ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. 59, pp. 505–520, 2014

0305-750X/$ - see front matter

http://dx.doi.org/10.1016/j.worlddev.2013.10.009

Moving Off the Farm: Land Institutions to Facilitate Structural Transformation and Agricultural Productivity Growth in China

KLAUS DEININGER
World Bank, Washington, USA

SONGQING JIN
Michigan State University, East Lansing, USA

FANG XIA
Central University of Finance and Economics, Beijing, China

and

JIKUN HUANG *
Chinese Academy of Science, Beijing, China

Summary. — Agriculture made major contributions to China's growth and poverty reduction, but the literature has rarely focused on the institutional factors that might underpin such structural transformation and productivity. Drawing on an 8-year panel of 1,200 households in six provinces, we find that land tenure insecurity, measured by past land reallocations, discourages households from quitting agriculture, and the recognition of land rights through formal certificates encourages the temporary migration of rural labor. A sustained increase in nonagricultural opportunities will reinforce the importance of secure land tenure, a precondition for successful structural transformation and continued economic attractiveness of rural areas.

Key words — China, agricultural productivity, structural change, nonagricultural development, allocative efficiency

1. INTRODUCTION

Agriculture has made enormous contributions to poverty reduction and overall development in China. However, in the presence of other impediments to the free movement of factors, growth of economic opportunities and demand for labor in the nonagricultural sector has given rise to significant inter-sectoral and -regional income disparities that are a concern for policy-makers. The magnitudes involved can be appreciated by noting that, while agriculture's contribution to the economy declined from 40% in 1970 to less than 10% now, the share of labor employed in the sector in 2005, though down from 81% in 1970, still stood at 45%. This raises the question whether China can release labor from agriculture in a way that enhances productivity and brings about gradual increases in farm size and adoption of mechanized labor-saving methods of cultivation rather than relying on potentially distorting subsidies and at a pace that is fast enough to prevent further rapid widening of the gap between rural and urban incomes.

While policy-makers are aware of these issues and have tried to address them through a number of measures, including the 2003 rural land contracting law (RLCL), evidence on the effectiveness of these provisions remains limited. Understanding of whether they had the desired impact and the magnitude of any effects on shifting labor out of agriculture to bring about rural structural transformation will be important in light of a number of recent concerns. These include, in addition to rising rural–urban inequality, the challenges posed by a gradual exhaustion of the pool of cheap labor in the country's interior, an aging rural population, and a need for continued agricultural productivity growth to overcome land and water scarcity.

Institutional arrangements for the functioning of land and labor markets are a determinant of the ease with which this objective can be achieved. It is well known that restrictions on migrants' ability to gain urban residency permits (*hukou*) may impede migration, thus driving a wedge between the returns to labor received by farmers working their own plot and the wages they could earn outside of agriculture. This paper explores how land tenure arrangements can affect allocative efficiency and thus productivity of land use by either reducing the ease of transferring land temporarily to take up nonfarm employment or by precluding exit from agriculture.

* Financial support from the Knowledge for Change Trust Fund is gratefully acknowledged. The views expressed in this paper are those of the authors and do not necessarily reflect those of the World Bank, its Board of Executive Directors, or the countries they represent, of the Michigan State university, and of the Central University of Finance and Economics. Final revision accepted: October 6, 2013.

Our central argument is that, as long as there is a residual threat of land redistribution, maintaining some labor supply to farming and not exiting agriculture altogether can help reduce the probability of losing land. Temporary off-farm work and exit from agriculture are thus distinct processes that respond to different institutional arrangements. In particular, land certificates can reduce the transaction cost of transferring land to those who can make more productive use of it. However, while certificates can increase the number of efficiency-enhancing land transactions, they are issued and enforced locally. If households have reason to fear that local leaders may not honor existing property rights and redistribute land at some point in the future, they are likely to conclude that certificates alone are insufficient and cultivation will be required to guard against the possibility of land loss. While they may join nonagricultural activities temporarily, they may not exit agriculture unless the risk of redistribution is very low.

This generates testable hypotheses regarding impacts of land institutions on allocative efficiency that go beyond the impacts of tenure security on attached investment studied in a large existing literature: First, land *certificates* are expected to encourage part-time participation in nonagricultural employment but have no effect on exit from the agricultural sector. Second, low *expropriation risk* (as proxied by village leaders' adherence to the 2003 rural land contracting law that explicitly proscribes reallocations) is conducive to exit from the agricultural sector but will have little impact on short-term leasing within the village economy. [1]

Panel data covering a period of almost 10 years (2000–08) with information on whether households took up (part-time) nonagricultural employment or exited the sector can be used to empirically test these hypotheses. Methodologically, this allows us to use panel estimators to control for unobserved time-invariant household characteristics which, if there are no pre-existing structural differences between treated and control groups—a notion supported by the failure to reject the parallel trends assumption in the pre-2000 period—can be interpreted as causal effects. Substantively, the period covered is characterized by far-reaching economic and institutional changes in terms of off-farm labor market participation and agricultural productivity changes; real output per mu more than doubled from Y 2,550 to Y 5,588, despite declining staple crop prices. Some 15% of sample households exited agriculture and the mean share of household labor supplied to the nonagricultural sector increased from less than 50% to more than 60%.

We find that tenure insecurity, as measured by recent land reallocations, and transferability of land, as proxied by the share of households with certificates in a village, indeed affect nonagricultural labor supply very differently. Having experienced land reallocation discourages exit from agriculture but has no impact on labor supply to the nonfarm sector. Coverage with land certificates, a variable rarely considered in the literature, is estimated to have potentially large effects on participation in off-farm work and short-term migration but does not affect exit from agriculture. The size of estimated impacts on labor supply are not inconsequential; compared to a village with no land documents, the average household in a village fully covered with certificates is estimated to supply about half a person-year more to nonfarm labor markets via migration. Security against reallocation and the ease of transferring land are thus likely to play important but very different roles as determinants of China's ability to transform its rural sector.

To the extent that they affect households' labor supply, we would expect certificates and land redistribution to also impact agricultural productivity. Significant and quantitatively large productivity-effects are indeed confirmed by the data. Having been affected by reallocation after 2000 is estimated to reduce productivity by some 30% whereas possession of a land certificate in either period increases productivity by between 30% and 32%. These effects are quantitatively large and, in both cases, seem to be driven by allocative efficiency than by investment-effects considered in the literature.

The paper is structured as follows: Section two provides context by reviewing the role of agriculture in China's long-term development, recent institutional challenges in this respect, and legal initiatives taken to deal with them. Section three discusses the data used in more detail, reporting descriptive statistics on movement out of agriculture as well as agricultural productivity, in addition to introducing the conceptual framework for subsequent analysis. Section four presents econometric results to quantify impacts of institutional arrangements on partial or full movement out of agriculture and agricultural productivity. Section five concludes by drawing out implications for policy and possible future research.

2. BACKGROUND AND CONTEXT

While agricultural growth in China has made unprecedented contributions to poverty reduction, institutional factors also pose enormous challenges to the smooth movement of labor out of the agricultural sector into higher-paying nonagricultural pursuits and to market-based land transfers to more productive farmers who can then expand the scale of their operations. Such transfers will become more important to prevent or limit widening of rural–urban income gaps in light of the challenges posed by rapid aging of the rural population, a tighter overall labor supply, and environmental issues arising from scarcity of land and water resources. We review evidence of how reallocations and lack of documented property rights in the past limited investment and farmers' movement out of agriculture, the legislative measures taken to address this, and ways in which institutional changes could affect outcome variables included in our data.

(a) *Agriculture in China's economic development: Past contributions and future challenges*

Growth of the rural economy, driven by agriculture, and distributed equally as a consequence of egalitarian access to land, has been a key reason for rapid poverty reduction in China. In 1981, China was sixth-poorest country in the world, [2] with a poverty headcount of 84%. Growth in the primary sector, i.e., mainly in agriculture was four times more effective in reducing poverty than growth in secondary or tertiary sectors (Ravallion & Chen, 2007); it helped to reduce the poverty headcount to 16% by 2005, well below the developing world average of 26% (Ravallion, 2011).

While improved technology created the preconditions for rural growth, institutional changes that made property rights more secure and transferable, thereby facilitating a shift of labor out of agriculture, were critical in facilitating this transition. After an eventful history, [3] the first step was the 1978 Household Responsibility System (HRS) that made households residual claimants to output by contracting land from collectives to cultivators, initially for a period of 15 years. It set off unprecedented increases in productivity (Lin, 1992; McMillan, Whalley, & Zhu, 1989). However, the long-term effect was limited as many contracts remained verbal and failed to provide protection against administrative land reallocations (Rozelle, Brandt, Guo, & Huang, 2002). Land transfers were

often still administered by village leaders in discretionary ways (Kung & Liu, 1997),[4] creating conflicts of interest (Benjamin & Brandt, 2002) and failing to capitalize on opportunities to increase allocative efficiency created by rapid nonagricultural development. Agriculture was characterized by enormous improvements in total factor productivity (Jin, Ma, Huang, Hu, & Rozelle, 2010) that relate to different phases of policy reform (Brummer, Glauben, & Lu, 2006).

Concentration of industry and rapid economic growth in the country's coastal region provided incentives for migration and temporary movement out of agriculture (Zhao, 1999). As they responded to employment prospects and income differences (Lin, Wang, & Zhao, 2004), migrants contributed to rising rural incomes and well-being and success of coastal export industries (Liu, Carter, & Yao, 1998; Zhai & Wang, 2002).[5] The magnitudes are immense: The 2000 census counted 124.6 million internal migrants (Liang & Ma, 2004) or about 17% of the labor force (Taylor, Rozelle, & de Brauw, 2003), up from less than 5% in 1988 and some 10% in 1995 (Rozelle, Li, Shen, Hughart, & Giles, 1999). Restrictions on migrants' ability to gain residency at the destination imply that virtually all migration is temporary (Fleisher & Yang, 2003), prevent equalization of income levels (Whalley & Zhang, 2007), and contribute to persistent cross-regional imbalances (Au & Henderson, 2006).

At the household level, the high risk of moving out of agriculture and abandoning land use in favor of off-farm ventures has been identified as a key reason for returns to agricultural labor remaining persistently below what can be obtained from nonagricultural work or self employment (Cook, 1999). It contributed to factor market imperfections (Wang, Herzfeld, & Glauben, 2007) that often resulted in nonseparability of decisions on consumption and production (Bowlus & Sicular, 2003) and limited income diversification, and use of land as a key safety net and source of old-age support with few substitutes (Zhang, 2010). While high incidence of migration by the poor (de Brauw, Huang, Rozelle, Zhang, & Zhang, 2002) could in principle reduce poverty in sending communities (Zhao, 2002), actual impacts are less clear (Du, Park, & Wang, 2005). Still, similar to other countries' experience, migration is often complemented by local off-farm employment and part-time farming (Brosig, Glauben, Herzfeld, & Wang, 2009) or complete exit from agriculture.

To develop institutional arrangements that can help improve functioning of factor markets, especially those for land, the Government conducted a range of land tenure experiments (Kung, 2006), building on the results to put in place legal measures to strengthen tenure security. Key among these are the 1998 Land Management Law (Chen & Davis, 1998) and then the 2003 Rural Land Contracting Law. The latter puts focus on three areas, namely (i) a more stringent definition of land rights as property rights rather than just private contracts; (ii) a ban on big reallocations and setting off clear conditions for small readjustments;[6] and (iii) a commitment to issuance of land documents. However, while studies have explored determinants and impacts of land takings and the amount of compensation paid (Deininger & Jin, 2009), the effect of institutional arrangements on labor supply and allocative efficiency has not been explored in any depth. Study of this issue will be critical not only because of its direct bearing on rural–urban inequality but also as exogenous factors that create opportunities for factor markets to enhance allocative efficiency are likely to become more pronounced in the near future. For example, China may be entering a period of labor shortage (Cai & Wang, 2010) where near-unlimited supply of cheap migrant labor from the country's interior can no longer be taken for granted (Zhang, Yang, & Wang, 2010). Other countries' experience suggests that the institutional arrangements to promote structural change may persist and have long-term consequences, reinforcing the importance of carefully studying this issue.[7]

(b) *The role of land institutions in fostering structural transformation and off-farm development*

The literature holds that secure property rights to land can facilitate structural transformation in two ways (Besley & Ghatak, 2010). On the one hand, increased tenure security and the associated reduction of expropriation risk will increase investment incentives. On the other hand, formal documentation of rights, e.g., through certificates, makes it easier to unambiguously identify legitimate owners and thereby reduces the transaction cost of market-based land transfers. If other conditions—such as differences in productivity between producers because of availability of other sources of employment or a sufficiently liquid land sales market—are in place, this can facilitate either efficiency-enhancing land transfers to more productive users or use of land as collateral in credit markets (Deininger & Feder, 2009). Adapting these principles to Chinese conditions, where use of rural land as collateral is not permitted, reallocations could threaten those who have left their place of residence to pursue opportunities in distant places, and coverage with certificates is uneven, allows us to derive testable hypotheses.

Regarding *land reallocation*, the risk of dispossession for a resident cultivator who uses all or part of her land for agricultural purposes is low. This is one reason why studies find higher tenure security, defined as reduced probability of administrative reallocation, to have limited investment impact (Jacoby, Li, & Rozelle, 2002; Li, Rozelle, & Brandt, 1998). At the same time, the danger that renting out of land by somebody exiting agriculture could be perceived as a signal that the land is no longer required and could be transferred by administrative reallocation has long been identified as a potential challenge (Brandt, Rozelle, & Turner, 2004; Yang, 1997). Reallocation may thus discourage exit from the sector at the margin, consistent with findings that, where factor markets function reasonably well, such intervention significantly reduces technical efficiency (Zhang, Wang, Glauben, & Brummer, 2011).

Regarding *transferability*, measures to facilitate market-based land transfers, e.g., by increasing coverage with land certificates and outlawing reallocation can potentially make very positive contributions to the economy (Carter & Yao, 2002). Indeed, China witnessed rapid emergence of land rental markets which had hardly existed even in the mid-1990s (Deininger & Jin, 2005). In a situation where land loss by cultivators is unlikely and use of rural land as collateral not allowed, certificates can improve operation of local land markets through two channels. First, they can make contract enforcement easier, thus facilitating land transactions with individuals who are not close kin and with whom use of informal mechanisms to enforce contracts is not an option. Second, they will make it easier to recover land that is transferred for longer periods, thus allowing use of long-term contracts that can more effectively foster to structural transformation, e.g., by allowing tenants to make long-term plans and investment.[8]

A number of recent studies provide partial empirical support for these arguments. In a 2006 representative sample, land rental facilitated a major shift from agriculture toward migration (from 57% to 17%). On rented plots, net revenue was some 60% higher than what the landlord had obtained

under self-cultivation, and the proceeds made landlords and tenants better off (Jin & Deininger, 2009). A productivity-enhancing role of land markets can be inferred from the fact that, in a more limited sample from Southern China, productivity on leased plots is consistently higher (Feng, Heerink, Ruben, & Qu, 2010). For agricultural land, rental rights and higher tenure security have been found to increase the probability of migration while higher levels of tenure security alone may reduce migration levels on agricultural land but increase it on forest land where differences in labor-land complementarities are less pronounced (Mullan, Grosjean, & Kontoleon, 2011). [9]

While this points toward positive impacts of factor market operation, there is evidence that, even after reforms, institutional barriers to achieving fully efficient outcomes remain. Household perceptions and observed behavior—such as *a priori* limitation of the set of possible transaction partners—point toward remaining barriers to land market operation (Jin & Deininger, 2009). Those predicted to be constrained in the off-farm labor market benefit more from exogenous increases in labor demand brought about by the sloping land conversion program, a key intervention increasing labor demand (Groom, Grosjean, Kontoleon, Swanson, & Zhang, 2010).

Whether, even with current restrictions on migration, institutional arrangements constrain farmers' ability to participate in nonagricultural activities is of high policy relevance. Evidence on this remains scant and public opinion on the merits of institutional reforms, e.g., the ban on land reallocation, continues to be strongly polarized (Wang, Tong, Su, Wei, & Tao, 2011). Our paper adds to the literature by focusing on allocative rather than investment-effects and by distinguishing between institutional arrangements that only improve transferability but leave tenure security unchanged (certificates) and those that also increase tenure security (no redistributions in line with legal provisions). [10]

3. DATA AND DESCRIPTIVE EVIDENCE

Descriptive data on changes in overall income levels and sources, occupational status, and agricultural productivity from our six-province panel highlight the dynamic nature of China's rural sector and the geographically differentiated pattern of productivity and income growth as well as occupational diversification. They provide the basis for a discussion of the empirical strategy exploring determinants of part-time and full-time movement out of agriculture as well as agricultural productivity.

(a) *Sample composition and key definitions*

Our data are from a two-period household survey conducted in China's six major agricultural provinces in 2000 and 2008. [11] In each province, counties are stratified into five sub-groups by gross value of industrial output to represent varying income levels. Per province, one county and two villages were randomly selected from each sub-group and 20 households interviewed in each selected village. This yields a total sample (in 2000) of 1,200 households. In 2008, two earthquake-damaged villages in Sichuan could not be interviewed, reducing the sample to 1,160 households. Of these, 88 had moved to urban areas (of which 74 could be traced) while 53 dropped out and were replaced, leaving us with 1,093 households for which information in 2000 as well as 2008 is available. [12] The household survey includes detailed information on agricultural outputs and inputs, endowments with key factors of production, off-farm activities, whether or not and when households received land use certificates, and whether or not and when households experienced land reallocations.

We categorize households into non, full-time, or part-time farmers. Nonfarmers are those who report neither agricultural output nor using any inputs for agricultural activity. Part-time farmers have at least one individual whose main activity is not farming but who instead works outside the home county as a migrant or in local off-farm activities within the home county. In addition to the number of days spent in farming, the survey also includes information on the number of labor days supplied to the nonfarm sector by migrants or those engaging in local off-farm activity. [13] Overall economic development during the period is evidenced by considerable shifts in occupational status; in 2000, 21% of the 1,093 sampled households engaged in farming only, 73% were part-time farmers, and 6% relied only on off-farm occupations. In the meantime, 5% more part-time farmers became nonfarmers than full-time farmers, and 64% of the full-time farmers either devoted some labor (52%) or all labor (12%) to off-farm employment.

By 2008, the share of nonfarmers (19%) had marginally eclipsed that of full-time farmers (17%) and the share of part-time farmers was reduced from 73% to 64% (Table 1). This very aggregate picture show significant variation across provinces with the biggest increase in off-farm households (nonfarmers) observed for Zhejiang (from 10% to 34%), followed by Hubei (7% to 21%) and Hebei (6% to 16%). Even in Liaoning, some 11% of the sample engaged in off-farm activities by 2008. In Hebei, Liaoning, and Hubei, both full-time and part-time farmers abandoned agricultural production, leading to increases in the share of nonfarmers from 6.1%, 3.2% and 7.3% to 16.0%, 10.8% and 20.9% respectively. In Shaanxi, the share of full-time farmers remained constant at 16.7% and all of the increase in the share of nonfarmers (from 2.7% to 12.4%) came through a shift out of part-time farming. In Zhejiang, more than one third of previously rural households have shifted out of farming completely while the share of part-time farmers has remained more or less constant. Differences across types in terms of demographics, labor supply and its distribution, and aggregate agricultural productivity, provide interesting insights.

In addition to the types of data routinely included in multi-purpose household surveys and detailed information on agricultural production, our data includes evidence on institutional arrangements that affect land tenure security, in particular the coverage with certificates and levels of land reallocations at different points in time. [14] Assets include agricultural equipment, fixed business equipment, durable goods, and residential structures.

(b) *Descriptive statistics*

While there is a universal decrease in household size, the variable dropped most markedly for full-time farmers, from 3.55 to 2.75 persons, along with an increase in the dependency ratio from 36% in 2000—an already very high level—to 50%, compared to some 20% for the rest of the sample, in 2008. In line with this, income for this group was, with Y 6,223 in 2008, much lower than income by part-time (Y 21,845) and nonfarmers (Y 22,737) during the period. [15] Education levels increased to 10.5 years and 10.2 years in 2008 for part-time and nonfarmers, respectively, but only 7.3 years for full-time farmers. While income increased more than 60% in real terms during 2000–08, inequality in per capita income narrowed slightly, with the Gini decreasing from 0.53 to 0.50, possibly due to a marked increase in subsidies (Huang, Wang, Zhi,

Table 1. *Descriptive statistics by type of employment*

	Total		Full-time farmers		Part-time farmers		Nonfarmers	
	2000	2008[a]	2000	2008[a]	2000	2008[a]	2000	2008[a]
Household demographics								
Head's age	45.06	52.58	46.99	57.79	44.38	51.39	46.83	51.82
Male head	0.97	0.94	0.96	0.92	0.97	0.96	0.98	0.88
Household size	4.06	3.74	3.55	2.75	4.23	4.06	3.70	3.58
Population <14 years	0.72	0.42	0.75	0.30	0.71	0.49	0.75	0.30
Population 14–60 years	3.00	2.83	2.30	1.53	3.24	3.18	2.53	2.84
Population >60 years	0.34	0.49	0.50	0.92	0.28	0.39	0.42	0.44
Dependency ratio	25.90	26.36	35.69	50.11	22.30	20.17	36.44	25.49
Head's education (year)	6.61	6.54	5.77	5.46	6.82	6.75	7.00	6.86
Highest education (year)	9.60	9.89	7.52	7.26	10.19	10.52	9.47	10.19
Labor supply and income sources								
Total labor supply (days)	508	622	288	273	578	738	413	545
Days worked per adult	170	224	125	158	182	241	168	205
from agriculture (%)	51.1	40.2	100.0	100.0	41.4	35.5	0.0	0.0
from migration (%)	16.5	30.4	0.0	0.0	20.8	31.3	22.5	60.0
from local off-farm (%)	32.4	29.4	0.0	0.0	37.8	33.2	77.5	40.0
Income per adult eq.	2,518	5,670	892	3,015	2,854	6,123	4,047	6,595
Gini of income per adult eq.	0.53	0.50	0.45	0.55	0.48	0.43	0.56	0.56
Total income (Yuan)	8,940	19,295	2,498	6,223	10,356	21,845	13,929	22,737
from agriculture (%)	46.8	37.5	100.0	100.0	35.6	31.3	0.0	0.0
from migration (%)	19.1	34.1	0.0	0.0	24.4	36.2	17.0	62.4
from local off-farm (%)	34.1	28.4	0.0	0.0	40.0	32.5	83.0	37.6
Income per day worked (Yuan)	25.00	43.49	14.95	47.61	25.73	37.01	57.43	65.47
Number of off-farm individuals	1.36	1.62	0.00	0.00	1.72	1.81	1.59	2.49
Share of off-farm individuals	0.43	0.52	0.00	0.00	0.51	0.52	1.00	1.00
Number of migrants	0.44	0.84	0.00	0.00	0.56	0.81	0.38	1.70
Share of migrants	0.14	0.27	0.00	0.00	0.17	0.23	0.24	0.68
Number of local off-farm individuals	0.92	0.78	0.00	0.00	1.16	0.99	1.22	0.79
Share of local off-farm individuals	0.29	0.25	0.00	0.00	0.34	0.28	0.77	0.32
Productive activity								
Owned land area (mu)	7.70	6.52	9.07	6.94	7.69	7.01	3.00	4.35
Gini of owned land area	0.46	0.43	0.48	0.46	0.44	0.42	0.44	0.43
Cultivated land area (mu)	8.05	7.23	9.68	8.83	8.23	8.87	0.00	0.00
Gini of asset	0.64	0.72	0.59	0.68	0.62	0.62	0.72	0.80
Assets (Yuan)	32,491	105,310	16,863	53,445	33,432	84,355	75,880	226,816
of which agricultural (%)	9.02	5.47	13.71	9.12	8.36	5.90	0.70	0.35
Geographical distribution								
Hebei (%)	16.6	16.6	22.7	21.6	71.3	62.4	6.1	16.0
Shaanxi (%)	17.0	17.0	16.7	16.7	80.7	71.0	2.7	12.4
Liaoning (%)	16.9	16.9	32.4	29.7	64.3	59.5	3.2	10.8
Zhejiang (%)	17.9	17.9	10.2	11.8	79.6	54.1	10.2	34.2
Sichuan (%)	14.1	14.1	28.6	17.5	66.2	67.5	5.2	14.9
Hubei (%)	17.5	17.5	15.7	7.9	77.0	71.2	7.3	20.9
No. of observations	1,093	1,093	226	190	803	701	64	202

Source: Own computation from 2000 to 2010 panel household survey.
[a] Monetary values for 2008 are deflated by CPIs (Consumer Price Index) from NBSC (National Bureau of Statistics of China).

Huang, & Rozelle, 2011). Gaps in asset levels were more pronounced and with the Gini for total asset endowments rising from 0.64 to 0.72 during 2000–08, asset inequality increased markedly: While full-time farmers increased their asset endowment from Y 16,863 to Y 53,445, part-time farmers did so from Y 33,432 to Y 84,355 and nonfarmers from Y 75,880 to Y 226,816.

Differences in demographic structure gave rise to marked variations in labor supply and sources and income levels across household types. Part-time farmers increased labor supply from 578 to 738 days in total (or 182 to 241 days per adult), compared to an increase from 413 to 545 days (168 to 205 days per person) for nonfarm and a change from 288 to 273 (125 to 158 days per person) for full-time farmers. With the exception of full-time farmers, the composition of labor supply changed markedly as well; although their total number of labor days in agriculture increased slightly (from 240 to 262), part-time farmers reduced the share of time spent on agriculture from 41% to 36%, while expanding labor in migration from 21% to 31% and reducing local off-farm work from 38% to 33%. Nonfarm households expanded supply of labor to migration from 23% to 60% while reducing labor in local off-farm activity from 78% to 40%. Shifts in labor supply are mirrored by corresponding changes of income composition.

The data also point toward improved functioning of factor markets, especially those for land. While the amount of owned land decreased 9.1 to 6.9 mu for full-time and from 7.7 to 7.0 mu for part-time farmers, cultivated land area decreased much less (from 9.7 to 8.8 mu) for full-time farmers and increased (from 8.2 to 8.8 mu) for part-time farmers, presumably as a result of better functioning of land rental markets. At the same time, land ownership by nonfarmers increased, from 3.0 to 4.4 mu. The most likely reason is that the 2003 RLCL policy of stopping land redistribution was more strictly adhered to. More importantly, and in contrast to what would be expected in environments with missing markets where land reallocation might be the only mechanism to restore balance, our data suggest that having had a high level of land reallocation in the past will increase the expectation of future redistributions. A review of institutional variables, in particular the incidence of land reallocations and land certificates by province, can provide insights on this (Table 2).[16] Two findings emerge. First, land reallocation overall was infrequent; 70% of producers were never affected by such an event. Second, while the rate of reallocations decreased from 17% to 10%, marked differences emerge across provinces; while Hebei shows the most marked drop from 23% to 2% and redistributions more or less halved in Shaanxi (18% to 8%) and Zhejiang (21% to 14%), they decreased less or stay constant in others, such as Hubei (15% to 11%), Sichuan (8% to 7%), and Liaoning (15%).[17] Details on the type of reallocation are available only from village level data which confirm a consistent trend toward reducing the number of reallocations across provinces. During 2000–08, no reallocations were carried out in Sichuan and Hebei and Zhejiang. In Hubei numbers are trivial (both 0.09) despite the existence of major and minor reallocations. On the other hand, while major reallocations were more limited in Shaanxi (0.29) and Liaoning (0.11), the share of minor reallocations remained high (0.38 and 0.40, respectively). To interpret these figures recall that many villages did have a reallocation around 1998 in the context of renewal of land use contracts that had expired after the first 15-year period following the HRS.

Table 2 illustrates that, although one third of households still lack a land use certificate, issuance of certificates has progressed more uniformly, in contrast to variable levels of compliance with policies to stop land reallocations. Between 32% and 52% of households had certificates before 2000 and lagging provinces, in particular Hubei and Liaoning where levels of issuance in 2000 had remained very low caught up rapidly by providing certificates to 39% and 19% of producers, respectively, after 2000. To the extent that having certificates enhances transferability more than tenure security, we would expect it to facilitate out-migration and operation of land rental markets.

In line with aggregate data, descriptive statistics in Table 3 point toward large increases in real output per area and profit (including returns to family labor) over the period. The fact that cultivated area remained almost constant despite a decline in owned area to 83% of the 2000 value points toward increased rental market activity. Profit per mu increased by a factor of 2.3 and labor and capital intensity, defined as the amount of agricultural assets per mu, increased by 13% and 85%, respectively. Resource endowments varied widely across regions. In 2008, average owned and cultivated are 10.2 and 14.8 mu, respectively, in Liaoning as compared to 4.0 and 7.1 mu in Zhejiang. Relative factor intensities varied as expected, with labor intensity higher in land-scarce provinces such as Sichuan (82 days/mu in 2000 and 114 days/mu in 2008) compared to "land abundant" ones such as Liaoning (24 and 32 days/mu, respectively) although alternative employment opportunities also appear to play a role, as illustrated by the decrease of labor intensity (from 32 to 28 days/mu) in Zhejiang. The total amount of agricultural assets, which increased by 70% overall, more than doubled in Shaanxi while declining slightly in Zhejiang. The data also indicate considerable increase in major purchased inputs of crop production. Expenditure on fertilizer and other inputs (including pesticides, machinery, fuel, and electricity) almost doubled over the 8-year period (from 77 to 143 Yuan/mu for fertilizer and from 70 to 120 for other inputs) while spending on seeds increased by more than 50% (from 21 to 33 Yuan/mu), with regional variations. In Hebei, Shaanxi, Sichuan, and Hubei values of these inputs in 2008 were more than 1.5 times the values in 2000, the increases were less than 50% for all inputs in Zhejiang and for seeds and others in Liaoning.

The literature is ambiguous on whether having experienced a reallocation in the past will increase or reduce tenure security.[18] Our data include information on whether or not a

Table 2. *Incidence of land reallocations institutional preconditions for tenure security and land market development*

	Total	Hebei	Shaanxi	Liaoning	Zhejiang	Sichuan	Hubei
Land reallocations (household level)							
Never had reallocation (%)	70.17	74.03	68.82	67.57	60.71	84.42	68.59
Reallocation before 2000 (%)	17.02	23.20	18.28	15.14	20.92	7.79	15.18
Reallocation after 2000 (%)	9.61	2.21	7.53	14.59	14.29	7.14	10.99
Realloc. in both periods (%)	3.20	0.55	5.38	2.70	4.08	0.65	5.24
Land reallocations (village level)							
Share with major reallocations before 2000	0.58	1.00	0.21	1.00	0.90	0.12	0.19
Share with minor reallocations before 2000	0.67	0.39	0.90	0.61	0.80	0.62	0.70
Share with major reallocations after 2000	0.14	0.00	0.29	0.11	0.30	0.00	0.09
Share with minor reallocations after 2000	0.20	0.28	0.38	0.40	0.00	0.00	0.09
Land use certificates							
No land certificate (%)	31.93	30.94	39.78	29.73	28.57	27.92	34.03
Certificate before 2000 (%)	31.75	45.30	29.57	43.78	35.71	26.62	9.42
Certificate after 2000 (%)	16.10	2.21	6.99	18.92	10.20	18.83	39.27
Certificate, date unknown (%)	20.22	21.55	23.66	7.57	25.51	26.62	17.28
No. of observations	1,093	181	186	185	196	154	191

Source: Own computation from 2000 to 2010 panel household survey.

Table 3. *Descriptive statistics for agricultural production*

	Total	Hebei	Shaanxi	Liaoning	Zhejiang	Sichuan	Hubei
2000							
Output (Yuan)	2,550.05	3,658.54	2,366.68	3,269.12	2,142.68	1,781.75	1,848.72
Yield (Yuan/mu)	368.97	373.03	352.663	287.50	409.17	430.13	386.45
Profit and return to labor (Yuan/mu)	196.44	197.64	206.69	101.60	211.21	275.75	208.61
Owned land area (mu)	8.47	13.69	7.94	11.73	5.24	4.76	6.11
Cultivated land area (mu)	9.12	14.77	8.09	12.62	6.85	4.88	6.25
Total labor (manday/mu)	47.03	28.81	48.07	24.07	32.44	81.94	71.68
Family labor (manday/mu)	46.77	28.77	47.75	23.58	32.02	81.87	71.51
Hired labor (manday/mu)	0.26	0.03	0.32	0.48	0.42	0.07	0.17
Seed exp. (Yuan/mu)	20.70	13.42	16.70	33.80	18.79	17.69	21.94
Fertilizer exp. (Yuan/mu)	77.29	75.01	66.26	59.61	78.36	94.43	95.41
Other expenditure (Yuan/mu)	69.57	86.36	59.08	83.68	88.17	41.11	57.46
Head's age	45.02	45.00	45.39	45.58	47.62	42.43	44.05
Male head	0.98	0.98	0.94	0.99	0.98	0.97	0.99
Household size	4.13	4.12	4.35	3.64	4.14	4.27	4.30
Population 14–60 years	3.09	3.14	3.16	2.76	3.34	3.05	3.19
Highest education (year)	9.58	9.03	10.08	10.23	10.26	8.10	9.60
Agricultural assets (Yuan)	1,084	2,043	796	1,419	618	760	737
Nonagricultural assets (Yuan)	25,119	24,812	14,400	27,010	52,977	9,534	25,002
Household w certificate (%)	33.60	47.26	31.65	45.40	34.96	29.92	10.96
Household date unknown (%)	14.95	17.81	16.46	3.68	21.95	25.20	8.22
Experienced reallocations (%)	19.58	23.97	22.15	19.02	25.20	8.66	17.81
2008[a]							
Output (Yuan)	5,588.29	8,115.37	4,427.23	8,501.52	5,061.67	3,168.09	3,614.18
Yield (Yuan/mu)	775.04	828.79	688.02	787.32	1,030.54	661.58	685.17
Profit and return to labor (Yuan/mu)	456.27	502.10	403.30	485.15	694.48	334.95	340.36
Owned land area (mu)	7.06	10.86	5.81	10.21	3.98	4.94	5.51
Cultivated land area (mu)	8.98	12.59	6.44	14.78	7.05	5.20	6.60
Total labor (manday/mu)	53.19	33.13	62.01	32.16	28.12	113.54	55.84
Family labor (manday/mu)	52.73	32.79	61.81	31.94	26.90	112.59	55.72
Hired labor (manday/mu)	0.47	0.34	0.19	0.22	1.22	0.95	0.12
Seed exp. (Yuan/mu)	33.28	31.74	25.48	43.16	19.84	33.58	43.27
Fertilizer exp. (Yuan/mu)	142.93	137.34	141.35	122.87	115.49	175.78	167.15
Other expenditure (Yuan/mu)	120.41	145.34	107.73	124.58	120.37	96.52	125.33
Head's age	52.59	51.97	52.92	53.65	55.26	49.69	51.94
Male head	0.95	0.96	0.92	0.98	0.98	0.94	0.95
Household size	3.79	3.66	3.98	3.34	3.77	3.98	4.07
Population 14–60 years	2.84	2.80	3.01	2.46	2.83	2.91	3.03
Highest education (year)	9.84	9.21	10.22	10.01	10.24	9.00	10.29
Agricultural assets (Yuan)	1,845	2,815	2,122	2,704	598	998	1,401
Nonagricultural assets (Yuan)	70,683	44,319	40,718	58,072	199,150	39,138	62,763
Household w certificate (%)	66.86	67.81	56.33	69.94	69.92	72.44	66.44
Experienced reallocations (%)	12.98	2.74	13.92	19.02	14.63	8.66	17.81
No. of observations	863	146	158	163	123	127	146

Source: Own computation from 2000 to 2010 panel household survey.
[a] Monetary values for 2008 are deflated by CPIs from NBSC.

household expects to be able to use a given plot in the future (one and 3 years for the 2000 and 5 and 10 years in the 2008 survey). Although it is not clear whether this question refers to expropriation only or may include other life cycle events, we note that in both periods, the share of those who expect to no longer be able to use a plot is significantly larger in villages that had experienced a reallocation than in those that did not. This interpretation is reinforced by the finding that the share of those who experienced a reallocation in the 2000–08 period was higher in villages that also had experienced a reallocation before 2000.

(c) *Conceptual framework and estimation strategy*

Our empirical analysis focuses on determinants of households' moving off the farm in line with the expectation that reallocations reduce exit from agriculture and certificates enhance temporary labor supply to nonagriculture. We use a reduced form equation to identify these. Letting subscripts i, j, k, and t index individuals, villages, province, and time we estimate

$$L_{ijkt} = \beta_1 X_{ijkt} + \beta_2 V_{jkt} + \psi_k + \gamma_t + \varepsilon_{ijkt} \quad (1)$$

$$\varepsilon_{ijkt} = a_{ijk} + c_{jk} + \mu_{ijkt} \quad (2)$$

where L_{ijkt} represents either (i) an indicator variable that is one if the household derives all its income from nonfarm activities and zero otherwise; (ii) the number of individuals in the household who derive their main income from off-farm activities; or (iii) the number of labor days supplied to off-farm labor markets. X_{ijkt} is a vector of household characteristics including demographics, asset values, land endowments, and an indicator for

whether or not reallocation of land had been experience. V_{jkt} is a vector of village level variables that includes population, the share of workers, distance to the nearest road, share of households with tap water, number of enterprises, total land endowment, and the share of households with land certificates. ψ_k controls for time-invariant differences between provinces, γ_t controls for time-variant changes affecting all households equally, and the error term ε_{ijkt} is composed of three unobserved components, heterogeneity at household and village level (a_{ijk} and c_{jk}) and a time-variant term (μ_{ijkt}).

To avoid the drawbacks of using a linear model for discrete responses, we use nonlinear models for different dependent variables, namely (i) a probit model is used for farm exit (a binary variable); (ii) a Poisson model for the number of household members participating in off-farm labor markets (a count variable); and (iii) a tobit model for the number of days supplied to off-farm labor markets to deal with the fact that this variable will be truncated at zero.

In panel data settings, the independence between covariates and the unobserved heterogeneity is a strong assumption. Compared to probit and tobit models, the fixed-effect Poisson estimation is well-defined (Hausman, Hall, & Griliches, 1984; Wooldridge, 1999). However, it does not allow an observation to contribute to the estimation if its outcomes are zeros in all periods, which will reduce our sample size by 8.8%, 39.9%, and 27.1% in terms of total number of individuals engaging in off-farm employment, migrants, and local off-farm participants, respectively. We follow recent studies and apply the correlated random effects (CRE) model that includes average levels of time-variant variables (Egger, Greenaway, & Seidel, 2011; Lewis, Barham, & Robinson, 2011; Ricker-Gilbert, Jayne, & Chirwa, 2011), thus relaxing the independence assumption by modeling the distribution of the unobserved effect conditional on exogenous variables (Chamberlain, 1984; Mundlak, 1978). The generalized estimation equation (GEE) and the pooled tobit (Wooldridge, 2010) allow us to enhance efficiency without sacrificing consistency. We also estimate the linear model with household fixed effects as a robustness check.

To assess whether institutional arrangements can directly or indirectly affect productivity, we estimate a Cobb-Douglas production function.

$$Q_{ijt} = \exp(\alpha_{ij} + \alpha_j + \gamma_t + \alpha_j t + \delta S_{ijt} + \varepsilon_{ijt}) A_{ijt}^{\theta_2} L_{ijt}^{\theta_2} K_{ijt}^{\theta_3} I_{ijt}^{\theta_4} \quad (3)$$

where Q_{ijt} is the value of crops produced by household i in village j in year t; A_{ijt}, L_{ijt}, K_{ijt}, and I_{ijt} are cultivated area, labor for production, value of agricultural assets, and a vector of inputs that includes seeds, chemical fertilizer, and others (the sum of organic manure, pesticides, and agricultural machinery); θ_1, θ_2, θ_3, and θ_4 are technical coefficients to be estimated; S_{ijt} is a vector of institution variables including whether a household had a land use certificate or experienced a land reallocation; α_{ij} and α_j are time-invariant household and village characteristics; γ_t controls for time-variant changes that affect all households equally; and $\alpha_j t$ controls for village-specific time trends given that institutional changes are likely to be determined locally. The error term ε_{ijt} captures time-variant household heterogeneity. Taking logarithms on both sides yields

$$q_{ijt} = \alpha_{ij} + \alpha_j + \gamma_t + \alpha_j t + \delta S_{ijt} + \theta_1 a_{ijt} + \theta_2 l_{ijt} + \theta_3 k_{ijt} + \theta_4 i_{ijt} + \varepsilon_{ijt} \quad (4)$$

where q_{jit}, a_{ijt}, l_{ijt}, k_{ijt} and i_{ijt} are logarithms of Q_{ijt}, A_{ijt}, L_{ijt}, K_{ijt}, and I_{ijt}. To eliminate unobservable time-invariant characteristics, we take first differences to obtain

$$\Delta q_{ij} = \Delta\gamma + \alpha_j + \delta \Delta S_{ij} + \theta_1 \Delta a_{ij} + \theta_2 \Delta l_{ij} + \theta_3 \Delta k_{ij} + \theta_4 \Delta i_{ij} + \Delta\varepsilon_{ij} \quad (5)$$

In addition to technical coefficients θ regarding the impact of inputs, δ captures the impact of having received a land certificate or been affected by land reallocation in 2000–08. Based on the literature discussed earlier, we expect certificates affect productivity positively by enhancing allocative efficiency and land reallocations to have a negative impact as they reduce tenure security and thus, in addition to any potential investment-effect, the propensity to exit agriculture for those who are not good farmers. To interpret the coefficients on these variables as indicators of impact and thus attribute productivity changes to institutional changes we need to ensure that both initial conditions and pre-intervention trends do not differ significantly between those who did and did not receive certificates or were affected by redistribution. We conduct relevant tests and discuss them below.

4. ECONOMETRIC RESULTS

Econometric analysis allows us to assess the relevance of institutional variables and the magnitude of their impact on relevant outcomes. We find that having been affected by reallocation reduces the propensity of exiting agriculture by a modest amount but leaves the amount of time supplied to the nonagricultural sector (migration or local) on a part-time basis unaffected. Coverage with certificates, on the other hand, increases the likelihood of working off-farm, largely via migration. In both cases effects are large—no reallocation and certificates increase productivity by almost a third each and robust to a range of checks for potential endogeneity.

(a) *Nonagricultural labor supply and exit from the sector*

Coefficients in Table 4 are average partial effects for the probability of exiting agriculture, the number of individuals participating in nonagricultural activities (both migration and local off-farm employment), and the number of days supplied to the different types of nonagricultural labor markets.

Households who had been affected by land reallocations are less likely to exit the agricultural sector. The estimated effect is about 5%, i.e., households who experienced reallocation after 2000 are 5% less likely to exit agriculture than those who did not. While it has higher standard errors as expected, the linear model with household fixed effects yields a very similar coefficient estimate (Appendix A). Part-time labor supply to nonagricultural labor markets is estimated to not be affected by reallocation; all relevant coefficients are small and insignificantly different from zero. Reallocations thus appear to affect farmers' decisions on staying in agricultural production rather than the extent to which they engage in off-farm activity. In line with our hypotheses that, because they rely on local enforcement, [19] certificates do not significantly enhance tenure security, the share of certificates at village level is indeed not significant, suggesting that certificates do not affect exit decisions.

Secondly, certificates contribute significantly to participation in off-farm labor markets, an effect driven entirely by their impact on encouraging migration. The size of estimated coefficients is large; compared to a village with no land certificates, issuance of land use certificates to every household in the village would be predicted to result in a 67% increase in the number of individuals supplying labor to nonagricultural labor markets or an increase of households' labor supply to such

Table 4. *Regressions for households moving off the farm and the labor supplied to off-farm activities*

	Exit from agriculture	No. of individuals employed in			Days worked in		
		off-farm	migrating	local	off-farm	migrating	local
Own land area per capita	−0.001	0.005	−0.013	0.019	2.046	−4.218	3.886
	(0.012)	(0.018)	(0.013)	(0.018)	(3.120)	(3.069)	(3.099)
Head's age	−0.002	−0.017**	−0.009	−0.008	−3.752**	−1.086	−2.837**
	(0.002)	(0.007)	(0.007)	(0.008)	(1.541)	(1.538)	(1.122)
Male head	−0.107*	−0.132	−0.116	−0.096	−22.645	−11.254	−20.118
	(0.057)	(0.174)	(0.132)	(0.149)	(42.029)	(38.335)	(40.856)
Highest education	−0.002	0.031***	0.022***	0.009	9.234***	6.960***	3.805*
	(0.003)	(0.009)	(0.008)	(0.008)	(2.500)	(2.131)	(2.008)
Population <14 years	−0.028**	−0.049	−0.105***	0.066**	5.621	−31.400***	25.116***
	(0.013)	(0.037)	(0.035)	(0.033)	(11.453)	(9.217)	(9.537)
Population 14–60 years	−0.000	0.485***	0.307***	0.195***	121.486***	56.979***	56.069***
	(0.010)	(0.033)	(0.032)	(0.029)	(8.453)	(8.361)	(9.443)
Population >60 years	−0.003	0.113*	0.047	0.069	43.690**	6.778	33.963**
	(0.021)	(0.062)	(0.051)	(0.054)	(18.274)	(12.484)	(15.293)
Value of assets ('000 Yuan)	0.000	−0.000	−0.001***	0.000***	−0.026	−0.205***	0.069***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.031)	(0.070)	(0.021)
Land reallocation	−0.051***	−0.021	−0.043	0.006	−11.128	2.391	−11.957
	(0.020)	(0.075)	(0.063)	(0.067)	(13.764)	(17.341)	(16.057)
Share of certificates (village level)	0.003	0.673***	0.273**	0.198	100.332**	95.300**	−1.549
	(0.056)	(0.154)	(0.131)	(0.174)	(49.053)	(40.032)	(57.628)
Log population (village level)	0.065	0.028	−0.093	0.037	−34.413	−29.882	−7.816
	(0.044)	(0.160)	(0.147)	(0.149)	(38.664)	(41.469)	(25.157)
Share of workers (village level)	0.019	−0.341	−0.538**	0.251	−18.753	−120.856*	84.731
	(0.100)	(0.282)	(0.245)	(0.257)	(74.963)	(68.893)	(82.949)
Distance to nearest road (village level)	−0.011	0.020	−0.034*	0.087***	0.987	−8.492*	15.201***
	(0.009)	(0.023)	(0.019)	(0.024)	(5.310)	(5.131)	(4.951)
Share of households with tap water (village level)	0.005	0.076	0.098	0.043	32.351	32.351	3.505
	(0.027)	(0.079)	(0.075)	(0.071)	(21.121)	(22.030)	(23.487)
No. of enterprises (village level)	0.001	0.000	−0.001	−0.000	−0.369	−0.223	−0.238
	(0.000)	(0.002)	(0.002)	(0.001)	(0.288)	(0.248)	(0.186)
Log area of arable land (village level)	−0.059*	−0.126	0.129	−0.198*	10.775	34.791	−21.757
	(0.031)	(0.110)	(0.094)	(0.107)	(27.141)	(28.589)	(20.923)
Year 2008 dummy	0.114***	0.315***	0.446***	−0.070	119.711***	78.241***	27.604*
	(0.035)	(0.089)	(0.115)	(0.079)	(18.294)	(20.077)	(15.931)
Shaanxi	−0.057***	−0.062	0.739***	−0.457***	16.642	150.989***	−135.446***
	(0.019)	(0.082)	(0.173)	(0.048)	(28.922)	(28.658)	(26.992)
Liaoning	−0.030	−0.097	0.229*	−0.211***	27.336	44.472	−22.250
	(0.024)	(0.086)	(0.123)	(0.060)	(26.683)	(32.045)	(27.801)
Zhejiang	−0.006	0.256**	0.678***	−0.084	93.677***	108.530***	2.527
	(0.031)	(0.113)	(0.218)	(0.082)	(28.808)	(35.336)	(34.773)
Sichuan	−0.031	−0.214**	0.581***	−0.487***	−23.012	126.128***	−138.474***
	(0.025)	(0.086)	(0.171)	(0.050)	(29.408)	(31.120)	(34.507)
Hubei	0.039	0.297***	0.845***	−0.241***	95.284***	159.389***	−63.600**
	(0.034)	(0.099)	(0.189)	(0.066)	(31.518)	(32.240)	(28.550)
Observations	2,186	2,186	2,186	2,186	2,186	2,186	2,186
Wald chi^2	281.93	1,422.25	891.60	608.91			
Pseudo R^2					0.037	0.042	0.029
R^{2a}	0.142	0.411	0.318	0.223	0.345	0.237	0.216

Mean household- and village-level variables included throughout but not reported.
* Statistically significant at 10%.
** Statistically significant at 5%.
*** Statistically significant at 1%.
[a] R^2 is calculated based on the correlation coefficient between predicted and observed values (see Egger *et al.*, 2011).

markets by 100 days. Most of these effects would come about through migration. Appendix A illustrates that results for the number of migrants are robust to inclusion of household fixed effects in a linear model, further increasing our confidence in their validity. The results are particularly remarkable as second round data were collected at the height of the financial crisis.

In addition to the institutional variables, we note that off-farm participation increases significantly over time. The positive and highly significant time dummy captures a secular increase in the propensity of exiting agriculture; the probability of exiting agricultural production in 2008 is estimated to be higher by an average of 11% as compared to that in 2000. The positive coefficients on the size of population 14–60 years

of age across all measures of off-farm participation point to the importance of the labor endowment for off-farm labor supply. At the mean, having one more adult in the household increased the number of individuals with off-farm pursuits by 49% and the number of labor days by 121, while the number of individuals in local off-farm work increased by 20%, that of migrants rose by 31% with increases of 56 and 57 labor days, respectively. Higher numbers of dependents, however, reduce the propensity to migrate but increase the likelihood of engaging in local off-farm labor markets, an effect that is even stronger for over 60 year olds. While this may be due to the timing of the survey, it may also indicate that the latter can support farming in some periods but not take full management responsibility. Each additional year of education is estimated to translate into a 3% increase in the number of individuals supplying labor to the nonfarm sector as well as nine total off-farm labor days.

The fact that assets are predicted to reduce the likelihood of migration while increasing the propensity to engage in off-farm employment is in line with the notion that lack of assets or local demand for labor is a key reason for households to migrate rather than participate in local off-farm employment. From a policy perspective, this reinforces the importance of policies favoring local asset accumulation.[20] The increases in real asset values reported in Table 3 (Y 46,324 for the entire sample, from Y 20,278 in Hebei to 146,153 in Zhejiang) would, according to the estimates, have led to a decrease in the number of individuals migrating by 4.6 percentage points on average, ranging from 2.0 in Hebei to 14.6 in Zhejiang. Access to road increases local off-farm labor supply but reduces migration. The significant positive coefficient on the 2008 year dummy for migration points toward an increase in off-farm participation over time. The lack of a corresponding trend in local nonagricultural employment may indicate that the contribution to local economic growth rather than just out-migration is not yet assured. Differences in signs and magnitudes of the coefficients on province dummies also point toward marked inter-regional variation in the extent of changes in nonagricultural labor market participation over time; moves into off-farm occupations are more likely in Zhejiang whereas local off-farm employment is less likely in Shaanxi, Liaoning, Sichuan, and Hubei.

(b) *Determinants of agricultural productivity*

If certificates and reallocations systematically affect households' participation in nonagricultural labor markets, one would expect them to also have an impact on the productivity of land use. In line with earlier discussion, three possible mechanisms are possible. First, greater transferability may allow productive farmers to lease in land and increase the size of their operation. Second, access to nonagricultural income could, either directly or indirectly alleviate liquidity constraints that might have led to lower levels of productivity. Finally, increased tenure security and possibly long-term contracts could prompt those involved to make longer-term investments which may not necessarily be observable in the

Table 5. *Determinants of agricultural productivity*

	Output (log)		Output (log)	
Cultivated land area (log)	0.670***	0.642***	0.782***	0.757***
	(0.119)	(0.114)	(0.115)	(0.112)
Total labor (log)	−0.040		−0.058	
	(0.046)		(0.046)	
Family labor (log)		−0.030		−0.040
		(0.045)		(0.046)
Hired labor (log)		−0.006		−0.023
		(0.099)		(0.093)
Highest education (log)	0.004	−0.026	0.040	0.015
	(0.130)	(0.130)	(0.127)	(0.126)
Value of agricultural assets (log)	0.032	0.030	0.008	0.004
	(0.020)	(0.020)	(0.019)	(0.018)
Expenditure on seeds (log)	0.045	0.046	0.021	0.017
	(0.042)	(0.042)	(0.044)	(0.044)
Expenditure on fertilizer (log)	0.157**	0.146**	0.138**	0.123**
	(0.062)	(0.061)	(0.062)	(0.059)
Other expenditure (log)	0.158***	0.160***	0.108**	0.108**
	(0.051)	(0.049)	(0.049)	(0.048)
Land certificates before 2000 (δ_1)	0.304***	0.318***	0.273**	0.280**
	(0.105)	(0.104)	(0.114)	(0.114)
Land certificates after 2000 (δ_2)	0.258*	0.243*	0.288*	0.272*
	(0.144)	(0.138)	(0.165)	(0.162)
Land reallocations before 2000 (δ_3)	0.005	0.037	0.027	0.062
	(0.109)	(0.114)	(0.113)	(0.116)
Land reallocations after 2000 (δ_4)	−0.305**	−0.293**	−0.389***	−0.392***
	(0.124)	(0.126)	(0.148)	(0.151)
Village level time trends	No	No	Yes	Yes
Observation	863	863	863	863
R^2	0.358	0.364	0.462	0.470
Tests:				
$\delta_1 = \delta_2$	0.10	0.29	0.01	0.00
$\delta_3 + \delta_4 = 0$	2.84*	2.03*	3.39*	2.74*

* Statistically significant at 10%.
** Statistically significant at 5%.
*** Statistically significant at 1%.

survey (e.g., if those remaining in agriculture invest to improve their agricultural skills to be able to farm greater land sizes more efficiently). Results from estimating a production function on the panel of 863 full- or part-time farmers in Table 5 provide a direct test of this and allow us to explore the plausibility of different channels through which such effects could materialize.

As household fixed effects control for unobserved time-invariant characteristics only, effects estimated in this way can be interpreted as causal impact of institutional change in the 2000–08 period only if, before the intervention, those who were and were not affected by the change were on similar growth trajectories. While testing this "parallel trends" assumption requires panel data, we use the fact that individual-level job histories for the last decade and beyond were obtained from a subset of the households in the 2000 survey to obtain information on changes in households' overall level of labor force participation, the share of households participating in full and part-time agriculture, and the share of total labor time spent in migration and outside of agriculture. Appendix A presents levels and changes in these variables for the groups of interest does not allow us to reject the hypothesis of no significant difference in pre-intervention trends for any of the variables. To explore this further, we also check equality in key variables pertaining to household characteristics, labor supply, and endowments with productive factors such as land and assets. Appendix A points toward significant differences in few of these variables only for households affected by reallocations who were more educated and affluent than those who were not. Under the assumption that education and wealth allow more rapid adoption of technical change, this should bias coefficients in the productivity regression downward so that our estimate will be a lower bound of redistribution-induced productivity effects.

We find evidence of a negative and significant impact of reallocations conducted after 2000 but not ones before this date.[21] The point estimate of 0.30 in both specifications suggests that, by reducing productivity by almost a third, redistributions could have had large productivity-effects. Further research is needed to determine whether this occurs because operators without comparative advantage in farming stay in agriculture as they fear to lose to reallocation or whether it prevents efficiency-enhancing investments by tenants who are able to obtain land only for a short duration of time.

While qualitative effects of reallocation on various determinants of productivity have been found—though not always quantified—before, our regressions also point toward possession of certificates having clear and quantitatively large productivity-effects. The magnitude of the coefficients, 0.30 for certificates that had been held before 2000 and 0.26 for those received during 2000–08, suggests that households with a certificate are about one third more productive than those without a certificate.[22] If this effect were to come via higher levels of investment, we would expect it to increase in the length for which the certificate has been held. Results for the relevant test, reported in the bottom panel, do not allow us to reject equality of the relevant coefficients between households who received them earlier and later, implying that, rather than through investment, large part of the effects measured here may be driven by differences in unobserved farmer ability and allocative efficiency.

Coefficients on other factors such as land, fertilizer, and other purchased inputs are highly significant and with the large point estimate of the coefficient on land reinforcing the relevance of this factor. The insignificant coefficient of labor, while consistent with findings from other studies (Benjamin, Brandt, & Giles, 2005) is surprising in view of recent concerns about emerging labor shortages in China's export sector but may be explained by the notion that it is the old who take care of agricultural cultivation in many contexts, especially if there is significant out-migration (Chang, Dong, & Macphail, 2011).

5. CONCLUSION AND POLICY IMPLICATIONS

The fact that productivity growth in nonagriculture has consistently been higher than in the agricultural sector implies a secular movement of labor out of agriculture with economic development. The nature and speed of this process, and the implications for household welfare as well as policies to address rural–urban income gaps, will depend on the policy and institutional environment. The issue is particularly acute for China given the spatial concentration of industry, small size of average agricultural land endowments, large numbers of farmers, and generational dynamics created by rapid aging of rural populations. These suggest large potential for market-based transfers to improve allocative efficiency and rural economic development in the near future. Better appreciation of how institutional factors affect the direction and pace of rural structural transformation and productivity is thus critical to understand the underlying dynamics and help design policies that can avoid rising rural–urban inequality without having to resort to very costly and potentially distorting transfer payments.

We use recent panel data to study the impact of two key institutional factors—nonmarket land reallocation and local issuance of land use certificates—on structural transformation and agricultural productivity in rural areas. With tenure security and transferability as main ways through which land tenure affects behavior, we hypothesize that reallocations may impede exit from agriculture whereas certificates could make it easier to transfer land and leave the current residence to join the nonagricultural labor force on a temporary basis.

Three empirical results stand out. First, experience of reallocations after 2000 reduces incentives for exiting agriculture (but not part-time nonagricultural labor supply). Second, certificates seem to affect participation in nonagricultural labor markets almost entirely through their impact on enhancing temporary migration. Estimated coefficients are large; having certificates for all households in village would increase an average household's supply of labor to the off-farm sector by half a person. Third, while we find little evidence of investment impacts from higher levels of tenure security, institutional variables' impact on allocative efficiency may be an alternative channel that may merit greater attention. Having been affected by reallocation after 2000 is estimated to reduce productivity by about 30%. Receipt of a land use certificate during this period is estimated to have had an equally large impact on productivity.

There are two areas for follow-up research. First, it will be of interest to explore channels for institutional arrangements to affect outcomes in more detail, complementing the reduced form approach taken here. Second, land and labor are undeniably linked labor market distortions may have very significant impact on economic outcomes as well. Some recent national experiments on land reform also involved loosening of residency requirements, thus allowing study of interactions between these two markets. In light of the magnitude of productivity-effects from land market restrictions only estimated here, such analysis would appear both timely and policy relevant.

NOTES

1. We assume that households' level of agricultural ability is e and that a household supplies labor to the nonagricultural sector as long as the exogenous wage rate minus a transaction cost (proportional to the size transferred and depending on institutional conditions) from leasing all or part of the land is higher than the return they can obtain from working in agriculture. This implies that there is a critical level of ability e^* for a household to be indifferent between cultivating her own fields or working off-farm. Issuance of certificates reduces the transaction cost of leasing out land and thus decreases e^*, increasing land rental activity and local nonfarm labor participation. Given China's small plot sizes, off-farm labor supply can be adjusted more or less continuously without giving up village residence. By contrast, exit from agriculture creates a nonzero probability p which is itself a function of the incidence of past redistributions (r) with $p' < 0$. Households will thus exit agriculture and physically leave their farm only if r is sufficiently low. As certificates are issued and enforced by local authorities and thus can be ignored by them as well, having a certificate is unlikely to increase the likelihood of exiting from agriculture. We expect that having certificates increases productivity, but experiencing reallocation reduces productivity by allocative efficiency.

2. Only Cambodia, Burkina Faso, Mali, and Uganda had, in 1981, a higher headcount index than China (Ravallion, 2011).

3. Before the revolution, most farmers were poor tenants or owners of small plots. The communist government confiscated large landlords' holdings and distributed land rights to households on an egalitarian basis (Prosterman, Temple, & Hanstad, 1990). In the 1950s, collectivization was adopted, with disastrous consequences for output and rural welfare (Lin & Yang, 2000; Putterman & Skillman, 1993; Yao, 1999).

4. Exchanges of land within the village had been prohibited before the 1986 Land Management Law legalized them. Transfers to outsiders remained illegal until allowed in 1998, although without clarifying specific modalities to be followed (Li, 2003).

5. As inter-regional linkages and spillovers from the export- and foreign investment-driven boom in coastal areas remain limited (Fu, 2004), migration is the only opportunity for many rural residents to benefit from the country's economic boom.

6. In the course of "big" reallocation, all farmland in the village was given back to the collective and, after subtracting proportional shares for land needed for other purposes, reallocated in equal sizes among villagers. "Small" readjustments, by contrast, merely transfer land from households who experienced changes in family composition but left the rest unaffected. The RLCL completely bans big reallocations while more clearly defining "small" readjustment and requires that it be approved by two thirds of the village.

7. Data spanning several decades up to a century from the US show that (i) there is a close correspondence between the nonagricultural wage rate and average farm size as a determinant of the potential income that can be achieved from agriculture (Gardner, 2002); and (ii) exit from the agricultural sector is affected by expected returns to agricultural cultivation (Barkley, 1990).

8. Of course, easier transferability will allow benefitting from an investment even if the land is no longer used. This may be the reason why some studies find that investment made in and/or after 1998, was 9.8% higher for households that have land use certificates (Zhu & Riedinger, 2011).

9. Higher tenure security alone, without a commensurate increase in transfer rights, reduces the probability of migration whereas increasing both rental rights and tenure security makes migration more likely but an increase in tenure security alone. The opposite is true for forest land where the differences in labor-land complementarities are less pronounced.

10. To be credible and policy relevant, such analysis of the impact of land institutions will have to avoid pitfalls such as (i) mistakenly interpreting inter-regional variation as a causal effect as may be the case with simple cross sectional analysis; (ii) neglecting exit from agriculture by restricting the sample to agricultural producers present in both periods; and (iii) looking at migration behavior without drawing out productivity implications.

11. Note that the second round of the survey was undertaken when the impact of the 2008 global financial crisis was most acute. If, as the literature suggests, the agricultural sector provided an employment buffer during the crisis, this will have to be factored in when interpreting results.

12. Excluding earthquake-damaged households, attrition, including replacements, is thus 5.78% (53 replaced + 14 untraceable/1,160 households).

13. Although this variable could, in principle, measure the extent of off-farm participation at the household level better than just the number of individuals, this variable is likely to be measured with high levels of error for migrants where information was not provided by the concerned person directly. We therefore choose the number of individuals participating in off-farm markets as our main measure but report both.

14. There are two caveats worth noting. First, a total of 129 households reported to have a certificate without being able to recall the exact time when it was received. All of the regressions below are based on the assumption that this group received documents before 2000 although results are robust to various alternative assumptions or dropping this group altogether. Second, as households who exited agricultural production did not report whether or not they had land certificates, we are forced to use village averages for the share of households with certificates instead.

15. Note that, possibly a result of subsidies having increased significantly over the period, the rate of income growth experienced by full-time farmers was slightly higher than that for non or part-time farmers.

16. The share of households with land use certificates must be undervalued as 129 households did not report the exact years when the certificates were issued, in which sense we only know they had certificates in year 2008 but we have no idea whether they had or not in the year 2000. If these households were assumed to have received certificates in year 2000, the percentage would be 52% in total, 67% in Hebei, 53% in Shaanxi, 51% in Liaoning, 61% in Zhejiang, 53% in Sichuan, and 27% in Hubei.

17. This is consistent with evidence of high levels of continued reallocation in many provinces that seems to be rooted in a continued gap between equity and efficiency with the policy of no redistribution (or full compensation for land taken from migrants) being supported by more educated, male-headed, and agriculture-dependent households (Wang *et al.*, 2011).

18. One may argue that in earlier periods, having had experienced a reallocation recently would reduce the likelihood of having another one in the near future. The fact that reallocations were forbidden by law in the post-2000 period makes such an interpretation less plausible. The survey

also includes a question on "do you think you can have this plot after the next reallocation?" A clear interpretation of this variable is difficult as it constitutes a combination of assessing the timing/likelihood of redistribution plus the ability to deal with the associated challenges. Establishing causality in efforts at trying to interpret it will be difficult and endogeneity a serious concern.

19. In fact, a recent study by Zhu, Prosterman, Ye, Li, and Ouyang (2006) found that majority of land documents actually do not comply with the national law. Using a 2005 national representative survey from 17 provinces, they found that while more than 60% households in their sample reported to have land documents, only 10% of households hold the documents the content of which was fully in compliance with the 2002 RLCL.

20. The fact that remittances from migration were found to have increased spending on housing and consumer durables but not productive investment (de Brauw & Rozelle, 2008) may point toward a need of exploring this issue more carefully.

21. Although this could be interpreted as suggesting only a short-lived impact of reallocations, a more plausible interpretation for the lack of pre-2000 reallocations is that that many villages had some form of redistribution when original land use contracts expired in the 1990s.

22. Note that, because the regression includes only those who reported agricultural production in both periods, we are able to use the possession of land certificate at the household level as the relevant variable.

REFERENCES

Au, C. C., & Henderson, V. (2006). How migration restrictions limit agglomeration and productivity in China. *Journal of Development Economics, 80*(2), 350–388.

Barkley, A. P. (1990). The determinants of the migration of labor out of agriculture in the United-States, 1940–85. *American Journal of Agricultural Economics, 72*(3), 567–573.

Benjamin, D., & Brandt, L. (2002). Property rights, labour markets, and efficiency in a transition economy: The case of rural China. *Canadian Journal of Economics, 35*(4), 689–716.

Benjamin, D., Brandt, L., & Giles, J. (2005). The evolution of income inequality in rural China. *Economic Development and Cultural Change, 53*(4), 769–824.

Besley, T., & Ghatak, M. (2010). Property rights and economic development. In M. R. Rosenzweig, & D. Rodrik (Eds.). *Handbook of economic development* (Vol. 5). Amsterdam, The Netherlands: North-Holland.

Bowlus, A. J., & Sicular, T. (2003). Moving toward markets? Labor allocation in rural China. *Journal of Development Economics, 71*(2), 561–583.

Brandt, L., Rozelle, S., & Turner, M. A. (2004). Local government behavior and property right formation in rural China. *Journal of Institutional and Theoretical Economics, 160*(4), 627–662.

Brosig, S., Glauben, T., Herzfeld, T., & Wang, X. (2009). Persistence of full- and part-time farming in Southern China. *China Economic Review, 20*(2), 360–371.

Brummer, B., Glauben, T., & Lu, W. (2006). Policy reform and productivity change in Chinese agriculture: A distance function approach. *Journal of Development Economics, 81*(1), 61–79.

Cai, F., & Wang, M. (2010). Growth and structural changes in employment in transition China. *Journal of Comparative Economics, 38*(1), 71–81.

Carter, M. R., & Yao, Y. (2002). Local versus global separability in agricultural household models: The factor price equalization effect of land transfer rights. *American Journal of Agricultural Economics, 84*(3), 702–715.

Chamberlain, G. (1984). Panel data. In Z. Grilliches, & M. D. Intriligator (Eds.). *Handbook of econometrics* (Vol. 2, pp. 1247–1318). Amsterdam, The Netherlands: North-Holland.

Chang, H., Dong, X., & Macphail, F. (2011). Labor migration and time use patterns of the left-behind children and elderly in rural China. *World Development, 39*(12), 2199–2210.

Chen, F., & Davis, J. (1998). Land reform in rural China since the mid 1980s. *Land Reform, Land Settlement, and Cooperatives, 6*(2), 123–137.

Cook, S. (1999). Surplus labour and productivity in a Chinese agriculture: Evidence from household survey data. *Journal of Development Studies, 35*(3), 16–44.

de Brauw, A., Huang, J., Rozelle, S., Zhang, L., & Zhang, Y. (2002). The evolution of China's rural labor markets during the reforms. *Journal of Comparative Economics, 30*(2), 329–353.

de Brauw, A., & Rozelle, S. (2008). Migration and household investment in rural China. *China Economic Review, 19*(2), 320–335.

Deininger, K., & Feder, G. (2009). Land registration, governance, and development: Evidence and implications for policy. *World Bank Research Observer, 24*(2), 233–266.

Deininger, K., & Jin, S. (2005). The potential of land markets in the process of economic development: Evidence from China. *Journal of Development Economics, 78*(1), 241–270.

Deininger, K., & Jin, S. (2009). Securing property rights in transition: Lessons from implementation of China's rural land contracting law. *Journal of Economic Behavior & Organization, 70*(1–2), 22–38.

Du, Y., Park, A., & Wang, S. (2005). Migration and rural poverty in China. *Journal of Comparative Economics, 33*(4), 688–709.

Egger, P., Greenaway, D., & Seidel, T. (2011). Rigid labour markets with trade and capital mobility: Theory and evidence. *Canadian Journal of Economics, 44*(2), 509–540.

Feng, S., Heerink, N., Ruben, R., & Qu, F. (2010). Land rental market, off-farm employment and agricultural production in Southeast China: A plot-level case study. *China Economic Review, 21*(4), 598–606.

Fleisher, B. M., & Yang, D. T. (2003). Labor laws and regulations in China. *China Economic Review, 14*(4), 426–433.

Fu, X. (2004). Limited linkages from growth engines and regional disparities in China. *Journal of Comparative Economics, 32*(1), 148–164.

Gardner, B. L. (2002). *US agriculture in the 20th century: How it flourished and what it cost*. Cambridge, MA: Harvard University Press.

Groom, B., Grosjean, P., Kontoleon, A., Swanson, T., & Zhang, S. (2010). Relaxing rural constraints: A 'win-win' policy for poverty and environment in China?. *Oxford Economic Papers—New Series, 62*(1), 132–156.

Hausman, J., Hall, B. H., & Griliches, Z. (1984). Econometric models for count data with an application to the patents–R & D relationship. *Econometrica, 52*(4), 909–938.

Huang, J., Wang, X., Zhi, H., Huang, Z., & Rozelle, S. (2011). Subsidies and distortions in China's agriculture: Evidence from producer-level data. *Australian Journal of Agricultural and Resource Economics, 55*(1), 53–71.

Jacoby, H. G., Li, G., & Rozelle, S. (2002). Hazards of expropriation: Tenure insecurity and investment in rural China. *American Economic Review, 92*(5), 1420–1447.

Jin, S., & Deininger, K. (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.

Jin, S., Ma, H., Huang, J., Hu, R., & Rozelle, S. (2010). Productivity, efficiency and technical change: Measuring the performance of China's transforming agriculture. *Journal of Productivity Analysis, 33*(3), 191–207.

Kung, J. K.-S. (2006). Do Secure Land use rights reduce fertility? The case of Meitan county in China. *Land Economics, 82*(1), 36–55.

Kung, J. K.-S., & Liu, S. (1997). Farmers' preference regarding ownership and land tenure in Post-Mao China: Unexpected evidence from eight counties. *The China Journal, 38*(2), 33–63.

Lewis, D. J., Barham, B. L., & Robinson, B. (2011). Are there spatial spillovers in the adoption of clean technology? The case of organic dairy farming. *Land Economics, 87*(2), 250–267.

Li, P. (2003). Rural land tenure reforms in China: Issues, regulations and prospects for additional reform. *Land Reform, Land Settlement, and Cooperatives, 11*(3), 59–72.

Li, G., Rozelle, S., & Brandt, L. (1998). Tenure, land rights, and farmer investment incentives in China. *Agricultural Economics, 19*(1–2), 63–71.
Liang, Z., & Ma, Z. (2004). China's floating population: New evidence from the 2000 census. *Population and Development Review, 30*(3), 467–488.
Lin, J. Y. (1992). Rural reforms and agricultural growth in China. *American Economic Review, 82*(1), 34–51.
Lin, J. Y., Wang, G., & Zhao, Y. (2004). Regional inequality and labor transfers in China. *Economic Development and Cultural Change, 52*(3), 587–603.
Lin, J. Y., & Yang, D. T. (2000). Food availability, entitlements and the Chinese famine of 1959–61. *Economic Journal, 110*(460), 136–158.
Liu, S., Carter, M. R., & Yao, Y. (1998). Dimensions and diversity of property rights in rural China: Dilemmas on the road to further reform. *World Development, 26*(10), 1789–1806.
McMillan, J., Whalley, J., & Zhu, L. (1989). The impact of China's economic reforms on agricultural productivity growth. *Journal of Political Economy, 97*(4), 781–807.
Mullan, K., Grosjean, P., & Kontoleon, A. (2011). Land tenure arrangements and rural-urban migration in China. *World Development, 39*(1), 123–133.
Mundlak, Y. (1978). On the pooling of time series and cross section data. *Econometrica, 46*, 69–85.
Prosterman, R. L., Temple, M. N., & Hanstad, T. (1990). *Agrarian reform and grassroots development: Ten case studies*. Boulder, CO: Rienner.
Putterman, L., & Skillman, G. L. (1993). Collectivization and China's agricultural crisis. *Journal of Comparative Economics, 17*(2), 530–539.
Ravallion, M. (2011). A comparative perspective on poverty reduction in Brazil, China, and India. *The World Bank Research Observer, 26*(1), 71–104.
Ravallion, M., & Chen, S. (2007). China's (uneven) progress against poverty. *Journal of Development Economics, 82*(1), 1–42.
Ricker-Gilbert, J., Jayne, T. S., & Chirwa, E. (2011). Subsidies and crowding Out: A double-hurdle model of fertilizer demand in Malawi. *American Journal of Agricultural Economics, 93*(1), 26–42.
Rozelle, S., Brandt, L., Guo, L., & Huang, J. (2002). Land rights in China: Facts, fictions, and issues. *China Journal, 47*(1), 67–97.
Rozelle, S., Li, G., Shen, M., Hughart, A., & Giles, J. (1999). Leaving China's farms: Survey results of new paths and remaining hurdles to rural migration. *China Quarterly, 158*, 367–393.
Taylor, J. E., Rozelle, S., & de Brauw, A. (2003). Migration and incomes in source communities: A new economics of migration perspective from China. *Economic Development and Cultural Change, 52*(1), 75–102.
Wang, X., Herzfeld, T., & Glauben, T. (2007). Labor allocation in transition: Evidence from Chinese rural households. *China Economic Review, 18*(3), 287–308.
Wang, H., Tong, J., Su, F., Wei, G., & Tao, R. (2011). To reallocate or not: Reconsidering the dilemma in China's agricultural land tenure policy. *Land Use Policy, 28*(4), 805–814.
Whalley, J., & Zhang, S. (2007). A numerical simulation analysis of (Hukou) labour mobility restrictions in China. *Journal of Development Economics, 83*(2), 392–410.
Wooldridge, J. M. (1999). Distribution-free estimation of some nonlinear panel data models. *Journal of Econometrics, 90*(1999), 77–97.
Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. Cambridge, MA: The MIT Press.
Yang, D. T. (1997). China's land arrangements and rural labor mobility. *China Economic Review, 8*(2), 101–115.
Yao, S. (1999). A note on the causal factors of China's famine in 1959–1961. *Journal of Political Economy, 107*(6), 1365–1369.
Zhai, F., & Wang, Z. (2002). WTO accession, rural labour migration and urban unemployment in China. *Urban Studies, 39*(12), 2199–2217.
Zhang, H. (2010). The Hukou system's constraints on migrant workers' job mobility in Chinese cities. *China Economic Review, 21*(1), 51–64.
Zhang, X., Yang, J., & Wang, S. (2010). *China has reached the Lewis turning point*. Discussion paper 977. Washington, DC: International Food Policy Research Institute.
Zhang, Y., Wang, X., Glauben, T., & Brummer, B. (2011). The impact of land reallocation on technical efficiency: Evidence from China. *Agricultural Economics, 42*(4), 495–507.
Zhao, Y. (1999). Leaving the countryside: Rural-to-urban migration decisions in China. *American Economic Review, 89*(2), 281–286.
Zhao, Y. (2002). Causes and consequences of return migration: Recent evidence from China. *Journal of Comparative Economics, 30*(2), 376–394.
Zhu, K., & Riedinger, J. M. (2011). *Chinese farmers' land rights at the crossroads: Findings and implications from a 2010 nation-wide survey*. Paper presented at the annual bank conference on land and poverty. Washington, DC.
Zhu, K., Prosterman, R., Ye, J., Li, P., & Ouyang, Y. (2006). The rural land question in China: An analysis and recommendations based on a 17-province survey in 2005. *New York University Journal of International Law and Politics, 38*(4), 761–839.

APPENDIX A.

See Tables 6–8.

Table 6. *Household fixed effects estimates for exit from agric. and labor supply to local off-farm activities*

	Exit from agriculture	No. of individuals employed in			Days worked in		
		off-farm	migrating	local	off-farm	migrating	local
Own land area per capita	0.000	0.005	−0.012	0.017	3.581	−2.456	6.037*
	(0.006)	(0.012)	(0.017)	(0.018)	(4.242)	(4.141)	(3.393)
Head's age	−0.002	−0.013	−0.006	−0.007	−2.481	−0.568	−1.913
	(0.003)	(0.008)	(0.007)	(0.008)	(2.335)	(2.139)	(2.039)
Male head	−0.138	−0.128	−0.000	−0.128	−32.217	−11.353	−20.864
	(0.109)	(0.177)	(0.221)	(0.176)	(64.111)	(55.613)	(58.611)
Highest education	−0.002	0.022*	0.017	0.005	7.660*	4.887	2.773
	(0.004)	(0.012)	(0.010)	(0.012)	(3.935)	(3.282)	(3.113)
Population <14 years	−0.027	−0.071	−0.134**	0.064	1.542	−26.941*	28.483*
	(0.017)	(0.050)	(0.058)	(0.051)	(18.094)	(13.554)	(16.191)
Population 14–60 years	0.007	0.496***	0.299***	0.197***	133.816***	66.738***	67.078***
	(0.017)	(0.059)	(0.055)	(0.055)	(14.518)	(13.996)	(16.807)
Population >60 years	0.002	0.195**	0.073	0.122	59.131**	10.007	49.125*
	(0.029)	(0.097)	(0.083)	(0.084)	(26.685)	(18.826)	(24.697)
Value of assets ('000 Yuan)	0.000	−0.000	−0.001***	0.000***	−0.017	−0.140***	0.123***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.057)	(0.031)	(0.041)

Land reallocation	−0.058*	−0.047	−0.050	0.003	−13.042	−5.888	−7.154
	(0.034)	(0.094)	(0.104)	(0.084)	(21.942)	(23.816)	(27.050)
Share of certificates (village level)	0.012	0.739***	0.543**	0.196	98.439	91.167	7.271
	(0.085)	(0.208)	(0.262)	(0.300)	(70.119)	(70.903)	(87.428)
Log population (village level)	0.032	0.037	−0.006	0.044	−28.721	4.267	−32.988
	(0.088)	(0.200)	(0.310)	(0.218)	(56.535)	(60.972)	(38.021)
Share of workers (village level)	−0.029	−0.377	−0.627	0.250	−37.070	−125.898	88.828
	(0.114)	(0.479)	(0.561)	(0.444)	(121.794)	(115.059)	(121.763)
Distance to nearest road (village level)	−0.013	0.021	−0.056	0.077**	−1.026	−14.381*	13.355*
	(0.012)	(0.026)	(0.035)	(0.032)	(7.984)	(7.884)	(7.202)
Share of households with tap water (village level)	−0.000	0.063	0.021	0.042	38.824	21.936	16.888
	(0.041)	(0.102)	(0.103)	(0.122)	(33.167)	(30.170)	(36.604)
No. of enterprises (village level)	0.001	0.001	0.002	−0.001	−0.404	−0.070	−0.334
	(0.001)	(0.002)	(0.001)	(0.001)	(0.468)	(0.306)	(0.356)
Log area of arable land (village level)	−0.042	−0.125	0.066	−0.192	5.847	9.225	−3.377
	(0.069)	(0.127)	(0.207)	(0.164)	(38.031)	(44.494)	(26.937)
Year 2008 dummy	0.113**	0.287**	0.389***	−0.103	131.582***	81.144***	50.438*
	(0.044)	(0.112)	(0.137)	(0.128)	(29.196)	(29.116)	(25.346)
Observations	2,186	2,186	2,186	2,186	2,186	2,186	2,186
R^2	0.632	0.741	0.676	0.699	0.722	0.667	0.709

Standard errors are clustered at the village level.
* Statistically significant at 10%.
** Statistically significant at 5%.
*** Statistically significant at 1%

Table 7. *Test for parallel trends during 1990–95 and 2000*

	Total	Received certificates in 2000–08			Affected by reallocations 2000–08		
		No	Yes	*t*-test	No	Yes	*t*-test
Levels in 2000							
No. of working individuals	3.78	3.81	3.65		3.79	3.72	
Share in agric. full-time	0.48	0.47	0.51		0.48	0.42	
Share in agric. part-time	0.28	0.28	0.28		0.28	0.29	
Share of migrants	0.14	0.14	0.14		0.13	0.17	
Share outside of agriculture	0.25	0.25	0.21		0.24	0.29	
Changes during 1990–2000							
No. of working individuals	0.90	0.94	0.74		0.89	0.97	
Share in agric. full-time	−0.23	−0.24	−0.20		−0.24	−0.19	
Share in agric. part-time	0.09	0.10	0.06		0.10	0.03	
Share of migrants	0.10	0.10	0.11		0.09	0.11	
Share outside of agriculture	0.14	0.14	0.14		0.14	0.15	
Growth rates during 1990–2000							
No. of working individuals	0.03	0.03	0.02		0.03	0.03	
Share in agric. full-time	−0.21	−0.24	−0.10		−0.22	−0.20	
Share in agric. part-time	0.66	0.66	0.64		0.68	0.50	
Share of migrants	0.83	0.84	0.77		0.83	0.77	
Share outside of agriculture	0.95	0.94	1.00		0.96	0.84	
Changes during 1995–2000							
No. of working individuals	0.49	0.51	0.40		0.47	0.61	
Share in agric. full-time	−0.14	−0.15	−0.12		−0.15	−0.13	
Share in agric. part-time	0.06	0.05	0.07		0.06	0.03	
Share of migrants	0.06	0.06	0.07		0.06	0.07	
Share outside of agriculture	0.09	0.10	0.05		0.09	0.10	
Growth rates during 1995–2000							
No. of working individuals	0.03	0.03	0.03		0.03	0.04	
Share in agric. full-time	−0.38	−0.42	−0.18		−0.35	−0.54	
Share in agric. part-time	0.83	0.81	0.88		0.86	0.57	
Share of migrants	1.13	1.14	1.08		1.15	1.02	
Share outside of agriculture	1.31	1.35	1.12		1.31	1.29	
No. of observations	517	431	86		450	67	

Source: Own computation from 2000 to 2010 panel household survey.
Notes: *, **, and *** represent statistically significant at 10%, 5%, and 1%, respectively.

Table 8. *Comparison of initial conditions for households receiving certificates/affected by redistribution*

	Total	Received certificates in 2000–08			Affected by reallocations 2000–08		
		No	Yes	*t*-test	No	Yes	*t*-test
Household demographics							
Male head	0.98	0.97	0.99		0.97	0.99	
Household size	4.12	4.12	4.13		4.11	4.21	
Population <14 years	0.71	0.70	0.73		0.71	0.69	
Population 14–60 years	3.09	3.11	3.04		3.08	3.21	
Population >60 years	0.33	0.32	0.35		0.33	0.31	
Dependency ratio	0.24	0.24	0.26		0.25	0.22	
Highest education (year)	9.58	9.52	9.89		9.47	10.35	**
Labor supply & income sources							
Total labor supply (days)	526	530	506		523	545	
Days worked per adult	170	171	169		171	168	
in agriculture (%)	56.2	56.1	56.4		56.7	52.6	
in migration (%)	16.4	16.2	17.2		16.0	18.6	
in local off-farm (%)	27.5	27.7	26.4		27.3	28.8	
Income per adult eq.	2,080	2,078	2,091		2,006	2,578	***
Total income (Yuan)	7,581	7,606	7,471		7,263	9,714	***
from agriculture (%)	51.4	52.2	47.8		51.6	50.4	
from migration (%)	19.4	18.8	21.7		19.1	20.9	
from local off-farm (%)	29.2	28.9	30.5		29.3	28.7	
Number of off-farm individuals	1.34	1.34	1.32		1.32	1.44	
Share of off-farm individuals	0.39	0.39	0.39		0.38	0.41	
Number of migrants	0.46	0.45	0.49		0.44	0.54	
Share of migrants	0.12	0.12	0.13		0.12	0.13	
Number of individuals in local off-farm	0.88	0.90	0.82		0.88	0.90	
Share of individuals in local off-farm	0.27	0.27	0.26		0.26	0.28	
Endowments and productive activity							
Owned land area (mu)	8.46	8.63	7.71		8.51	8.13	
Cultivated land area (mu)	9.12	9.34	8.13		9.22	8.43	
Assets (Yuan)	26,203	26,823	23,435		24,536	37,379	***
of which agricultural (%)	0.10	0.10	0.09		0.10	0.09	
No. of observations	863	705	158		751	112	

Source: Own computation from 2000 to 2010 panel household survey.
*Statistically significant at 10%.
** Statistically significant at 5%
*** Statistically significant at 1%.