter-regional competition for capital. We have

$$K^i = K^s = \bar{K}/M. \tag{24}$$

Furthermore, at an interior equilibrium,

$$\begin{aligned} \frac{\partial W^i}{\partial T_a^i} &\equiv W_a^s(T_a^i) = 0 \qquad (25)\\ &\Leftrightarrow (1-\rho)[(1-\tau(1-\nu))A_T(T_a^s) - \delta_t(t_a^s) + s] + \rho[(1+\theta)N_T(K^s, T_n^s)\\ &\quad -\delta_t(t_a^s) - \gamma(t_c^s) + s] = 0\\ &\Leftrightarrow (1-\rho)W_a^i(T_a^s, T_n^s) + \rho W_c^i(T_a^s, T_n^s) + s = 0, \end{aligned}$$

where the impact of a subsidy s is highlighted. We have thus:

Proposition 3 *A land development allowance policy with earmark subsidy (ρ^s, s^s) that replicates the first best land allocation T_a^o and T_n^o takes the form:*

$$\frac{\rho^s}{1-\rho^s} = \frac{T_n^o - \bar{T}_n}{T_a^o - \bar{T}_a}. \tag{26}$$

and

$$s^s = (1-\rho^s)\tau(1-\nu)A_T(T_a^o) - \rho^s\theta N_T(\bar{K}/M, T_n^o). \tag{27}$$

Thus, the land development allowance policy requires an earmarked subsidy to achieve first-best if the land development disincentives induced by incomplete fiscal decentralization $(1-\nu)$ is sufficiently high. Alternatively, if competition for capital is sufficiently intense, the first best replicating land development allowance policy can in fact be a source of central government tax revenue for $s^s < 0$ from (27).

4 Conclusion

The contributions of this paper are three-fold. First, we address the issue of land use allocation in economies where land ownership is public. Based on the salient features of the land administration

and public finance policy landscape in China, we provide a model that brings together two previously unrelated areas of active research: farmland preservation and fiscal decentralization with competition for mobile capital inputs to examine the public economics of land preservation policies in economies where land is public property. In doing so, the model shows the economic rationale for inefficient land use allocation where local governments, as opposed to private individuals, are in fact custodians of land administration and land use allocation.

Second, we examine in this context the analytics of a land development allowance policy. In particular, our results allow us to make sense of the empirical observations discussed in the introduction, that socially excessive land conversion from agriculture to construction can occur in tandem with aggressive land development efforts in rural areas, through a land administration policy that explicitly links allowable land conversion quotas with land development efforts.

Indeed, we show that the forces of urbanization if appropriately harnessed, can be directed towards the re-invigoration of land development efforts in agriculture. It is shown that an appropriately designed land development allowance policy can be put in place to replicate nationally first-best land use allocation, in an economy where land use is otherwise excessively tilted in favor of urban expansion, because of inter-jurisdictional competition for mobile capital, and because of a tax schedule that favors one sector as opposed to another.

Future research in this area can exploit of recent changes in Chinese tax laws, for example, which has completely eliminated agricultural taxation. Based on the model developed in this paper, this change can be readily shown to alter the land use and land conversion incentives of local governments.

Appendix

Proof of Proposition 1: With incomplete fiscal decentralization and inter-regional competition for capital, the first order conditions facing a local government i are shown in (11) - (12):

$$\begin{aligned}(1+\theta)N_T(K^c, T_n^c) - \gamma_t(T_n^c - \bar{T}_n) - \delta_t(T_a^c + T_n^c - \bar{T}_a - \bar{T}_n) &= 0 \\ (1-\tau(1-\nu))A_T(T_a^c) - \delta_t(T_a^c + T_n^c - \bar{T}_a - \bar{T}_n) &= 0.\end{aligned}$$

Comparing the above with the first order conditions in the first best regime, the decisions of local government coincide with that of the central government if and only if $\theta = 0$, or equivalently when local government disregards the role of urban land use in attracting mobile capita, and $1 - \nu = 0$, or

equivalently when there is full tax revenue retention of local tax revenue. Put another way, the extent of deviation from first best with incomplete fiscal decentralization and inter-regional competition for capital will depend on the size of θ and ν. More specifically, from (15) - (16), we have

$$\begin{pmatrix} (1+\theta)N_{TT} - \gamma_{tt} - \delta_{tt} & -\delta_{tt} \\ -\delta_{tt} & (1-\tau(1-\nu))A_{TT} - \delta_{tt} \end{pmatrix} \begin{pmatrix} dT_n^i \\ dT_a^i \end{pmatrix} = \begin{pmatrix} -N_T d\theta \\ -\tau A_T d\nu \end{pmatrix}.$$

It follows straightforwardly that as stated in Proposition 1, with incomplete fiscal decentralization $1-\nu > 0$, and inter-regional competition for capital $\theta > 0$, there is over-provision of non-agricultural land relative to first best for:

$$\frac{\partial T_n^i}{\partial \theta} = \frac{-N_T((1-\tau(1-\nu))A_{TT} - \delta_{tt})}{D} > 0, \quad \frac{\partial T_n^i}{\partial(1-\nu)} = \frac{\delta_{tt}\tau A_T}{D} > 0$$

where

$$D = [(1+\theta)N_{TT} - \gamma_{tt}][(1-\tau(1-\nu))A_{TT} - \delta_{tt}] - \delta_{tt}(1-\tau(1-\nu))A_T T > 0.$$

Accordingly, there is also excessive land conversion from agricultural to non-agricultural uses since $t_c^i = T_n^i - \bar{T}_n$. Meanwhile, there is under-provision of agricultural land relative to first best since:

$$\frac{\partial T_a^i}{\partial \theta} = \frac{-N_T \delta_{tt}}{D} < 0, \quad \frac{\partial T_a^i}{\partial(1-\nu)} = \frac{((1+\theta)N_{TT} - \gamma_{tt} - \delta_{tt})\tau A_T}{D} < 0.$$

Since T_a^i and T_n^i respond in opposite directions to both θ and $1-\nu$, land development effort $t_a^i = T_a^i + T_n^i - \bar{T}_a - \bar{T}_n$, which depends on the sum of these two effects, exhibits:

$$\frac{\partial t_a^i}{\partial \theta} = \frac{-N_T(1-\tau(1-\nu))A_{TT}}{D} > 0, \quad \frac{\partial t_a^i}{\partial(1-\nu)} = \frac{((1+\theta)N_{TT} - \gamma_{tt})\tau A_T}{D} < 0.$$

It follows that the net effect of fiscal decentralization $1-\nu$ and inter-regional competition for capital θ on land development is strictly negative if the latter effect dominates, or if $(1-\nu)$ is sufficiently large.

Proof of Proposition 2: Recall from (11) - (12) that the necessary and sufficient conditions for a first best outcome are

$$\begin{aligned} N_T(K^o, T_n^o) - \gamma_t(T_n^o - \bar{T}_n) - \delta_t(T_a^o + T_n^o - \bar{T}_a - \bar{T}_n) &= 0 \\ A_T(T_a^o) - \delta_t(T_a^o + T_n^o - \bar{T}_a - \bar{T}_n) &= 0. \end{aligned}$$

Meanwhile, the first order condition of a local government that internalizes the incentives offered by the land development policy are as shown in (20):

$$(1-\rho)[(1-\tau(1-\nu))A_T(T_a^r) - \delta_t(t_a^r)] + \rho[(1+\theta)N_T(K^r, T_n^r) - \delta_t(t_a^r) - \gamma(t_c^r)] = 0.$$

A land development allowance policy $\{\rho^r, \Delta^r\}$ that replicates the first best outcome sets $T_a^r = T_a^o$, and $T_n^r = T_n^o$, and thus from (11) - (12) and (20),

$$\begin{aligned} & -(1-\rho^r)\tau(1-\nu)A_T(T_a^r) + \rho^r\theta N_T(K^r, T_n^r) = 0 \\ \Leftrightarrow \quad & \frac{\rho^r}{1-\rho^r} = \frac{\tau(1-\nu)A_T(T_a^r)}{\theta N_T(\bar{K}/M, T_n^r)} = \frac{\tau(1-\nu)A_T(T_a^o)}{\theta N_T(\bar{K}/M, T_n^o)} \end{aligned}$$

since $K^r = K^o = K/M$. It follows furthermore from (17) that the corresponding minimal land development quota is:

$$\Delta^r = T_a^o - \bar{T}_a - \frac{\theta N_T(\bar{K}/M, T_n^o)}{\tau(1-\nu)A_T(T_a^o)}(T_n^o - \bar{T}_n).$$

Proof of Proposition 3: From (25), the first order condition of a local government facing a land development allowance policy with an earmarked subsidy is:

$$(1-\rho)[(1-\tau(1-\nu))A_T(T_a^s) - \delta_t(t_a^s) + s] + \rho[(1+\theta)N_T(K^s, T_n^s) - \delta_t(t_a^s) - \gamma(t_c^s) + s] = 0.$$

A land development allowance policy with earmarked subsidy $\{\rho^s, s^s\}$ that replicates the first best outcome sets $T_a^s = T_a^o$, and $T_n^s = T_n^o$, and $K^s = K/M$. Thus from (11) - (12) and (25),

$$\begin{aligned} s^s &= (1-\rho^s)\tau(1-\nu)A_T(T_a^r) - \rho^s\theta N_T(K^r, T_n^r) \\ &= (1-\rho^s)\tau(1-\nu)A_T(T_a^o) - \rho^s\theta N_T(K/M, T_n^o). \end{aligned} \tag{28}$$

From (17), with $\Delta^i = 0$, the implied land development allowance follows directly from first best levels:

$$\frac{\rho^s}{1-\rho^s} = \frac{T_n^o - \bar{T}_n}{T_a^o - \bar{T}_a}. \tag{29}$$

Using (25) and (29), the corresponding earmarked subsidy can be written in terms only of first best land allocation, θ and ν:

$$s^s = \frac{(T_a^o - \bar{T}_a)\tau(1-\nu)A_T^o - (T_n^o - \bar{T}_n)\theta N_T^o}{T_a^o - \bar{T}_a + T_n^o - \bar{T}_n},$$

where $A_T^o = A_T(T_a^o)$ and $N_T^o = N_T(K^o, T_n^o)$ evaluated at first best input allocations. It follows that the land development earmark subsidy is strictly positive if revenue retention of value added tax is sufficiently imperfect – $(1-\nu)$ is large enough – and negative if inter-jurisdictional competition generates land allocational distortions that are sufficiently acute – θ is large enough.

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Notes

[1]Russia is another example where the public ownership of all farmland has been argued to be a main cause of the slow pace of land reform (Swinnen 2002).

[2]Farmland protection programs that are guided by private ownership of land, the presence of market prices, but uncertain values of amenities, for example, have been studied extensively. For a synthesis, see for example, Hellerstein et. al (2002). Our paper contributes to this literature by addressing the same objective of farmland protection, but in a wholly different institutional context with public land ownership, and state government stewardship of land resources.

[3]Zhang, Mount and Boisvert (2004) presents evidence of strategic interaction in the form of a peer pressure variable, significant only in the post-reform period, on provincial level arable land use.

[4]The literature on fiscal decentralization with footloose capital is longstanding. Some studies illustrate the negative impact of the need to encourage capital inflow on local public good provision (Oates 2972, Zodrow and Mieszkowski 1986, Keen and Marchard 1996), while others emphasize capital mobility as a discipline device (Qian and Roland 1998, Montinola et al. 1995, and Obstfeld 1998) where sound policies are rewarded.

[5]By land development, we do not imply forcible consolidation of marginal farms by removing small farmers from the land. Such acts are prohibited by according to the Law of Rural Land Contract in China.

[6]The productivity implications of land development naturally differ depending on whether it is achieved via land consolidation, reclamation, or rehabilitation. For example, reclamation of land may not offset the loss of fertile land particularly when reclamation takes place in ecologically fragile regions, with less favorable climatic conditions, and location disadvantages (Ash and Edmonds 1998, Yang and Li 2000, Lin and Ho 2003). These concerns make it all the more imperative that policy measures are designed not just to maintain a "dynamic balance" in the total quantity of cultivated land at the national level, requiring only a ban on uncompensated conversion of cultivated land without adjusting for land quality. Our objective in this paper is to evaluate the potential role of a land development allowance policy in contributing to effective improvements in farmland protection incentives at the local government level.

[7]Also see Ministry of Agriculture of the People's Republic of China (2002) and Tong and Chen (2008) for an in-depth discussion of China's land administration policy at the national level. See Wang, Tao and Tong (2009) for an account from a provincial perspective with specific reference to Zhejiang province.

[8]By 2008, concerns regarding uncontrolled urban expansion has led to an official tightening of the regulation prohibiting further increases in construction land, according to The Circular of Strictly Implementing the Laws and Policies of Rural Collective Construction Land. The impact of this change is an important issue that warrants future research.

[9]See Ding and Lichtenberg (2008) for empirical evidence demonstrating that local governments face significant gains in revenue by diverting land from agricultural to non-agricultural uses.

[10]Extra-budgetary revenue is made up of a number of revenue items not included as part of provincial budgetary revenue, and hence beyond the monitoring of the National People's Congress. This includes revenues and income of institutional and administrative units, specialized funds held by state-owned enterprizes, and fees and incomes collected from local enterprises.

[11]These results also complements Ding and Lichtenberg (2008), where it is shown that urban land generates higher revenue than agricultural land in the eastern provinces of China.

[12]See for example Fan and Zhang (2004) for a recent study on the empirical relationship between land use and agricultural productivity.

[13]We refer to γ as the minimum cost schedule to indicate that γ is the lowest cost required to increase non-agricultural land use, given existing geography and spatial distribution of land use within a province. In Lichtenberg and Ding (2009), for example, increasing and convex land conversion cost also captures market driven compensation for land requisition. Other cost of land conversion can also include cost of resettlement, and basic infrastructure including water, electricity, and transportation.

[14]There is an alternative interpretation of our specification of land development and land conversion costs – investing in newly added land is less expensive in agriculture than in non-agriculture, due for example for the additional need for infrastructure, amenities, services and access to markets required by the latter. As such the marginal cost of an increase in T_n^i, $\gamma_t(t_c^i) + \delta_t(t_d^i)$, is strictly higher than $\delta_t(t_d^i)$. To maintain consistency, we will refer to γ as land conversion cost, and δ as land development cost throughout.

[15]It can be readily shown that our qualitative findings are robust to the introduction of a positive distortionary tax on non-agriculture, provided that the forces of inter-jurisdictional competition for capital is sufficiently intense.

[16]In agriculture, similar land use fees do not apply.

[17]The assumption of a benevolent state government is commonplace in the fiscal decentralization literature. See for example Qian and Roland (1998) for an analysis which sheds light particularly on the Chinese decentralization experience. Li (1998) furthermore argues that establishing a pro-reform, and pro-business reputation is important for bureaucrats interested in a position in the local business community after leaving government.

[18]From (11) and (12), the slope of D^oD^o is given by $\frac{\partial T_a^i}{\partial T_n^i}|_D = (N_{TT} - \delta_{tt} - \gamma_{tt})/\delta_{tt}$, and the slope of C^oC^o is $\frac{\partial T_a^i}{\partial T_n^i}|_C = -\delta_{tt}/(A_{TT} - \delta_{tt})$, and thus $\frac{\partial T_a^i}{\partial T_n^i}|_D > \frac{\partial T_a^i}{\partial T_n^i}|_C$ as shown in Figure 2.

[19]The Appendix contains a formal proof of each of the propositions below.

[20]At the provincial level, similar policies have been put into use. In Zhejiang province, the 1998 Notice on Encouraging Rural Land Consolidation stipulates that 72% of the total effective added areas of cultivation can be used for approved infrastructure, core village, small town and industrial district.

[21]Henceforth, we assume that the constraint (17) is strictly observed. A report commissioned by the Shanghai Bureau of State Land Supervision (Wu et. al 2010) summarized the findings of a series of interviews conducted with officials in 13 counties of Zhejiang Province – a province with arguably one of the highest demands for land conversion in China. The report finds a clear understanding among local officials concerning the detail requirements of the land administration legislation. The report additionally identified a number of critical areas of concern, principle among which are the need for land quota determination criteria that balance local economic and ecological conditions, and the difficulty with enforcement and evaluation. A useful extension of our model to capture the possibility of a "soft" land development allowance constraint will thus be of particular interest. To do so will involve a full-fledged paper, that takes into account the system of checks and balances between central and local governments relevant in China (Laffont 2004), other determinants of local government accountability including the role of the media (Besley and Burgess 2002), the time dimension of the reform process (Laffont and Qian 1999), and other incentives / awards (e.g. additional land use quotas (http://house.china.com.cn/Specialreport/view/79753.htm)) that the central government can offer for land use regulations to be self-enforcing (Laffont 2004). We thank an anonymous referee for pointing out this possibility.

[22]Suppose otherwise, it follows from (15) and (16) that either $W_a^i(T_a^r, T_n^r) > 0$ and $W_n^i(T_a^r, T_n^r) > 0$, or $W_a^i(T_a^r, T_n^r) < 0$ and $W_n^i(T_a^r, T_n^r) < 0$, violating the first order condition in (20).

[23]The case where Δ^r in (22) happens to be negative will be discussed in what follows in the context of a land development allowance policy with earmarked subsidy instead of a land development quota.

Table 1: Additions and Losses in Cultivated Land in China, 1999 - 2006. (Million Hectares)

Year	Total Addition			Total Loss			Total Area of Cultivated Land (year end)
	Total	Of which due to Land Development, Consolidation, and Reclamation	Percentage due to Land Development, Consolidation and Reclamation	Total	Of which due to Conversion to Construction Land	Percentage due to conversion to construction land	
1999	0.41	0.26	63.57%	0.85	0.21	24.39%	129.85
2000	0.61	0.29	48.21%	1.57	0.16	10.42%	128.88
2001	0.27	0.20	76.18%	0.90	0.16	18.32%	128.25
2002	0.34	0.26	76.43%	2.04	0.20	9.69%	126.56
2003	0.35	0.31	90.46%	2.90	0.23	7.95%	124.01
2004	0.53	0.35	65.17%	1.49	0.29	19.81%	123.06
2005	0.63	0.31	49.23%	0.99	0.21	21.54%	122.69
2006	0.72	0.37	51.01%	1.03	0.26	25.18%	122.38
1999-2006	3.85	2.35	61.11%	11.76	1.73	14.71%	

Source: Authors Calculation based on China Land and Resources Yearbook (2000-2007)

Table 2: Land Development and Investment Costs in China, 2000. (Hectares)

Province	Land Consolidation			Land Reclamation			Land Rehabilitation		
	Added Land		Investment (10,000 yuan)	Added Land		Investment (10,000 yuan)	Added Land		Investment (10,000 yuan)
	Agriculture	Construction		Agriculture	Construction		Agriculture	Construction	
National	**87478.57**	**3030.00**	**13684.16**	**234026.92**	**13684.16**	**685195.11**	**60016.80**	**2211.72**	**127794.68**
Beijing	303.27	69.33	1161.51	820.55	38.00	4751.04	172.54	23.33	415.72
Tianjin	123.41	35.00	140.00	961.74	39.52	1843.87	426.47	6.91	574.20
Hebei	1436.75	170.72	6269.24	10874.86	202.52	27309.54	1602.18	34.34	3282.11
Shanxi	3292.72	174.83	5956.31	12436.10	1013.84	26432.61	5718.62	173.07	3676.31
Inner Mongolia	23839.60	47.20	2705.24	11814.47	110.20	1856.07	13878.54	166.67	2006.71
Liaoning	429.80	103.93	2177.96	6151.25	184.67	34073.65	613.59	18.30	1965.41
Jilin	100.00	0.00	612.60	1299.91	0.00	3363.16	2447.00	0.00	7084.00
Heilongjiang	966.10	350.00	1012.90	11448.97	594.00	5732.43	1047.84	327.58	1922.25
Shanghai	417.24	0.00	8719.71	413.90	0.00	5073.55	1410.11	0.00	7960.66
Jiangsu	4202.84	635.65	17135.14	3399.56	129.41	17078.68	4844.96	355.67	19656.50
Zhejiang	9421.70	24.05	86990.76	8631.76	21.96	32617.84	884.91	0.00	354.54
Anhui	3954.17	190.30	16037.45	3744.73	159.95	14519.08	2061.61	79.04	10382.70
Fujian	705.88	16.30	9637.08	7141.52	77.51	19545.54	347.13	16.00	808.40
Jiangxi	951.96	146.89	2019.48	2708.31	373.08	5929.39	687.55	53.01	852.66
Shandong	8517.97	267.31	17636.00	21018.21	698.94	68044.13	3913.71	118.12	13941.99
Henan	2994.45	89.31	10774.30	5978.27	33.72	22948.64	2853.67	113.32	10563.75
Hubei	2088.78	69.64	10373.82	8070.97	348.73	29493.59	1521.74	142.50	6466.87
Hunan	790.95	54.77	1671.77	8497.98	248.05	16340.71	456.15	19.56	1449.82
Guangdong	4507.73	18.70	27960.60	10045.23	4887.28	142663.24	1970.24	47.87	12989.03
Guangxi	326.33	0.10	5492.02	9194.56	159.78	36736.64	632.17	4.97	816.61
Hainan	50.30	0.00	150.90	564.91	0.00	1020.30	34.13	0.00	13.50
Chongqing	1498.13	208.63	16299.43	1366.99	594.63	5933.57	258.99	5.31	1014.43
Sichuan	3260.70	154.46	15573.49	7679.54	252.34	44354.04	1853.15	30.65	5340.27
Guizhou	1338.82	36.27	3129.52	3969.44	60.22	10969.12	311.86	10.36	883.30
Yunnan	6128.50	83.10	3785.69	16946.11	332.53	13570.85	3788.64	153.15	3975.22
Tibet	0.00	0.00	0.00	861.77	34.40	13665.81	1889.04	0.00	110.67
Shaanxi	1929.92	55.78	8325.36	3495.75	93.36	17692.53	2644.21	251.58	7943.18
Gansu	1212.78	1.42	1293.83	12543.31	516.01	19561.61	1103.11	4.93	911.61
Qinghai	5.53	11.30	45.80	631.91	0.00	505.70	36.86	0.23	78.00
Ningxia	270.42	8.36	64.40	3434.74	29.73	5443.55	45.24	12.40	43.85
Xinjiang	2411.82	6.65	659.55	37879.60	2449.78	36124.63	560.84	42.85	310.41

Source: Authors Calculation based on China Land and Resources Yearbook (2001).

Table 3: Comprehensive Land Use Planning Quota (1997-2010). (Million Hectares)

Use Category	Area
Reserved Cultivated Land	≥ 128.01
Protected Prime Farmland	≥ 108.56
Conversion from Cultivated to Construction Land	≤ 1.97
Additions to Cultivated Land through Development, Consolidation and Reclamation	≥ 4.41

Source: The Ministry of Land and Resources, Outline of National Comprehensive Land Use Planning (1997-2010), http://www.mlr.gov.cn/zwgk/ghjh/200710/t20071017_88615.htm

Table 4: Land Revenue in Local Public Finance (1998 - 2006)

Variable	**Mean**	**Std.Dev.**
Share of Extra-budgetary Revenue in Local Revenue	0.497	0.211
Share of Land Revenue in Extra-budgetary Revenue	0.321	0.402
Area of State-Owned Land Lease (Hectares)	3946.10	5173.44

Source: Authors Calculation based on China Land and Resources Yearbook (1999 – 2007) and Finance Yearbook of China (1999 – 2007)

Table 5: Net Revenue from Land Lease and Provincial Economic Performance in China, 1998 - 2006.

Province	Government Revenue per Hectare (10000 Yuan)	GDP per capita (Yuan)	Share of Secondary and Tertiary Sectors in GDP (%)
Anhui	105.50	6743	78.56
Beijing	574.61	30138	97.12
Chongqing	132.76	8469	83.43
Fujian	150.20	14063	85.27
Gansu	40.32	7373	81.34
Guangdong	131.09	16176	90.93
Guangxi	67.31	6776	74.84
Guizhou	122.54	5953	76.01
Hainan	118.74	12781	63.58
Hebei	115.12	10216	84.03
Heilongjiang	124.49	10994	87.77
Henan	97.36	7665	79.43
Hubei	89.13	8830	83.97
Hunan	92.78	7626	79.16
Inner Mongolia	39.54	10928	78.62
Jiangsu	165.75	15935	89.61

Table 5 (cont'd): Net Revenue from Land Lease and Provincial Economic Performance in China, 1998 - 2006.

Province	Government Revenue per Hectare (10000 Yuan)	GDP per capita (Yuan)	Share of Secondary and Tertiary Sectors in GDP (%)
Jiangxi	131.44	7384	78.63
Jilin	98.48	10147	79.31
Liaoning	151.68	13646	88.70
Ningxia	50.70	16106	84.11
Qinghai	47.39	16706	86.11
Shaanxi	74.43	7770	84.94
Shandong	95.90	13067	86.77
Shanghai	173.52	39999	98.47
Shanxi	109.18	8572	90.78
Sichuan	150.75	6663	77.87
Tianjin	181.99	25165	95.99
Tibet	101.55	30394	74.63
Xinjiang	33.69	10793	79.13
Yunnan	54.90	6608	79.01
Zhejiang	136.12	18296	90.87

Source: Authors Calculation based on China Land and Resources Yearbook (1999 – 2007) and China Statistical Yearbook (1999 – 2007)

Table 6: Results of Random Effects Estimation: Dep. Variable: Unit Revenue of Land Lease 1998 - 2006

Variable	Coefficient	Std. Err.
Share of Secondary and Tertiary Sectors	4.227	(1.914)
Lagged GDP	-0.007	(0.003)
Population Density	0.089	(0.044)
Year	5.489	(2.617)
Intercept	-11225.37	(5143.931)
N=278		
R-sq: within=0.0843		Number of Groups=31
R-sq: between=0.2836		Wald chi2=33.24
R-sq: overall=0.2129		Prob > chi2=0.0000

Figure 1a: Net Revenue from Land Lease and Provincial Economic Performance (1998 – 2006)

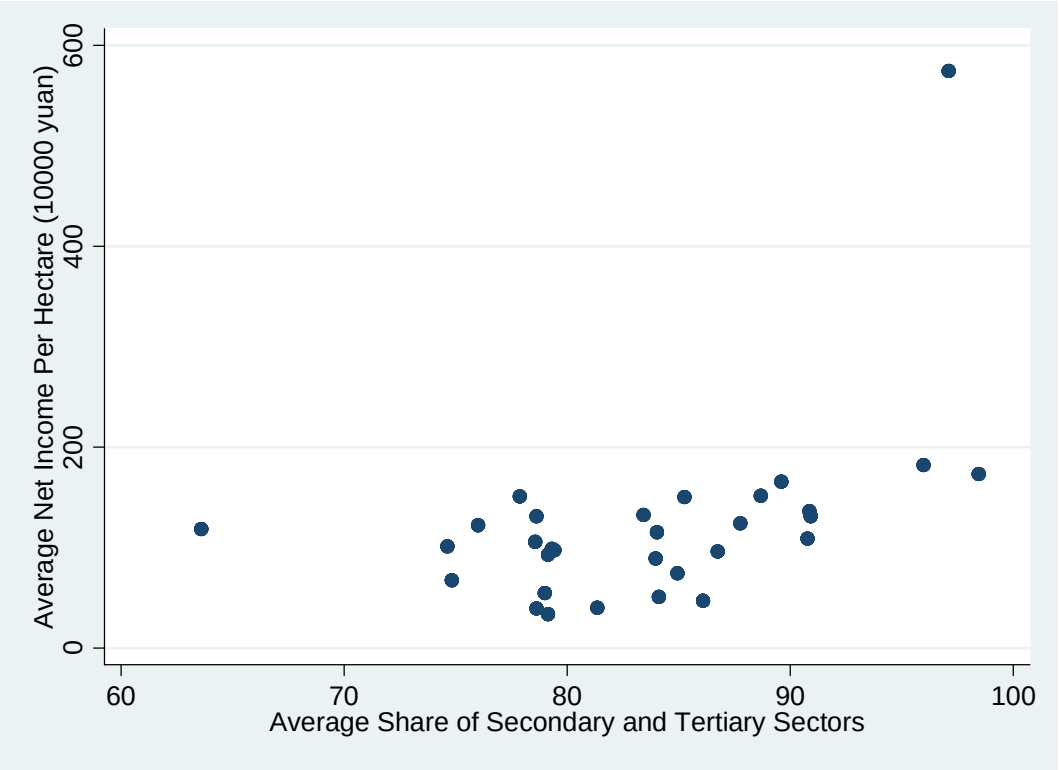

Figure 1b: Net Revenue from Land Lease and Provincial Economic Performance, excluding Beijing (1998 – 2006)

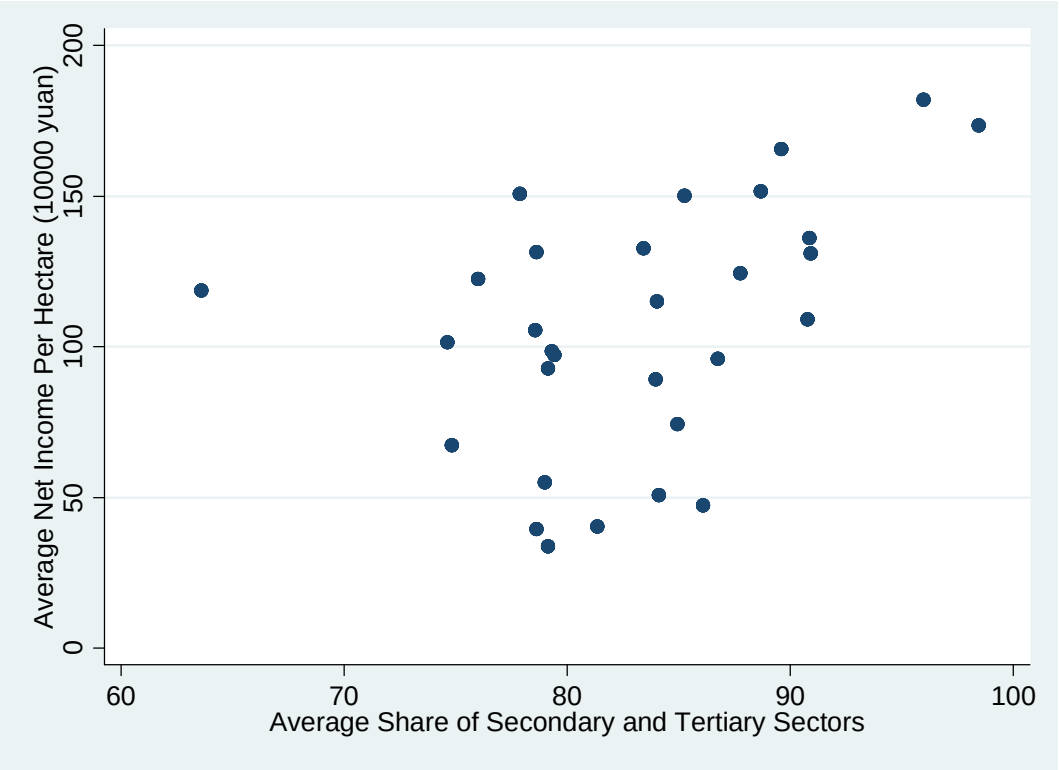

Figure 2. First Best Land Development
and Land Conversion

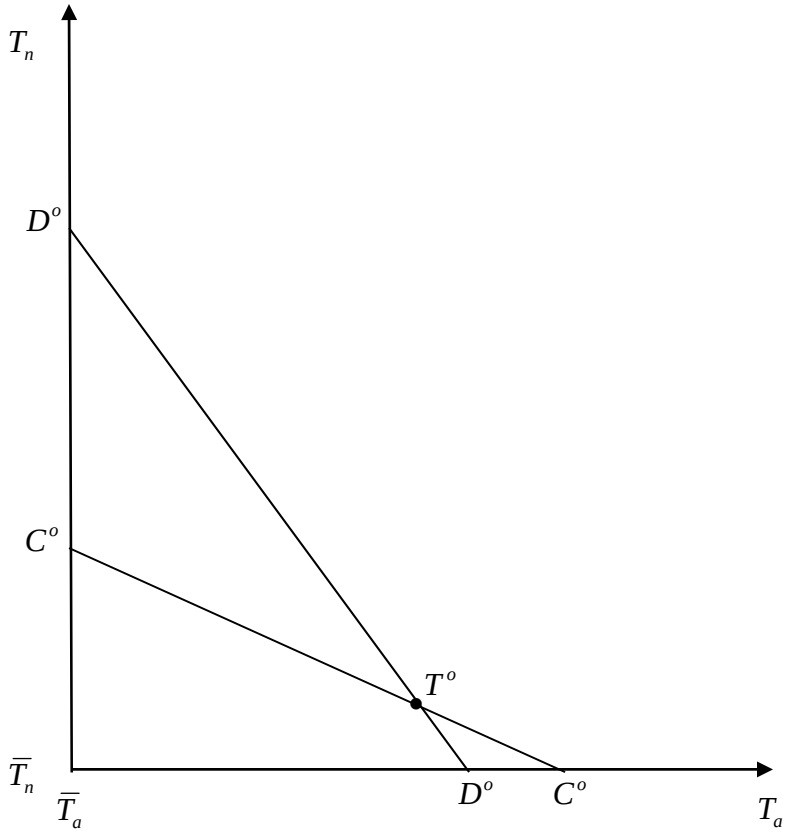

Figure 3. Decentralized Land Development
and Land Conversion

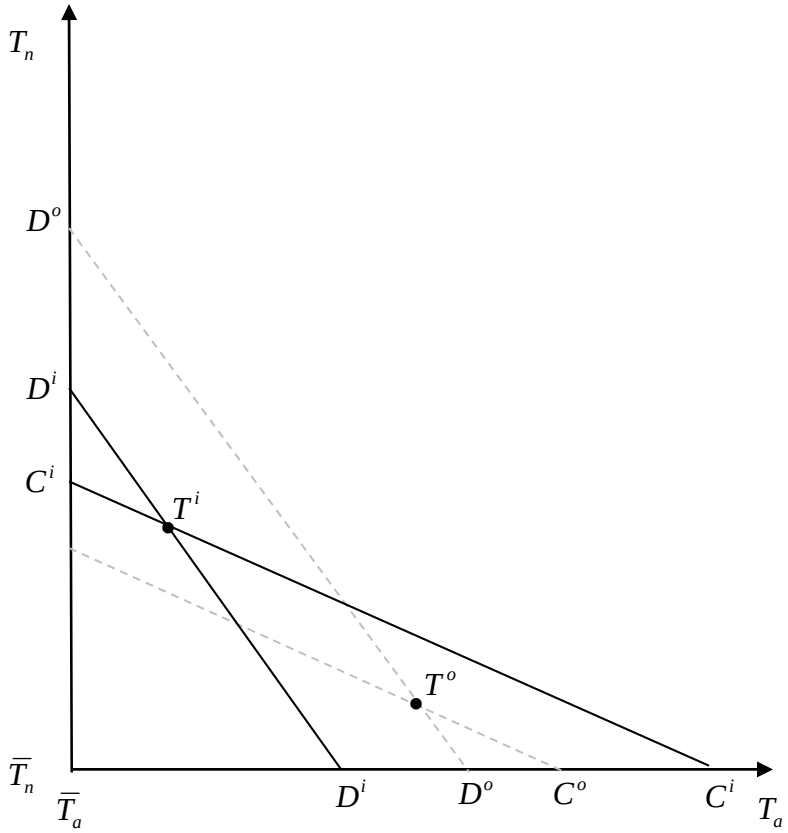

Figure 4. Land Development Allowance Policy

$$T_n = \overline{T}_n + \rho(T_a - \overline{T}_a - \Delta)/(1-\rho)$$