OFF-FARM EMPLOYMENT GROWTH AND AGRICULTURAL LAND CONSOLIDATION IN CHINA

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ABSTRACT

The history of now-developed countries implies a common transformation path of economic development. That is, within an economy, as wage grows in non-farm sectors, labour migrates out of agriculture. With fewer workers, agricultural land resources may concentrate into the hands of fewer but larger farm operations (agricultural land consolidation), with more investment and higher production specification. However, the development process of China is less likely to trace the same path as it does in these countries, given its distinctive institutions. To examine the development process in the unique context of China, this dissertation focuses on two questions: (1) how do China's rural workers self-select into off-farm employment (OFE)? (2) How does agricultural land consolidation occur in China?

In addressing the first question, I use Roy's self-section model to analyze the following three occupational choices of China's rural residents: farming only, local OFE, and migratory OFE. Based on household survey data from 101 communities in rural China in 2004 and 2007, the empirical results show that individual and household characteristics are important self-selecting factors for OFE participation. More importantly, I find that the increase of OFE in China is largely consistent with market-driven expectations.

In addressing the question of whether and why the consolidation of farm operations develops in China's agriculture, I assess the divergence between the size of farm operations from equal entitlements. The theoretical model predicts that a higher opportunity cost of farm labour, in the form of the urban wage, exerts a positive influence on consolidation of farm operations through rental arrangements. A *Gini* index is used to measure the inequality of farmland operations relative to equal farmland entitlements, with greater inequality being consist with higher consolidation of farm operations. Empirical results support the theoretical prediction,

specifically, a 1000-yuan increase in the annual urban wage, holding all other influences constant, increases the *Gini* index by 0.012 (mean=0.26) over the 2004-2007 period.

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Dedication

This dissertation is dedicated to my wife, Yujing Zhang. You are an amazing wife, a wonderful mother, and you are the one who keeps me going.

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1. INTRODUCTION

1.1 Background

Development economists perceive the out-migration of agricultural labour as an integral part of economic development, instrumental in improving workforce allocation among sectors, and a potential trigger for further economic development (Lewis 1954; Ranis and Fei 1961; Todaro 1969; Eswaran and Kotwal 1993; De Haas 2010). The transformation from an agrarian economy to one that is industry- and urban-oriented, requires labour to move from the low-productivity rural, agricultural sector to the higher-productivity urban, industrial sector. The labour migration ceases when the wages of rural, agricultural sector and the urban, industrial sector converge. As the opportunity cost of farm labour increases, the agricultural land holdings consolidate and the agricultural sector becomes transformed from small-scale subsistence farming to larger-scale commercial farming, including the investments in land and mechanization. This transition is both apparent in today's developing countries and in the histories of developed countries (Hathaway 1960; Barkley 1990; Auty 1994; Taylor and Martin 2001; Henderson 2005; World Bank 2008).

However, the development process of China may not trace the same path as it does in the developed countries, because of its institutional arrangements. For example, with respect to the agricultural labour out-migration, China rural residents face some regulatory restrictions of the *Hukou* system. In addition, the land tenure system in China will influence the process by which land consolidation occurs. Both of these institutions, *Hukou* and the absence of private ownership of agricultural land, will influence the transformation process in China.

The *Hukou* system was implemented during the 1950s, when China carried out a Big Push industrialization approach (Chan 2009). The Big Push industrialization approach designated the industrial, urban sector as a priority sector, offering superior welfare and subsidies for the

industrial sectors, mostly located in cities. As a result, The Big Push industrialization approach generated immense outflows of labour from agricultural, rural sector. To control the rural-urban migratory labour flows and maintain social and political stability, the *Hukou* system was then introduced by China's government.

The *Hukou* system was designed as a *de facto* internal passport system which works chiefly as an entitlement distribution mechanism to segregate rural and urban populations. Each Chinese person has a *Hukou* status (registration status), classified as "rural" or "urban", which is determined by his/her parent's *Hukou* status at the time of his/her birth[1]. An individual with rural *Hukou* is ineligible for the urban-based amenities, such as education, employment, medical care, retirement programs, affordable housing, and other basic public services of cities, for which ordinary urban residents qualify automatically. Similarly, the individual holding urban *Hukou* is not eligible for rural-based benefits and rights, for which ordinary rural resident qualify automatically, these include entitlement to agricultural land and dividends from the rural collectively owned businesses and properties of villages.

China's Hukou system is regarded as the major regulatory force that shapes its rural workers' off-farm activities. Due to the *Hukou* system, the rural workers of China who participate in urban-based OFE usually take marginal jobs (Wang and Zuo 1999; Meng and Zhang 2001), and their engagement in OFE has been characterized as partial, temporary, and circular (Hare 1999; Zhao 1999b; Hare 2002; Chang, Dong, and MacPhail 2011). Characterized by long hours, poor working conditions, and low and unstable pay, OFE of China's rural workers is described as "marginal." The word "partial" refers to the practice where most rural households send some of

[1] Although it is possible for an individual to change his/her *Hukou* status, the conversion of the *Hukou* status is under a strict quota and subject to approval by the relevant local government, with annual quota for each locale as low as 0.15 to 0.2 percent of the rural population (Wu 1994; Chan 2010).

their family members to work in urban employment, leaving the rest in the origin communities where they have some access to social services and a family support system. The "temporary" nature of OFE does not describe the duration of employment, since the time can be as short as several days or for several years. Instead "temporary" describes the low levels of attachment of the rural residents to their place of work, for they do not have employment guarantees or an urban *Hukou* in the non-farm work place. The OFE is "circular" in that some members of the household regularly leave for OFE in part of the year but return to the rural areas for the rest of the year and are thus still considered rural household members.

Despite the regulatory restrictions from the *Hukou* system, China's OFE has grown dramatically. Since China's market-oriented reforms[2] in the late 1970s, the urban sector and the rural nonfarm sector have grown dramatically (Borensztein and Ostry 1996; Zhu 2012). The fast growing nonfarm sectors provide OFE opportunities at wage rates higher than the returns to labour in agriculture (Yang and Zhou 1999; Yao 1999a; Cai and Du 2011), pulling hundreds of millions of farm workers out of agriculture (Zhao, 1999a; De Brauw et al. 2002; Dong, Bowles, and Chang 2009; Cai and Wang 2010, Wang et al. 2011a). In the future, as China's economic transformation proceeds, there will be more farmers moving into non-farm and urban sectors (Fan, Zhang, and Robinson 2003; Au and Henderson 2006). For example, in 2013, China announced an urbanization plan to move about 250 million rural residents into cities over the next dozen years (Johnson 2013).

At the same time as OFE is growing as part of China's urbanization, the structure of agriculture production may also change when more labour is removed from this sector. The

[2] Until the 1980s China pursued inward-oriented growth strategies, relying heavily on state-owned enterprises that were highly protected and regulated. China's industrialization process began with its vigorous export- oriented industrial policies after 1980s. The accession into the World Trade Organization (WTO) of China led to an explosion in international exports.

histories of developed countries suggest that the labour out-migration from agriculture coincides with a transition to larger scale and more mechanized production and a reduction in the rural-urban income gap. Hathaway (1960, p. 379) explains that "such a transfer" (a large-scale transfer of labour from agriculture) "would: result in a recombination of resources in agriculture …; increase incomes in agriculture relative to incomes in the nonfarm economy; and reduce the disparity in agricultural income between regions".

It has been a long-standing practice in the history of developed economies (Hathaway 1960; Peterson and Brooks 1993; Gebremedhin and Christy 1996) that agricultural land consolidation occurs through the transfer of ownership. However, this path is not applicable for China, because of its land tenure system – the Household Responsibility System (HRS).

The HRS, an institutional reform involving a shift from collective agricultural production systems to individual household production in China's agricultural sector, was established in the late 1970s. According to the HRS, the agricultural land resources were equally assigned to individual households on a per capita basis, giving the farming decision and residual claim of agricultural surplus to rural households. The HRS has proved a great success as an institutional innovation in China. It generated a private incentive for production by giving farmers land use rights and residual income rights, and consequently led to a dramatic increase in agricultural output in China during the early reform period (Lin 1992). Because of the HRS, China did not face serious problems of urban slums. Rural-urban migrants always have their entitlements of farmland in their origin villages, which provide the basic needs for living when they are unemployed in the urban areas.

At present, the HRS exposes a number of limitations for China's agricultural land consolidation. According to the HRS, farmland in a village is owned by all of its members

collectively. As a result, every member has equal claim on land property rights. The collective land ownership of farmland in China becomes an obstacle for agricultural land consolidation, as land consolidation cannot occur though land ownership transfers.

The land consolidation experience of developed countries may be somewhat modified for China. While agricultural land in China is collectively owned and equally distributed as entitlement, increased land tenure security and greater tolerance of rental or leasing arrangements since the late 1990s might have allowed for some consolidation of farm operations, if not ownership. Further, the attraction of urban wages, seen in the high level of participation in OFE by rural family members, results in reduced farm labour for all or parts of the year. This OFE creates pressures for consolidation of farm operations.

The discussion described above raise two critical questions: 1) how do China's rural workers self-select into OFE?; and 2) how will the required land consolidation occur as labour moves out of agriculture in the absence of ownership transfer? Answers to these questions have particular policy importance for China. The institutional arrangements of the *Hukou* system and the HRS were initially designated to address particular problems in another era. As the nature of China's economy has changed and new problems have risen, there may be a disconnect between these institutions and modern goals and objectives. For example, at present, the most important priority for China's development is to urbanize its rural population and increase the production efficiency in agriculture. However, the *Hukou* system and the collective land ownership of HRS, both more than 30 years old, makes the labour and land less mobile and less transferable, thus presenting obstacles to reaching these development goals. Although these institutions may represent barriers to China's economic transformation, removing them may create additional problems. For example, removing the *Hukou* system would lead to a massive increase in population flows to

urban areas, exacerbating the overpopulation problems of current large cities. Privatizing the collective land ownership would increase the income inequality of China's rural population, contributing to the poverty problem. To make effective urbanization policies and agricultural policies, one must understand the development process of China, such as the nature of OFE growth and agricultural land consolidation, given its unique institutional context. Beyond the importance for policy, it has been the long-standing interest of development economists to understand the development process in the unique context of China, given its mixed command-market economy.

1.2 Research Objectives

This dissertation has the following two objectives. First, based on the survey data from 101 communities in rural China in 2004 and 2007, I examine the farm and non-farm employment choices of rural residents in China. I view the decision as a self-selection process into one of three occupational choices: farming only; local OFE; and migratory OFE. A self-selection model is developed and is empirically tested to show how various economic factors influence the OFE decisions. Second, I assess whether land consolidation in China's agriculture is occurring and investigate its determinants, with a particular emphasis on the role of urban wages. A "*Gini*" index is used to measure the inequality of farmland operations relative to equal farmland entitlements, with greater inequality representing higher consolidation. Based on a market equilibrium model of the land rental market and a simplified household agricultural production model, I investigate the role of urban wages in the consolidation of farm operations.

1.3 Organization of Thesis

The remainder of the dissertation is organized as follows. Chapter 2 addresses the first objective –to provide better understanding of household OFE choices in China. Chapter 3 provides a link between Chapter 2 on OFE patterns and Chapter 4 on the consolidation of farm

operations. Chapter 4 addresses the second research objective of investigating whether and how the consolidation of farm operations is occurring in China's agriculture. This study concludes with a summary of the key findings, an outline of the policy implications of the current work and a discussion of areas of further study in Chapter 5.

2. OFF-FARM EMPLOYMENT IN CHINA: PATTERNS AND DRIVING FORCES

2.1 Introduction

China has experienced dramatic growth in non-farm employment since its economic reforms began in 1979 (Zhao 1999b; De Brauw et al. 2002; World Bank 2008; Cai and Wang 2010; CNBS 2010; Chan Forthcoming). From 1979 to 2009, the share of China's non-farm sectors in overall employment increased from 30 to 62% (CNBS 2010). Numerous studies show that the non-farm employment growth of China has raised household income and reduced poverty (De Brauw et al. 2002; Zhang, Huang, and Rozelle 2002; Du et al. 2005; De Janvry, Sadoulet, and Zhu 2005; Giles 2006; Goh, Luo, and Zhu 2009).

Despite the rapid growth of nonfarm employment, China's population is still disproportionately concentrated in agriculture[1]. Moreover, rural Chinese workers' participation in non-farm production, also termed "off-farm employment" (OFE), has been characterized as partial and temporary (Hare 1999; Zhao 1999b; Hare 2002; Chang, Dong, and MacPhail 2011). The word "partial" refers to the practice where most rural households send some of their family members to work in urban employment, leaving the rest in their origin communities where they have some access to social services and a family support system. The "temporary" nature of OFE does not describe the duration of employment, since the time can be as short as several days or for several years. Instead "temporary" describes the low levels of attachment of the rural residents to their place of work, for they do not have employment guarantees nor urban *Hukou* in the work place. Therefore, the transition to an urban-based economy in China requires more

[1] China's urbanization has lagged behind its economic development (Chen 2006). China has greater share of agricultural population than most countries with similar income levels. the Food and Agriculture Organization of United Nations (2012) reports that 60% of total population of China (about 830 million) depended for their livelihood on agriculture in 2011, a proportion significantly higher than most developing countries with similar per capita GDP.

farm/rural workers to move from subsistence farming to non-farm/urban sectors (Johnson 2000; Fan, Zhang, and Robinson 2003; Au and Henderson 2006).

In 2013, China announced its urbanization plan to move about 250 million rural residents into cities over the next dozen years (Johnson 2013). The urbanization plan not only refers to labour migration into cities but also the geographic expansion of urban areas, such as urban sprawl and the rise of new cities in rural areas. That is, rural workers' OFE in both urban and rural areas is critical for urbanization. For effective urbanization policy making, one must know how rural Chinese workers self-select into rural and urban off-farm activities.

The objective of this chapter is to provide empirical evidence of the farm and non-farm employment choices of China's rural workers. The employment decision is viewed as a self-selection process into one of three occupational choices: farming only; local OFE; and migratory OFE. "Farming only" includes the possibility of involvement in household domestic work. Local OFE refers to employment in non-farm sectors while living at home, thus allowing for the possibility of remaining involved in farming and domestic work. Most local OFE in China is with township and village enterprises (TVEs), rural private enterprises, and self-employment (De Brauw et al. 2002; Fu and Balasubramanyam 2003; Zhang, De Brauw, and Rozelle 2004; Zhang et al. 2006; Mohapatra, Rozelle, and Goodhue 2007; Cai and Wang 2010). In 2007, 32% (150.9 million people) of the rural labour force was employed in TVEs and 10% (48.6 million) were either self-employed or employed in private enterprises (Cai and Wang 2010). "Migratory OFE" refers to OFE in distant localities, thus not living at home. These individuals are not involved in household farm or domestic activities when they participate in OFE. Most migratory OFE opportunities are found in growth sectors or informal sectors in urban areas (Zhu 2002; Christiansen 2009; Chan Forthcoming), such as construction of new cities, railways, airports,

ports, and roads, manufacturing and mining sectors, and domestic service for urban families (Christiansen 2009). Without local *hukou* status in the workplace, migratory OFE workers usually take up marginal jobs with long working hours, poor working conditions, low and unstable pay, and enjoy no local-*hukou*-based benefits such as housing, education, and medical programs and other social insurance (Wang and Zuo 1999; Meng and Zhang 2001). My results are designed to provide a better understanding of rural labour force's OFE participation in China, and to inform the policies directed at China's transformation into an urbanized economy.

The remainder of this chapter is organized as follows: Section 2.2 presents a literature review related to China's OFE. Section 2.3 presents the theoretical model, followed by Section 2.4 which introduces the data and provides descriptive statistics. The empirical implementation is then presented in Section 2.5 and the results in Section 2.6, followed by conclusions and policy implications in Section 2.7.

2.2 Literature Review

2.2.1 Determinants of Labour Migration

The labour out-migration from agriculture is evident both in developing countries and in the history of developed countries (Hathaway 1960; Barkley 1990; Taylor and Martin 2001; World Bank 2008). In neo-classical labour migration theory, migration is perceived as a form of optimal allocation of labour as a production factor, with wage differentials among sectors and regions being the major driving force (De Haas 2010). For example, Lewis (1954) proposes a two-sector model and concludes that the wage differential between the capitalist sector (non-farm) and the subsistence sector (farm) drives labour migration. Todaro (1969) and Harris and Todaro (1970) focus on the rural-urban labour migration and argue that rural workers decide whether or not to re-locate to cities by considering not only the simple wage differential but the expected future

income differential between rural and urban, that is, the discounted future stream of expected income including the consideration of unemployment rates.

The Lewis and Todaro models stress the role of wage/income gaps in labour migration, while the self-selection within labour migration remains largely unexplored. That is, the out-migrants from agriculture may not be representative of the communities which they come from. Roy (1951) proposes a self-selection occupational choice model, showing how workers self-select into employment opportunities between fishing and hunting.

Borjas (1987) formalizes Roy's model in the context of labour migration, highlighting the endogeneity issues of the selection of labour migration. Later, the self-selection of labour migration is refined by using the elements of Sjaastad (1962) and Becker's (1964) human capital models (Taylor and Martin 2001), for example, in Taylor (1987), Borjas, Bronars, and Trejo (1992), Borjas (1999), Chiswick (1999), De Coulon and Piracha (2005), Feliciano (2005), and Zaiceva and Zimmermann (2008). First, it is proposed that the probability of migration may decrease with age, because older people will gain utility from the migration over only a shorter period of time. Second, the individuals facing higher migration costs[2] are less likely to migrate. Third, individuals move from places where the return on their individual human capital is relatively low, to places where their return is relatively high. In other words, human capital that yields higher returns in the destination localities, net of costs, may facilitate migration.

2.2.2 OFE in China

Most research examining the drivers of China's OFE has focused on migratory OFE. Many researchers find that migratory OFE is driven primarily by the expected wage differentials net of migration costs (Liang and White 1997; Zhao 1997; Hare 2002; Zhu 2002; Wu and Yao 2003;

[2] Migration costs include not only distance-related transportation costs, but also opportunity costs and psychic costs.

Zhang and Song 2003; Poncet 2006; Ge and Yang 2011). For example, Zhu (2002) argues that urban to rural income gaps provide strong economic incentives for China's rural workers to migrate to urban areas. Furthermore, Zhao (1997) and Zhu (2002) find that China's rural out-migrants are more likely to choose large urban centres or the coastal regions with higher wages and more job opportunities. Ge and Yang (2011) find that China's migration flows respond negatively to unemployment rates of urban areas.

China's OFE has been affected not only by the market forces of wage differences but also by its institutions. For example, the *Hukou* system, the HRS, and the mandatory quota system have made OFE labour supplies relatively inelastic in response to the increase of off-farm wages (Knight, Song, and Huaibin 1999; Yang 1999; Yang and Zhou 1999; Meng 2000; Meng and Zhang 2001; Lin, Wang, and Zhao 2004; Bao et al. 2011; Vendryes 2011). China's *Hukou* system is regarded as the major regulatory force that shapes its rural workers' off-farm activities. The *Hukou* system is a *de facto* internal passport system in China which works chiefly as an entitlement distribution mechanism to segregate rural and urban populations. Due to the *Hukou* system, most rural-urban migrants are excluded from the urban welfare system and urban-based jobs because of their rural *Hukou* (Zhao 2002; Bao et al. 2011; Cai 2011). Thus, the *Hukou* system, which has changed little throughout the reform era (Chan 2010), is considered to be a major institutional barrier, preventing many rural workers from participating fully in urban employment (Zhao 1999a; Meng and Zhang 2001; Au and Henderson 2006; Bao et al. 2011; Vendryes 2011). Yang and Zhou (1999), Meng (2000), Benjamin and Brandt (2002) and Brandt et al. (2002) argue that land tenure arrangements and the mandatory quota system increase the opportunity costs of migration and dampen migratory OFE.

The self-selection into OFE of China's rural workers is well-documented in literature. Individual-level characteristics are important self-selection factors because they represent differences in opportunity costs as well as different expected income. Fan (2003), Du, Park, and Wang (2005), and De Brauw et al. (2008) find that female workers are less likely to participate in migratory OFE than male workers, especially senior and married women. De Brauw et al. (2002) and Zhang, De Brauw, and Rozelle (2004) find that the probability of migration generally rises with years of schooling and decreases with age, suggesting that younger individuals with higher education may receive higher returns in migration. Zhang and Li (2003), Zhao (2003), and Giles (2006) find that individuals with better migration networks may have lower migration costs and be more likely to participate in migratory OFE. Cook (1998), Yao (1999b), Xia and Simmons (2004), Guang and Zheng (2005), Glauben, Herzfeld, and Wang (2008), and Zhou (2011) find that individuals with better local social connections have better access to local OFE opportunities.

Household characteristics, including household productive asset holdings, labour endowments, and labour composition, may also affect selection into OFE, through the opportunity cost of migratory OFE. For example, Hare (2002) argues that larger productive asset holdings of a household raise the household members' opportunity cost of OFE in distant locations, thereby discouraging selection into migratory OFE participations. Giles and Mu (2007) find that poor health of an elderly parent is likely to decrease his/her young adult child's probability of self-selection into migratory OFE. Similarly, having more young children within the family decreases the probability of an individual selecting into migratory OFE (Shi, Heerink, and Qu 2007).

2.2.3 Research Gaps

Most empirical studies of China's OFE are limited to particular geographic areas. Due to varying local socioeconomic conditions (e.g., differing industry structures, local institutions, social contexts, and histories), evidence from different regions are likely to be place-specific and might not be estimates of global outcomes. If the place-specific estimates about China's OFE are inconsistent or contradictory to the global outcomes, their policy implicaitons for national issues, e.g. urbanization, are likely to be biased and misleading. Having a wider coverage of China's rural areas, this research can generate results more consistent with a global assessment, thus yielding implications more generalizable for China's urbanization policy.

Second, another contribution of this study is to show that the pattern of self-selection can vary substantially for different types of labour market activities. In the literature, most researchers view the OFE participation of China's rural residents as a dichotomous choice. That is, rural residents of China choose between participating in OFE or not, participating in migration or not, or participating in local OFE or not. In contrast, for this study, I construct three mutually exclusive occupational choices, including farming only, local OFE, and migratory OFE, and integrate them within one framework. Since the effects of a given factor may differ across different occupational choices, I can systematically and simultaneously explain, within the same group of rural resident, the selectivity into OFE of China's rural residents. This approach offers a comparison of the influence of a given factor across different off-farm activities of China's rural residents, thereby offering a more complete picture of China's residents' responses to labour market incentives.

Third, most empirical studies of OFE determinants in China have found the significant effects of individual and household characteristics, implying a self-selection process. That is, OFE participants are not random samples of their home communities' work force. However, few of

these studies use Roy's (1951) self-selection model as their theoretical base. With Roy's model as a theoretical base, after a consistency check between theoretical prediction and empirical estimates, I can answer the core research question of this study–whether the OFE participation of China's rural residents is consistent with the market-driven expectations. The theoretical model predicts that an increase in the opportunity costs of migratory OFE (e.g. having more young dependents in a household) decreasing the probability of selection into migratory OFE. However, in the empirical results, I find that an increase in the opportunity costs of migratory OFE does not decrease the probability of selecting into migratory OFE. In this case the market-driven force (migration cost) does not play its expected role. In most other instances, however, market incentives have the expected influence.

Lastly, although some studies in China find that the wage growth in urban areas is a significant driving force behind migratory OFE participation, little is known about the role of rural-urban economic linkages in local OFE. Local OFE participation of a rural resident may not only be affected by the economic conditions of his/her rural community, but also by those of the nearby urban agglomerations. For example, a wage increase in an urban centre within daily commuting distance may increase the local OFE participation of a rural resident. Investigation of the role of rural-urban linkages in OFE participation has important policy implications for improving the effectiveness of urbanization plans.

2.3 Theoretical Model

In analyzing the labour supply of migration or OFE, some researchers use household model (Gronau 1977, Kooreman and Kapteyn1987, Olfert, Taylor, and Stabler 1992). Following Becker's (1965) household time allocation model, these studies consider a household as the decision unit. That is, the family members of a household act collectively and make time allocation decisions to maximize joint household utility, subject to time and income constraints.

The more time that is allocated towards increasing household income, the less time is available for other utility-generating activities (domestic work and leisure). As a result, households tend to choose a combination of market work, domestic work, and leisure hours that maximize its utility.

Becker's household time allocation model implies that an individual's time allocation decision is highly related to the characteristics of his/her household and the rest family members. For example, the individuals with more dependents in their families will spend more time in household domestic work, and thus spend less time for OFE.

Becker's household time allocation model models the household as it were a single individual. This assumption is convenient in model-building, but raises several conceptual and methodological difficulties. Theoretically, the household time allocation model ignores the fact that a household consists of a group of individuals who have different preferences and bargaining positions by construction[3] (Chiappori 1992). Empirically, household models may not be appropriate, as the prominent feature of migration or off-farm decisions is that they are made and conducted by individuals, not households. In recent years, increasing numbers of studies use individual models as their decision-making models for OFE or migration decision (Hunt 2006; Grogger and Hanson 2011; Kennan and Walker 2011). Therefore, in this study, I choose the individual-based Roy's self-selection model to analyse China's OFE. In addition, given that individuals within a household may make OFE decision collectively, I also add some household characteristics into the model so that I can control for some household differences, such as some time-variant household characteristics (land entitlement, young dependents, labour endowment

[3] The household time allocation model is built upon the assumption that there always exists an altruistic dictator who can freely modify allocation of the household resources and has the last word about "who get what", which is unlikely to be true. Further, it still faces another problem to aggregate the individual-based preferences into a household one because of heterogeneous tastes and information asymmetries.

and composition), a household fixed effects term, and the family role of an individual in his/her household.

The core analytical framework for this study is Roy's (1951) self-selection model. I assume that a rural worker *i* ($i \in I$) faces three occupational choices, $J = \{j \mid f, l, m\}$, which are: farming only ($j=f$); local OFE ($j=l$); and migratory OFE ($j=m$). Farming only ($j=f$) describes a worker who does not participate in OFE but may engage in household farm production. Local OFE ($j=l$) refers to participation in OFE while living at home. Migratory OFE ($j=m$) refers to participation in OFE and not returning to his/her home on a daily basis. Note that since workers who select into farming only or local OFE live at home, they can allocate parts of their labour to the household's farm or domestic production.

I assume that each of the occupational choices has its own expected utility, $E(W_j^i)$, measured as the expected utility that *i* can achieve in occupation *j*, measured in monetary value. Therefore, in my model, Roy's (1951) self-selection decision rule is that *i* will self-select into *j* if it provides maximum expected utility. Specifically, that is,

i will self-select into f iff $\mathrm{E}(W_f^i) \geq \mathrm{E}(W_l^i)$ *and* $\mathrm{E}(W_f^i) \geq \mathrm{E}(W_m^i)$

i will self-select into l iff $\mathrm{E}(W_l^i) \geq \mathrm{E}(W_f^i)$ *and* $\mathrm{E}(W_l^i) \geq \mathrm{E}(W_m^i)$

i will self-select into m iff $\mathrm{E}(W_m^i) \geq \mathrm{E}(W_f^i)$ *and* $\mathrm{E}(W_m^i) \geq \mathrm{E}(W_l^i)$

where $\mathrm{E}(W_f^i)$= *i*'s expected utility from participating in farming only;

$\mathrm{E}(W_l^i)$= *i*'s expected utility from participating in local OFE, potentially also including farm and domestic production; and

$\mathrm{E}(W_m^i)$= *i*'s expected utility from participating in migratory OFE.

Based on the self-selection rule, the theoretical model can be written in a linear probability function:

$$Pr(i\ select\ j) = \alpha_{jf}\mathrm{E}(W_f^i) + \alpha_{jl}\mathrm{E}(W_l^i) + \alpha_{jm}\mathrm{E}(W_m^i) \quad (2.1)$$

where $Pr(i\ select\ j)$= the probability that *i* self-select into *j* ;

Parameter constraints: $\begin{pmatrix} \alpha_{ff} > 0 & \alpha_{fl} < 0 & \alpha_{fm} < 0 \\ \alpha_{lf} < 0 & \alpha_{ll} > 0 & \alpha_{lm} < 0 \\ \alpha_{mf} < 0 & \alpha_{ml} < 0 & \alpha_{mm} > 0 \end{pmatrix}$.

The parameter constraints of equation (2.1) reflect the self-selection decision rule, which shows that having higher expected utility of a given occupational choice always increases the probability of selecting in this choice and reduces the probability of selecting in the other two competing occupational choices.

Specifically, I define the function forms of $E(W_f^i)$, $E(W_l^i)$and $E(W_m^i)$ as follows:

$$E(W_f^i) = w_f^i + u_{f,d}^i \quad (2.2)$$

$$E(W_l^i) = w_l^i + u_{l,f}^i + u_{lf,d}^i \quad (2.3)$$

$$E(W_m^i) = w_m^i - hc^i \quad (2.4)$$

where: w_f^i= the monetary value of *i*'s labour time when it is allocated entirely to farm production. Note that w_f^i is a function of *i*'s individual characteristics (ZI^i) and household characteristics (ZH^i). For example, w_f^i may be affected by *i*'s human capital and by *i*'s household land holdings;

$u_{f,d}^i$= the monetary value of the extra utility that *i* may gain by reallocating parts of his/her labour time to household domestic good[4] production. Note that,

[4] Household domestic good is a Beckerian "home-made and non-tradable commodity" (Becker 1991), such as child care, homemade meals, security, housekeeping, and other household collective utility-generating activities.

$u_{f,d}^{i} \geq 0$[5], and it is related to *i*'s preference for domestic goods as well as *i*'s marginal productivity in domestic good production. For example, $u_{f,d}^{i}$ is a function of ZI^{i} and ZH^{i}, e.g., *i*'s demographic variables[6] and the number of dependents[7] in *i*'s household;

w_{l}^{i}= the monetary value of *i*'s labour time if it is allocated exclusively to local OFE. Note that, w_{l}^{i} is a function of the average off-farm wage of *i*'s local community (ω_{l}^{i}), ZI^{i}, ZH^{i}, and *i*'s community characteristics (ZC^{i}). For example, individuals with higher levels of human capital may expect to receive higher income in local OFE. Individuals with more local political contacts may have more local OFE opportunities. Individuals whose local community have more enterprises are likely to have higher local OFE wages, given a fixed labour supply within the local community.

$u_{l,f}^{i}$= the monetary value of the additional utility from allocating labour time to household farm production, since *i* can continue to be engaged in farming when he/she selects into local OFE. Note that, $u_{l,f}^{i} \geq 0$[8] and it is a function of ZI^{i} and ZH^{i};

[5] $u_{f,d}^{i} \geq 0$, as *i* may gain more utility since *i* has an option to allocate part of his/her labour to domestic good production. If the marginal value of labour time in household domestic good production is greater than the marginal value of labour time in farm production, *i* will reallocate labour time to domestic good production, $u_{f,d}^{i}$.

[6] Conventional wisdom suggests that female and elderly individuals might be more experienced and productive in domestic good production, compared with males and the young.

[7] More dependents will tend to increase the marginal utility of household domestic goods.

[8] $u_{l,f}^{i} \geq 0$, as *i* may increase utility from farm production.

$u_{lf,d}^{i}$= the monetary value of the additional utility from allocating labour time to household domestic production, possible when he/she selects into local OFE. Note that, $u_{lf,d}^{i} \geq 0$[9] and it is a function of ZI^{i} and ZH^{i};

w_{m}^{i}= the monetary value of *i*'s labour time when it is allocated to migratory OFE; it is a function of the average wage in the potential migratory OFE destinations and ZI^{i}.; and

hc= the *Hukou* cost of migration. Note that, $hc \geq 0$, which is a function of ZH^{i} [10];

In reduced form, equations (2.2), (2.3), and (2.4) can be expressed as:

$$\mathrm{E}\left(W_{f}^{i}\right) = \theta_{f}^{I} ZI^{i} + \theta_{f}^{H} ZH^{i} \tag{2.5}$$

$$\mathrm{E}\left(W_{l}^{i}\right) = \omega_{l}^{i} + \theta_{l}^{I} ZI^{i} + \theta_{l}^{H} ZH^{i} + \theta_{l}^{C} ZC^{i} \tag{2.6}$$

$$\mathrm{E}\left(W_{m}^{i}\right) = \omega_{m}^{i} + \theta_{m}^{I} ZI^{i} + \theta_{m}^{H} ZH^{i} \tag{2.7}$$

Next I build up the rural-urban wage linkage and define ω_{l}^{i} and ω_{m}^{i}. Considering that urban centre c^{i} is the nearest city to *i*'s local community, with distance D_{c}^{i} from *i*'s local community. ω_{c}^{i} is the average wage of the urban residents of c^{i}, ω_{m}^{i} can be defined as:

$$\omega_{m}^{i} = \rho\omega_{c}^{i} - \varphi_{m} D_{c}^{i} \tag{2.8}$$

As shown in equation (2.8), ω_{m}^{i} is an increasing function of ω_{c}^{i} ($\rho > 0$). That is, if the average wage of the urban residents in c^{i} increase by 1 unit, it is expected that ω_{m}^{i} increase by ρ. ω_{m}^{i} is a decreasing function of the distance between *i*'s local community and c^{i}, D_{c}^{i} ($\varphi_{m} > 0$). I use D_{c}^{i} to index all forms of distance-related transaction costs, including information transfer

[9] $u_{lf,d}^{i} \geq 0$, as *i* may gain utility from labour allocation to domestic good production.

[10] The *Hukou* costs of migration refer to the extra costs due to the artificial barriers of the *Hukou* system. The *Hukou* system entitles the residents who live in their *Hukou* registration places to a set of local-based public goods and social services, such as access to public schools, medical programs, pension plans, and low-cost housing. As a result, migratory OFE workers who work and live outside of their *Hukou* registration places have to purchase them or learn to live without them. *Hukou* costs vary with the household characteristics, due to different number of dependents.

costs about migratory off-farm job opportunities, cultural and linguistic differences, psychic costs of migration, as well as simply transport costs of migration.

The average off-farm wage in *i*'s local OFE, ω_l^i, is defined as

$$\omega_l^i = \rho\omega_c^i(1 - \tau D_c^i) - \varphi_l D_c^i \quad (2.9)$$

As shown in equation (2.9), ω_l^i increases with the average wage of its nearest city (ω_c^i) and declines with greater distances from its nearest city (D_c^i). In equilibrium, an average rural worker's local off-farm wage,ω_l^i, will equal to his/her net income from commuting. As D_c^i increases, not only will a commuter incur more transport costs, but also will spend more time traveling (implying less time in working). Note that I assume that the transport costs increase at a rate of φ_l ($\varphi_l > 0$, a constant commuting monetary cost per unit distance), while the time consumed in commuting increases at a rate of τ ($\tau > 0$, a constant commuting time cost per unit distance).

With equations (2.5), (2.6), (2.7), (2.8), and (2.9), equation (2.1) can be transformed into:

$$Pr(i\ choose\ j) = \alpha_{jI} ZI^i + \alpha_{jH} ZH^i + \alpha_{jC} ZC^i + (\alpha_{jl} + \alpha_{jm})\rho\omega_c^i - (\alpha_{jl}\varphi_l + \alpha_{jm}\varphi_m)D_c^i - \alpha_{jl}\rho\tau\omega_c^i D_c^i \quad (2.10)$$

That is, the probability that *i* self-selects into *j* is a function of *i*'s individual's, household's and local community's characteristics, as these variables can affect *i*'s expected incomes in farming only, local OFE, and migratory OFE. For example, if a higher level of human capital yields higher marginal labour income in migratory OFE than in farming only, one may expect a negative coefficient of human capital for the probability of farming only and a positive coefficient for migratory OFE.

In equations (2.8) and (2.9), the urban wage of the nearest city (ω_c^i) and the distance to the nearest city (D_c^i) influence in a systematic way the average off-farm wages in the local

community and in the potential migratory destinations. In equation (2.10), the coefficients of $\omega_c^i$is $\rho(\alpha_{jl} + \alpha_{jm})$. According to the self-selection decision rule in equation (2.1) and definition in equation (2.8), it is expected that $\rho(\alpha_{fl} + \alpha_{fm}) < 0$. That is, higher urban wages in the nearest city (ω_c^i) will increase the expected income of the local and migratory OFE choices (part of the spatial wage structure), thus decreasing the probability of selection into farming only. The coefficient of D_c^i is $-(\alpha_{jl}\varphi_l + \alpha_{jm}\varphi_m)$. According to the self-selection decision rule in equation (2.1), it is expected that $-(\alpha_{fl}\varphi_l + \alpha_{fm}\varphi_m) > 0$. That is, greater distances to the nearest city (D_c^i) tend to decrease the expected income of local and migratory OFE choices, thus increasing the probability of selection into farming only.

The coefficient of the interaction term of distance and the nearest city's wage, $\omega_c^i D_c^i$, is $-\alpha_{jl}\rho\tau$. According to the self-selection decision rule in equation (2.1), it is expected that $-\alpha_{fl}\rho\tau > 0$; $-\alpha_{ml}\rho\tau > 0$ and $-\alpha_{ll}\rho\tau < 0$. That is, a decrease in the expected income in local OFE (or an increase of the monetary value of commuting time cost in traveling) will increase the probability of an individual's self-selection into farming only and migratory OFE, and decrease the probability of an individual's self-selection into local OFE.

2.4 Data

2.4.1 Household and Village Survey

The data for this study were collected by the Centre for Chinese Agricultural Policy (CCAP), Chinese Academy of Sciences in Beijing, China. Two separate rounds of surveys[11] were

[11] The data collection effort involved students and staff from the Centre for Chinese Agricultural Policy and a group of masters and Ph.D. students from a number of other agricultural universities. Households were paid 20 Yuan and given a gift in compensation for the time that they spent with the survey team. The author participated in collecting the data in the second round survey.

conducted: one in April 2005 and the second in April 2008. These surveys focused on the years 2004 and 2007, respectively.

The first survey covered a randomly selected, nationally representative sample of 101 rural villages in five provinces (Jiangsu, Sichuan, Shaanxi, Jilin, and Hebei). The sample provinces were randomly selected from each of China's major economic zones[12]. To reflect accurately the differing income distributions within each province, one county was selected randomly from within each income quintile for the province (Figure 2-1), as measured by the per capita gross value of industrial output. The same procedure was used in the selection of the townships and villages. Within each county, two townships were selected randomly within each county, and two villages were selected randomly within each township. Finally, the survey teams used village rosters to randomly choose eight households holding residency permits (*Hukou*) in each village. In total, 808 households (or 3,267 individuals) were included in the survey in 2005 (Table 2-1).

[12] To approximate a nationally representative sample, the provinces were selected from five distinct regions to reflect variations in economic development and geography. Jiangsu was selected to represent China's most developed southeast coastal area (Jiangsu, Zhejiang, Shandong, Shanghai, Fujian and Guangdong); Sichuan represents China's southwest area (Sichuan, Yunnan, Tibet, Guizhou and Guangxi); Shaanxi represents China's northwest area (Shaanxi, Gansu, Inner Mongolia, Qinghai, Ningxia and Xinjiang); Hebei represents north and central provinces (Hebei, Henan, Shanxi, Anhui, Hubei, Hunan and Jiangxi); Jilin represents China's north-eastern provinces (Liaoning, Jilin and Heilongjiang).

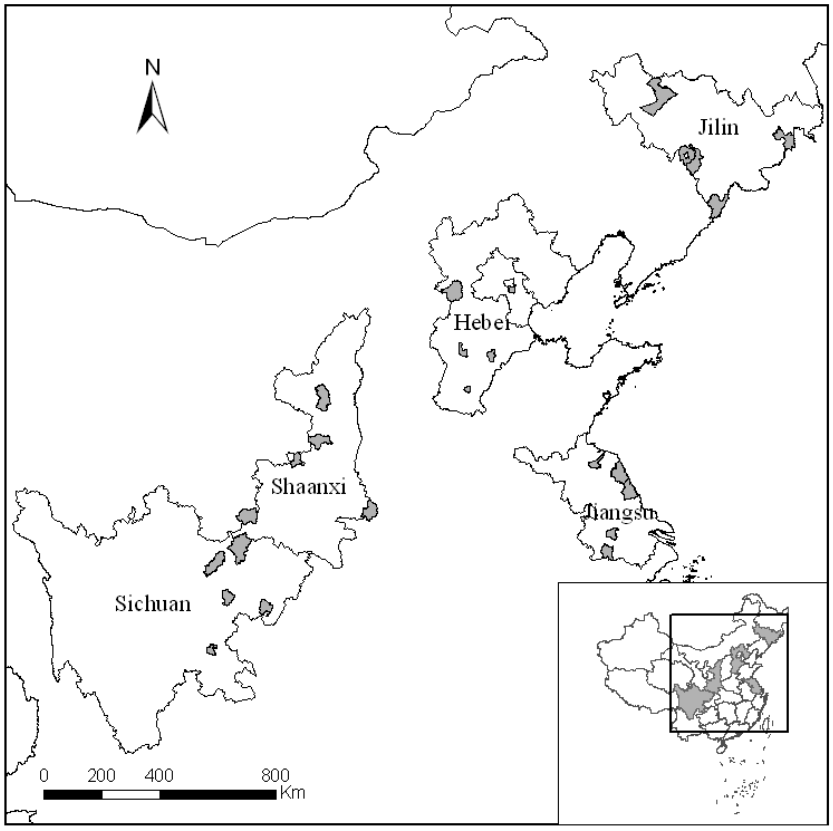


Figure 2-1. Sample provinces and counties

Table 2-1. Sample distribution

Province	County	Township	Village	2004		2007	
				Household	Individual	Household[a]	Individual
Jiangsu	5	10	20	160	644	401 (142)	1637
Sichuan	5	10	20	160	688	400 (125)	1752
Shaanxi	5	10	20	160	685	400 (129)	1765
Jilin	5	10	21	168	606	421 (137)	1550
Hebei	5	10	20	160	644	402 (149)	1623
Total	25	50	101	808	3267	2024 (682)	8327

[a] The number in the parentheses refers to the households that were visited in both survey years.
Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.

For the second survey, the same households that had been surveyed in 2005 were visited. Following the same sampling technique, the survey team increased the household sample size to 20 per village (the original eight survey households plus 12 other households randomly chosen

from the 2005 village rosters). There are 682 households that are included for both years. Including replacement, the second round survey included a total of 2,024 households and 8,328 individuals (Table 2-1).

During the survey, the enumerators used pre-coded forms (e.g., a village survey form and a household survey form) to collect a wide range of information about the villages, the households, and the individuals of the households during the survey years. In the village survey form, enumerators mainly questioned China's Communist Party secretaries and/or the accountants of the villages about the community characteristics in 2004 and 2007. In the household survey form, the enumerators mainly asked the heads of the selected households for detailed information about household members during the survey years, including their gender, ages, education, and production activities.

In the household survey, information on household members' activities in OFE during the survey years was included, such as the occupation, the locality and the residency of the OFE participants. Tables 2-2 and 2-3 summarize the information about the labour force composition and their production activities of my sample for the year 2004 and year 2007 respectively. The results show that, from 2004 to 2007, the farm labour force decreased from 74 to 70% and the OFE labour force increased from 52 to 54%.

2.4.2 Information about the Nearest Cities of Sample Villages

I collected the geographic, population, and wage information of the nearest cities of the sample villages from the China City Statistical Yearbook (CNBS 2005; 2008) and Google Maps (2012). Specifically, for each of the sample villages, I find its nearest city by using the electronic map of Google Maps (2012) and measure the distance from the centre of the village to the centre of the city. The urban wage, ω_c^i, which was collected from the China City Statistical Yearbook (CNBS 2005; 2008) for years of 2004 and 2007 respectively, is defined as "the average annual

wage of the urban residents (with urban *Hukou*) who live in the core area of the sample village's nearest city".

Table 2-2. Sample composition by production activities in 2004

	Total	Jiangsu (coastal)	Sichuan	Shaanxi (inland)	Jilin	Hebei
Sample size:	3267	644	688	685	606	644
Age<16	601	100	142	150	80	129
Age>65	200	22	63	33	35	47
Labour force[a]:	2182	456	449	428	439	410
Farming[b]	1607	314	307	323	324	339
	(74%)	(69%)	(68%)	(75%)	(74%)	(83%)
Farming only	1041	169	206	220	236	210
	(48%)	(37%)	(46%)	(51%)	(54%)	(51%)
OFE[c]:	1129	285	241	207	197	199
	(52%)	(63%)	(54%)	(48%)	(45%)	(49%)
Local OFE[d]	596	163	101	95	111	126
	(27%)	(36%)	(22%)	(22%)	(25%)	(31%)
Migratory OFE[e]	533	122	140	112	86	73
	(24%)	(27%)	(31%)	(26%)	(20%)	(18%)

[a] Labour force consists of everyone of working age, between 16 and 65, except for those in schooling, military and prison, those who do not participate in farming or OFE due to health consideration (e.g., too old and ill) and those who only do domestic work at own home.
[b] Farming refers to that an individuals in the labour force who participated in their own household farm production in a survey year.
[c] OFE refers to the individuals in the labour force who participated in OFE in the survey years.
[d] Local OFE refers to that an individuals in the labour force whose major OFE is local OFE in a survey year.
[e] Migratory OFE refers to an individuals in the labour force whose major OFE is migratory OFE in a survey year.
Percentage of the labour force in the parentheses
Source: Author's calculation using the CCAP rural household survey, 2005.

Table 2-3. Sample composition by production activities in 2007

	Total	Jiangsu (coastal)	Sichuan	Shaanxi (inland)	Jilin	Hebei
Sample size:	8327	1637	1752	1765	1550	1623
Age<16	1301	236	328	284	189	264
Age>65	619	88	173	113	106	139
Labour force[a]:	5600	1180	1145	1147	1072	1056
Farming[b]	3902	807	712	795	786	802
	(70%)	(68%)	(62%)	(69%)	(73%)	(76%)
Farming only	2443	411	500	543	527	462
	(44%)	(35%)	(44%)	(47%)	(49%)	(44%)
OFE[c]:	2996	748	609	565	509	565
	(54%)	(63%)	(53%)	(49%)	(47%)	(54%)
Local OFE[d]	1445	400	188	226	294	337
	(26%)	(34%)	(16%)	(20%)	(27%)	(32%)
Migratory OFE[e]	1551	348	421	339	215	228
	(28%)	(29%)	(37%)	(30%)	(20%)	(22%)

[a] Labour force consists of everyone of working age, between 16 and 65, except for those in schooling, military and prison, those who do not participate in farming or OFE due to health consideration (e.g., too old and ill) and those who only do domestic work at own home.
[b] Farming refers to that an individuals in the labour force who participated in their own household farm production in a survey year.
[c] OFE refers to the individuals in the labour force who participated in OFE in the survey years.
[d] Local OFE refers to that an individuals in the labour force whose major OFE is local OFE in a survey year.
[e] Migratory OFE refers to an individual in the labour force whose major OFE is migratory OFE in a survey year.
Percentage of the labour force in the parentheses
Source: Author's calculation using the CCAP rural household survey, 2008.

2.5 Empirical Framework

2.5.1 Pooled Linear Probability Model

The empirical model follows from the theoretical model represented by equation (2.10). For individual *i* in period *t (year 2004 or year 2007)*, the probability of self-selection into activity *j* can be estimated with a linear probability model (2.11) with robust standard errors adjusted for clustering. Although Logit, Probit or Multinomial models are technically preferred to a linear probability model, only the latter can be used as the base (comparison) model for a fixed effects model. A fixed effects model can remove the effect of all time-invariant influences from the dependent variable, including observable and the unobservable characteristics, thus it may produce estimates of the relationships closer to the true value than another estimator. Because of

the importance of controlling for the time-invariant disturbances which can only accomplished with a linear probability model I rely on the latter as the base model. I also estimate Logit, Probit, and Multinomial Logit models (selected results reported n Appendices) to test for robustness of my results.

The base linear probability model is:

$$P_{j,t}^{i} = \alpha_{j,t} + \alpha_{j,I} ZI_t^i + \alpha_{j,H} ZH_t^i + \alpha_{j,C} ZC_t^i + (\alpha_{jl} + \alpha_{jm})\rho\omega_{c,t}^i - (\alpha_{jl}\varphi_l + \alpha_{jm}\varphi_m)D_c^i - \alpha_{jl}\rho\tau\omega_{c,t}^i D_c^i + \mu_{i,j,t} \quad (2.11)$$

where j =*f*, *l*, and *m*, respectively farming only, local OFE, and migratory OFE.

$\alpha_{j,t}$= time specific constant term;

ZI_t^i = individual characteristics in period *t*;

$\alpha_{j,I}$= marginal effects of *i*'s individual characteristics on $P_{j,t}^i$;

ZH_t^i = household characteristics in period *t*;

$\alpha_{j,H}$= marginal effects of *i*'s household characteristics on $P_{j,t}^i$;

ZC_t^i = community characteristics in period *t*;

$\alpha_{j,C}$= marginal effects of *i*'s community characteristics on $P_{j,t}^i$;

$\omega_{c,t}^i$= the average wage rate of the urban residents of individual *i*'s nearest city c in period *t*;

$(\alpha_{jl} + \alpha_{jm})\rho$= marginal effects of $\omega_{c,t}^i$on $P_{j,t}^i$;

D_c^i= the distance to the nearest city c;

$-(\alpha_{jl}\varphi_l + \alpha_{jm}\varphi_m)$= marginal effects of D_c^i on $P_{j,t}^i$;

$-\alpha_{jl}\rho\tau$ = marginal effects of $\omega_{c,t}^i D_c^i$ on $P_{j,t}^i$,;

$\mu_{i,j,t}$= the error term.

The dependent variable $P_{j,t}^{i}$ of Eq. (2.11) is the dummy variable reflecting *i*'s probability of self-selection into *j* in period *t*. For example, $P_{f,2004}^{i}$ =1 if *i* participated in farming only in 2004; otherwise 0, similarly for selection into local and migratory OFE.

The vectors of independent variables of Eq. (2.11) are ZI_t^i, ZH_t^i, ZC_t^i, $\omega_{c,t}^i$, D_c^i, and an interaction term of wage and the distance, $\omega_{c,t}^i D_c^i$. The vector ZI_t^i consists of *i*'s individual characteristics, i.e., gender, age (age groups16-20; 21-30; 31-40; 41-50; 51-65), and education attainment (in five categories[13]). Younger age groups (e.g. age groups of 16-20, 21-30, and 31-40) are expected to have greater probability of selection into local and migratory OFE ($P_{l,t}^{i}$ and $P_{m,t}^{i}$) and lower probability of selection into farming only ($P_{f,t}^{i}$). Theoretically, younger workers have longer periods of lifetime to capture the income premium of OFE (Taylor and Martin 2001). Empirically, numerous studies show that migratory OFE participants are more likely to be young (Hare 1999; Knight, Song, and Huaibin 1999; Rozelle, Taylor, and De Brauw 1999; Zhao 1999b; Roberts 2001; Zhu 2002).

Education may play a critical role in individual's self-selection into OFE. The literature demonstrates that higher education attainment tends to garner higher incomes in markets with greater labour demand (Borjas, Bronars, and Trejo 1992; Taylor and Martin 2001; Hare 2002). Larger urban centres are more attractive to more skilled workers because of higher wages and built amenities (Partridge et al., 2009; Glaeser and Resseger, 2010). Therefore, it is expected those individuals with higher education attainments are more likely to self-select into migratory OFE rather than farming only and local OFE.

[13] The educational attainment ranges from "illiterate or primary school unfinished", through "primary school completed", "mid-school completed", "high school completed" and "college, university, or higher."

The vector ZH_t^i consists of *i*'s household characteristics including the number of pre-school children in the household, the number of additional female and male labour force members, the quantity of land entitlement at the beginning of the year, and household social contact (a dummy variable for the membership in China Communist Party).

The probability of self-selection into migratory OFE is expected to be negatively affected by the number of pre-school children in the household due to a higher shadow price of domestic good production and higher marginal labour productivity in domestic work. Note this negative relationship is empirically confirmed by Shi, Heerink, and Qu (2007) in the context of China. Also, more pre-school children in the household leads to higher *Hukou* costs, thereby decreasing the expected utility of migratory OFE.

The probability of self-selection into migratory OFE is expected to be positively related to the number of female labour force members in the household. De Brauw et al. (2002) and Zhang, De Brauw, and Rozelle (2004) document an increasingly feminized farming labour force in China. Therefore, individuals with more female family members are likely to have more labourers able to work on the farm. As a result, the number of female labour force members may positively affect $P_{m,t}^i$ and negatively affect $P_{f,t}^i$ and $P_{l,t}^i$

I expect that the probability of self-selection into migratory and local OFE decreases and the probability of farming increases with the quantity of household's land entitlement. Individuals from households with more land are likely to be more productive in farm production than the ones with less land. Therefore it is expected that greater land endowments of household to positively affect $P_{f,t}^i$ and negatively affect $P_{l,t}^i$ and $P_{m,t}^i$.

Numerous studies show how local political connections may facilitate local OFE participation (Cook 1998; Yao 1999b; Xia and Simmons 2004; Guang and Zheng 2005; Glauben, Herzfeld,

and Wang 2008; Zhou 2011). In the empirical model, I use a dummy variable that indicates if there is a Chinese Communist Party member (CCP member) among the family members of *i* to approximate individual's connections to local political power. In rural China, CCP members are more likely to be the political and economic elites of the local communities, usually having better connections with local political authorities. To become a CCP member, two current CCP members must recommend the applicant to the local party leadership. Further the recommending CCP members must acquaint themselves with the applicant, and be aware of their personnel records, educational attainment, and work performance (Sullivan 2012). Therefore, it is expected that individuals who have a family member in the CCP have better connections with the local governments, thus a greater probability of selection into local OFE and lower probability of selection into migratory OFE.

The vector ZC_t^i consists of the number of village enterprises[14] per 1000 population in *i*'s local rural community. Having more enterprises may increase local off-farm employment opportunities, thereby raising the expected income of local OFE. As a result, an increase of the number of enterprises per 1000 population in *i*'s community is expected to increase the probability of selection into local OFE and decrease the probability of selection into migratory and farming only.

The average urban wage of the nearest city ($\omega_{c,t}^i$) and the distance (D_c^i), and the interaction term of wage and distance ($\omega_{c,t}^i D_c^i$) are used to index the average off-farm wages of *i*'s local community and potential migratory destinations in period *t*. As shown in equation 2.9, I use the urban wage of nearest city $\omega_{c,t}^i$ to approximate the general off-farm wage accessible by potential participants. An increase in $\omega_{c,t}^i$ will increase the local OFE wage and the migratory OFE wage

[14] In this study, enterprises are businesses in the non-farm sector, both manufacturing and services.

of the rural residents of the community. I use the distance (D_c^i) to approximate the total migration cost of a rural resident participating in migratory OFE, and the commuting transportation costs when a rural resident participates in local OFE. That is, as shown in equation 2.9, the greater the distance D_c^i is, the higher the migration costs of a rural-urban migrant who chooses the nearest city as migration destination. The greater the distance D_c^i is, the higher the transport costs will be of a rural-urban commuter who chooses the nearest city as workplace. Moreover, when a rural resident commutes to an off-farm job in the nearest city, not only will he/she incur transport costs, but also time spent in traveling (implying less time in working). I use the interaction term of wage and distance ($\omega_{c,t}^i D_c^i$) to approximate this time costs spent in commuting. That is, the greater $\omega_{c,t}^i D_c^i$ is, the more time will be spent by a rural commuter in commuting when he/she commute daily from his/her community to the nearest city, and the greater will be the erosion of OFE income. The accuracy of this measurement is based on two assumptions. First, there is regional wage equilibrium that the rural workers in the local community are free to choose their off-farm work places, either in distant cities or in the local community. Second, the distance (D_c^i) is an accurate measurement of the transporting distance (the road distance) between the rural community and its nearest city. It is expected that $(\alpha_{fl} + \alpha_{fm}) < 0$ and $-(\alpha_{fl}\varphi_l + \alpha_{fm}\varphi_m) > 0$, as an increase in the expected income in local or migratory OFE will decrease the probability of an individual's self-selection into farming only. It is expected that $-\alpha_{fl}\rho\tau > 0$, $-\alpha_{ml}\rho\tau > 0$, and $-\alpha_{ll}\rho\tau < 0$, because an increase of the monetary value of commuting time cost in traveling will increase the probability of an individual's self-selection into farming only and migratory OFE and decrease the probability of an individual's self-selection into local OFE.

2.5.2 Repeated Observation of Individuals and Household Characteristics

Our data set contains repeated observations of individuals over two periods of time. However, the pooled OLS model (2.11) is based on the assumption that all observations are uncorrelated and independent. A partial solution is to exclude the repeated observations from the regression model. I therefore first exclude all 2007 observations that are repeated to construct the pooled sample.

Further, the individual observations in equation (2.11) are based on random sampling of households, not individuals, which may be problematic. For each individual within a household, all other household members are also in the sample. Since individuals within the same household will share the same household characteristics, household characteristics will be repeated and 'double-counted' to the extent of the number of individuals in the household, again violating the assumption of uncorrelated and independent observations thus introducing bias. My solution is to estimate the models for a number of 'focal persons' in the household, yielding a random subsample without repetition of household characteristics. For each household in the sample, I select three working-age labour force members as the 'focal person'. They are the household head, the spouse of household head, and the youngest[15] working-age child of household head (the youngest son/son-in-law or daughter/daughter-in-law), respectively. As the household sample is randomly generated and the selection rule of the focal person for each household sample is exogenous, the focal person sub-sample satisfies the assumption of OLS model. That is, the observations are independent.

[15] The youngest children are more likely to remain in the sample for the two survey period.

2.5.3 Fixed Effects Model

Using the dependent and independent variables in equation (2.11) and a panel data set[16], I estimate a fixed effects model (FE model). The construction of the FE model is shown as follows. For the observations in 2004 survey, one has

$$P_{j,2004}^{i} = \beta_{j,2004} + \beta_{j,I} ZI_{2004}^{i} + \beta_{j,H} ZH_{2004}^{i} + \beta_{j,C} ZC_{2004}^{i} + (\beta_{jl} + \beta_{jm})\rho\omega_{c,2004}^{i} - (\beta_{jl}\varphi_{l} + \beta_{jm}\varphi_{m})D_{c}^{i} - \beta_{jl}\rho\tau\omega_{c,2004}^{i} D_{c}^{i} + \beta_{j}^{i} + \varepsilon_{i,j,2004} \quad (2.12)$$

For the repeated observations in 2007 survey, one has

$$P_{j,2007}^{i} = \beta_{j,2007} + \beta_{j,I} ZI_{2007}^{i} + \beta_{j,H} ZH_{2007}^{i} + \beta_{j,C} ZC_{2007}^{i} + (\beta_{jl} + \beta_{jm})\rho\omega_{c,2007}^{i} - (\beta_{jl}\varphi_{l} + \beta_{jm}\varphi_{m})D_{c}^{i} - \beta_{jl}\rho\tau\omega_{c,2007}^{i} D_{c}^{i} + \beta_{j}^{i} + \varepsilon_{i,j,2007} \quad (2.13)$$

After taking the differencing between (2.12) and (2.13), one has

$$\Delta P_{j}^{i} = \Delta\beta_{j} + \beta_{j,I}\Delta ZI^{i} + \beta_{j,H}\Delta ZH^{i} + \beta_{j,C}\Delta ZC^{i} + (\beta_{jl}\rho + \beta_{jm}\rho - \beta_{jl}\rho\tau D_{c}^{i})\Delta\omega^{i} + \Delta\varepsilon_{i,j} \quad (2.14)$$

where $\beta_{j,t}$=a time-varying constant term;

$\beta_{j,I}$=marginal effects of *i*'s individual characteristics on $P_{j,t}^{i}$;

$\beta_{j,H}$=marginal effects of *i*'s household characteristics on $P_{j,t}^{i}$;

$\beta_{j,C}$=marginal effects of *i*'s community characteristics on $P_{j,t}^{i}$;

$(\beta_{jl} + \beta_{jm})\rho$=marginal effects of $\omega_{c,t}^{i}$on $P_{j,t}^{i}$, corresponding to the term of $(\alpha_{jl} + \alpha_{jm})\rho$ in equation (2.11);

$-(\beta_{jl}\varphi_{l} + \beta_{jm}\varphi_{m})$=marginal effects of D_{c}^{i} on $P_{j,t}^{i}$, corresponding to the term of $-(\alpha_{jl}\varphi_{l} + \alpha_{jm}\varphi_{m})$= in equation (2.11);

[16] I use a balanced panel data for the FE model who were interviewed both in 2004 and 2007.

$-\beta_{jl}\rho\tau$=marginal effects of $\omega_{c,t}^{i}D_{c}^{i}$ on $P_{j,t}^{i}$, corresponding to the term of $-\alpha_{jl}\rho\tau$ in equation (2.11);

β_{j}^{i}=individual dummy (the individual-based fixed effect);

$\Delta P_{j}^{i} = P_{j,2007}^{i}$-$P_{j,2004}^{i}$;

$\Delta\beta_{j} = \beta_{j,2007}$-$\beta_{j,2004}$;

$\Delta ZI^{i} = ZI_{2007}^{i}$-$ZI_{2004}^{i}$;

$\Delta ZH^{i} = ZH_{2007}^{i}$-$ZH_{2004}^{i}$;

$\Delta ZC^{i} = ZC_{2007}^{i}$-$ZC_{2004}^{i}$; and

$\Delta\omega_{m}^{i}$=$\omega_{m,2007}^{i}$-$\omega_{m,2004}^{i}$

The FE model removes the effect of all time-invariant influences from the dependent variables, including observable and the unobservable characteristics. Using a FE model, one can assess the net effects of variations in the independent variables for an individual. Each individual *i* has a fixed effect term, β_{j}^{i}, which can control for all of the individual-based time-invariant variables that cannot be observed or measured, like individual's preferences, ability, race, and cultural factors, etc. As the effect of all time-invariant characteristics has been removed from the outcome variables, the FE model can assess the net effect of the time-varying independent variables. The estimated coefficients of the FE models are more consistent because the FE model controls for the bias caused by the omitted time-invariant unobservable characteristics.

One side effect of FE model is that effects of time-invariant factors of the dependent variables (such as gender, education and distance variables) are not identified, as these time-invariant characteristics are perfectly collinear with the individual dummy, β_{j}^{i}. To get a sense of the correlations between OFE and time invariant characteristics, one can use the linear probability model (Eq. 2.11).

2.6 Results of Focal Person Approach[17]

2.6.1 Descriptive Statistics

In Appendices A-2 to A-7, I present some basic descriptive statistics of selected focal persons by self-selection for the years of 2004 and 2007 (the variable definition and sources are shown in Appendix A-1). In Appendices A-2 and A-3, I present the summary statistics of about 2,500 household head focal persons.[18] More than 95% were men, with average age around 47 to 49. In general, household heads are moderately educated. About 70% finished primary school or mid school, 10 to 12% completed high school, few have post-secondary degrees. Most household heads select "farming only" (46%) or "local OFE" (37 to 41%), while about 13 to 16% select migratory OFE. Through the migratory OFE is not the dominant occupational choice for household heads, its share increased from 2004 to 2007.

In Appendices A-4 and A-5, I report the summary statistics of the spouse focal person. Of the approximately 2,400 spouses, more than 96% are female, with an average age around 46 to 49. Spouses of household heads are less educated than the heads (their partners). More than 30% of spouses did not finish primary school, about 53 to 57% finished primary school or mid school, few completed high school or higher. As for their occupational choices, spouses concentrate in "farming only" (about 74 to 76%). Local OFE is the second most selected, about 20 to22%. Few spouses select into migratory OFE.

Appendices A-6 and A-7 contain descriptive statistics for the youngest working-age child of household heads (hereafter child focal persons). The child focal persons are almost equally

[17] All statistical and econometric analyses were performed with Stata 13.0 software in the Canada Rural Economy Research Lab (C-RERL) of University of Saskatchewan.

[18] Note that, I have 808 households for 2004. Each household has a household head, so I have 808 household head focal persons in 2004. However, as some household heads cannot be classified as working-age labour force (e.g. age above 65), the sample size of household head focal persons is 725. The same for 2007 sample, from 2,024 household heads, 1,757 are in the labour force.

distributed in terms of gender, and they are the most educated focal person group in this study. Their average age is around 24 to 25. About 61 to 68% have finished mid school or high school; 4 to 7% have college or university degrees. In terms of occupational choices, the majority of child focal persons select into “migratory OFE” (61%). “Farming only” and “local OFE” have about equal shares of 20% respectively.

Overall, these descriptive statistics suggest two patterns: (1) different focal persons have distinctive individual average characteristics; and (2) different focal persons select into different occupational choices. These observations suggest that there is a correlation between individual characteristics and occupational choices. Spouse focal persons, mostly female, are more likely to work in farming only than the household head focal persons, mostly male. The child focal persons, mostly young and more educated, are more likely to work in migratory OFE than the household head focal persons and the spouse focal persons. Within each focal person group, migratory OFE workers are more likely to be male, young, and highly educated, while farming only workers are more likely to be female, senior, and less educated.

In addition, some household and community characteristics seem to be correlated with occupational choices. Within each focal person group, the workers who select into farming only are more likely to come from the households with more land endowments. Migratory OFE participants are likely to come from the households with fewer preschool children. Local OFE participants are likely to come from the households with CCP member(s). Local OFE participants are more likely to come from communities with more village enterprises per 1000 population.

2.6.2 Results of Pooled Linear Probability and Fixed Effects Models

In Tables 2-4, 2-5, and 2-6, I report the estimated coefficients for household head focal persons, spouse focal persons, and child focal persons, respectively. Further, for each table,

columns (2), (3), and (4) present the results of pooled linear probability models for farming only, local OFE, and migratory OFE, respectively, while columns (5), (6), and (7) present the results of corresponding FE model.

2.6.2.1 Results for household head focal persons

The pooled linear probability (PLP) results in column (2) in Table 2-4 suggest that the female, senior, and less educated household head focal persons are more likely to select into farming only. Female household head has about 19 percentage points greater probability of selecting into farming only than males. Senior household heads (ages 41 and 50) have about 12 percentage points greater probability of selecting into farming only than ages 21 to 40. Household heads with lower educational attainment always have higher probabilities of selecting into farming only.

Columns (3) and (4) in Table 2-4 suggest that the male, young, and more educated household head focal persons are more likely to select into local or migratory OFE. For example, male household heads have about 15 percentage points greater probability of selecting into migratory OFE than female. Household heads between 21 and 40 have 5-8 percentage points greater probability of selecting into local or migratory OFE than those ages between 41 and 50. Higher educational attainment is associated with a higher probability of selecting into local OFE.

Table 2-4. Regression results for household head

	Pooled Linear Probability (PLP)			Fixed Effects (FE)		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.188***	0.04*	0.148***			
	(0.058)	(0.06)	(0.027)			
Age between 21-30	-0.336***	0.183***	0.153***	0.156	-0.125	-0.031
	(0.044)	(0.067)	(0.048)	(0.166)	(0.167)	(0.139)
Age between 31-40	-0.340***	0.150***	0.190***	-0.03	-0.002	0.032
	(0.034)	(0.035)	(0.03)	(0.113)	(0.106)	(0.097)
Age between 41-50	-0.211***	0.103***	0.108***	-0.011	-0.003	0.014
	(0.026)	(0.027)	(0.022)	(0.066)	(0.051)	(0.057)
Primary school	-0.125***	0.119***	0.006			
	(0.032)	(0.028)	(0.021)			
Mid school	-0.157***	0.148***	0.009			
	(0.033)	(0.03)	(0.024)			
High school	-0.213***	0.202***	0.011			
	(0.046)	(0.048)	(0.037)			
College or higher	-0.486***	0.237	0.249			
	(0.069)	(0.147)	(0.169)			
Number of children	-0.006	-0.003	0.009	0.029	-0.012	-0.017
	(0.021)	(0.023)	(0.022)	(0.03)	(0.037)	(0.032)
Hhld female labour	-0.004	0.002	0.002	0.062**	-0.033	-0.03
	(0.017)	(0.016)	(0.012)	(0.03)	(0.028)	(0.025)
Hhld male labour	-0.017	0.003	0.014	-0.036	0.048	-0.012
	(0.017)	(0.019)	(0.014)	(0.046)	(0.046)	(0.034)
Hhld entitled land	0.008***	-0.006**	-0.003**	0.003	0.005*	-0.008**
	(0.003)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)
Having CCP member	-0.013	-0.006	0.019	-0.088	0.017	0.071
	(0.044)	(0.041)	(0.03)	(0.099)	(0.12)	(0.073)
Village enterprises	-0.005*	0.008***	-0.004***	0.005**	-0.001	-0.004
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)
Distance to city	-0.01	0.006	0.004			
	(0.012)	(0.011)	(0.005)			
Wage of nearest city	-0.020***	0.025***	-0.005	0.001	-0.008***	0.007***
	(0.006)	(0.006)	(0.004)	(0.003)	(0.003)	(0.002)
Interaction term of distance and wage	0.001	-0.001	0.0002			
	(0.001)	(0.001)	(0.0003)			
Year 2007	0.094**	-0.186***	0.091***			
	(0.039)	(0.036)	(0.027)			
Obs.	1882	1882	1882	1112	1112	1112
R square	0.166	0.117	0.067	0.02	0.019	0.037

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The descriptive statistics and the definition of variables are shown in Appendix A.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table 2-5. Regression results for household head's spouse

	Pooled Linear Probability (PLP)			Fixed Effects (FE)		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.268***	0.089	0.180***			
	(0.076)	(0.055)	(0.061)			
Age between 21-30	-0.142**	0.102	0.041	0.172	-0.212	0.04
	(0.062)	(0.069)	(0.034)	(0.146)	(0.154)	(0.117)
Age between 31-40	-0.103***	0.078**	0.025	-0.076	0.049	0.026
	(0.036)	(0.033)	(0.017)	(0.084)	(0.08)	(0.053)
Age between 41-50	-0.080***	0.069**	0.011	-0.129**	0.109**	0.02
	(0.028)	(0.027)	(0.015)	(0.05)	(0.045)	(0.027)
Primary school	-0.038	0.031	0.006			
	(0.029)	(0.026)	(0.012)			
Mid school	-0.132***	0.099***	0.034*			
	(0.027)	(0.024)	(0.017)			
High school	-0.323***	0.221***	0.102***			
	(0.054)	(0.039)	(0.031)			
College or higher	-0.420***	0.430**	-0.009			
	(0.147)	(0.172)	(0.095)			
Number of children	0.017	0.005	-0.022**	0.059**	-0.045*	-0.013
	(0.026)	(0.025)	(0.009)	(0.025)	(0.024)	(0.013)
Hhld female labour	0.023	-0.039*	0.017**	0.046*	-0.044*	-0.001
	(0.017)	(0.016)	(0.008)	(0.025)	(0.022)	(0.015)
Hhld male labour	0.0001	-0.017	0.017**	-0.002	0.013	-0.01
	(0.013)	(0.013)	(0.008)	(0.027)	(0.027)	(0.013)
Hhld entitled land	0.006*	-0.005**	-0.002***	0.005*	-0.005*	0.0001
	(0.002)	(0.002)	(0.0005)	(0.002)	(0.002)	(0.001)
Having CCP member	0.018	-0.003	-0.015	0.063	-0.067	0.004
	(0.021)	(0.021)	(0.011)	(0.061)	(0.06)	(0.01)
Village enterprises	-0.007***	0.007***	0.0003	-0.003	0.004*	-0.002
	(0.002)	(0.002)	(0.001)	(0.004)	(0.002)	(0.002)
Distance to city	-0.006	0.004	0.003			
	(0.011)	(0.01)	(0.004)			
Wage of nearest city	-0.019***	0.022***	-0.003**	-0.004	0.003	0.001
	(0.005)	(0.005)	(0.001)	(0.003)	(0.002)	(0.001)
Interaction term of distance and wage	0.00005	-0.0002	0.0001			
	(0.0005)	(0.0005)	(0.0002)			
Year 2007	0.095***	-0.114***	0.019			
	(0.029)	(0.032)	(0.015)			
Obs.	1787	1787	1787	1064	1064	1064
R square	0.152	0.131	0.063	0.044	0.046	0.004

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The descriptive statistics and the definition of variables are shown in Appendix A.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table 2-6. Regression results for head's youngest working-age child

	Pooled Linear Probability (PLP)			Fixed Effects (FE)		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.065***	0.014	0.051*			
	(0.023)	(0.022)	(0.027)			
Age between 16-20	-0.016	-0.416*	0.432**	0.305	-0.655**	0.35
	(0.165)	(0.225)	(0.184)	(0.319)	(0.266)	(0.474)
Age between 21-30	-0.017	-0.363	0.380**	0.415	-0.571**	0.156
	(0.163)	(0.223)	(0.184)	(0.308)	(0.244)	(0.454)
Age between 31-40	-0.012	-0.255	0.267	0.29	-0.327	0.037
	(0.166)	(0.225)	(0.188)	(0.293)	(0.244)	(0.461)
Age between 41-50	0.19	-0.156	-0.034			
	(0.189)	(0.243)	(0.218)			
Primary school	-0.146**	0.075*	0.071			
	(0.06)	(0.044)	(0.064)			
Mid school	-0.277***	0.122***	0.155**			
	(0.058)	(0.042)	(0.058)			
High school	-0.316***	0.053	0.263***			
	(0.06)	(0.045)	(0.07)			
College or higher	-0.385***	0.013	0.372***			
	(0.063)	(0.064)	(0.078)			
Number of children	0.021	0.076**	-0.098***	-0.032	0.123**	-0.09
	(0.025)	(0.03)	(0.036)	(0.054)	(0.057)	(0.064)
Hhld female labour	-0.065***	-0.021	0.087***	0.024	0.022	-0.046
	(0.021)	(0.019)	(0.023)	(0.034)	(0.034)	(0.043)
Hhld male labour	0.041*	-0.042**	0.001	-0.007	-0.096	0.103
	(0.023)	(0.019)	(0.026)	(0.066)	(0.061)	(0.084)
Hhld entitled land	0.004***	-0.002	-0.002	-0.005	0.002	0.003
	(0.001)	(0.001)	(0.002)	(0.005)	(0.002)	(0.004)
Having CCP member	-0.033	0.032	0.001	-0.018	0.055	-0.037
	(0.025)	(0.029)	(0.032)	(0.083)	(0.075)	(0.117)
Village enterprises	0.0002	0.006***	-0.006**	-0.009	0.004	0.005
	(0.001)	(0.002)	(0.002)	(0.006)	(0.005)	(0.008)
Distance to city	-0.001	0.016	-0.015			
	(0.009)	(0.011)	(0.012)			
Wage of nearest city	-0.005	0.028***	-0.023***	-0.005	-0.005	0.010**
	(0.004)	(0.006)	(0.007)	(0.004)	(0.004)	(0.004)
Interaction term of distance and wage	0.0002	-0.001*	0.001			
	(0.001)	(0.0007)	(0.001)			
Year 2007	0.012	-0.138***	0.126***			
	(0.032)	(0.037)	(0.042)			
Obs.	1185	1185	1185	520	520	520
R square	0.115	0.128	0.123	0.048	0.079	0.047

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The descriptive statistics and the definition of variables are shown in Appendix A

The effects of individual characteristics above are consistent with the literature and the theoretical predictions. The influence of gender is consistent with the current literature on the feminization of China's agriculture (De Brauw et al. 2002; Zhang, De Brauw, and Rozelle 2004). Age and education results are likewise consistent with younger individuals being more likely to participate in migratory OFE, and higher education attainments garnering higher incomes in nonfarm sectors than the farm sector (Borjas, Bronars, and Trejo 1992; Taylor and Martin 2001; Hare 2002). The results also indicate that education contributes to higher income in the non-farm sector than that in the farm sector.

Column (4) of Table 2-4 shows that the quantity of household entitled land[19] has a negative highly statistically significant influence, decreasing the probability of selecting in migratory OFE. Further, this result continues to hold in column (7) of Table 2-4 (the FE model). The consistency of the Pooled Linear Probability (PLP) results and FE results shows that the estimate of household entitled land is robust to whether one adds controls for the individual time-invariant characteristics, supporting the theoretical prediction. That is, larger land endowment raises the opportunity cost of migratory OFE, thereby discouraging migratory OFE participation.

As for the community characteristics, the PLP results show that they are highly significant and have the expected signs. Column (3) of Table 2-4 shows that having one more enterprise per 1000 population in the local rural community significantly increases the probability of self-selecting into local OFE and decreases the probability of self-selecting into farming only and migratory OFE.

[19]While several institutional changes made access to land more secure in the late 1990s, land entitlements should fall out of the Fixed Effects specification. However, land still can be appropriated by the village collective for residential and industrial use, thus resulting in changes in household land entitlements. I still treat land entitlement as exogenous, as this land conversion is a collective decision of the village, rather than the individual household.

The main prediction of the theoretical model is that higher levels of wage faced by migrants and local enterprises will reduce the probability of selecting farming only and increase the probability of selecting OFE (Eq. 2.1). To test these predictions, I use the average urban wage of the nearest city, $\omega_{c,t}^{i}$, the distance from the community to its nearest city, D_c^i, and their interactive term, $\omega_{c,t}^{i} D_c^i$, to index local and migratory off-farm wages (as shown in Eq. 2.11). The estimates of the coefficients of $\omega_{c,t}^{i}$ in farming only decision are significant and consistent with the theoretical prediction. As shown in column (2) of Table 2-4, the estimate of the coefficients of $\omega_{c,t}^{i}$ is significant and negative, showing that $(\alpha_{fl} + \alpha_{fm})\rho < 0$ in the pooled linear probability model in (Eq. 2.11) and the theoretical model (Eq. 2.1). In column (2) of Table 2-4, the estimate of the interactive term $\omega_{c,t}^{i} D_c^i$ is not significant. To interpret these results, holding all else constant and D_c^i at its average (50km, shown in Appendix A), having an increase of 1000 yuan in $\omega_{c,t}^{i}$ decreases the probability of self-selecting into farming only, by about 2 percentage points.

The estimates of the coefficients of $\omega_{c,t}^{i}$ in local OFE decision are significant and consistent with the theoretical prediction. As shown in column (3) of Table 2-4, the estimate of the coefficients of $\omega_{c,t}^{i}$ is significant and positive, showing that $(\alpha_{ll} + \alpha_{lm})\rho > 0$ in the PLP model in (Eq. 2.11) and the theoretical model (Eq. 2.1). In column (3) of Table 2-4, the estimate of the interactive term $\omega_{c,t}^{i} D_c^i$ is not significant. To interpret these results, holding all else constant and D_c^i at its average (50km, shown in Appendix A), having an increase of 1000 yuan of $\omega_{c,t}^{i}$ increases the probability of self-selecting into local OFE, by about 2.5 percentage points.

With respect to the FE results, column (6) of Table 2-4 show that, holding all else constant, a 1000-yuan increase in $\omega_{c,t}^{i}$ decreases the probability of selecting into local OFE by about 0.8

percentage points, suggesting that $\left(\beta_{ll}\rho + \beta_{lm}\rho - \beta_{ll}\rho\tau D_c^i\right) < 0$ in the FE model (Eq. 2.14). Further, it is equivalent to $\left(\alpha_{ll}\rho + \alpha_{lm}\rho - \alpha_{ll}\rho\tau D_c^i\right) < 0$ in theoretical model (Eq. 2.10). Combining this results with the PLP results in column (3), that is $(\alpha_{ll} + \alpha_{lm}) > 0$, one has $\alpha_{ll} > 0$, which is the expected results of the theoretical model (Eq. 2.1).

Column (7) of Table 2-4 show that, holding all else constant, a 1000-yuan increase in $\omega_{c,t}^i$ increases the probability of selecting into migratory OFE by about 0.7 percentage points, which indicates that $\left(\beta_{ml}\rho + \beta_{mm}\rho - \beta_{ml}\rho\tau D_c^i\right) > 0$ in the FE model (Eq. 2.14). Further, it is equivalent to $\left(\alpha_{ml}\rho + \alpha_{mm}\rho - \alpha_{ml}\rho\tau D_c^i\right) > 0$ in theoretical model (Eq. 2.10).

2.6.2.2 Results for spouse focal persons

In general, the PLP results for spouse focal persons are consistent with the findings from household head focal persons. The results show that the female, senior, and less educated workers are more likely to select into farming only and less likely to select into local or migratory OFE. Household land endowment, the number of enterprises of the local rural community, and urban wage in the nearest city are all consistent with results described above for household heads.

As expected, the PLP results of the spouse focal person in column (4) Table 2-5 show that, holding all else constant, having one more preschool child in the family significantly decreases the probability of selecting into migratory OFE by about 2 percentage points. Additionally, the FE results in column (5) of Table 2-5 show that, holding all else constant, increasing the number of preschool child in a household by one significantly increases the probability of selecting into farming only by about 6 percentage points. Note that, these results support the theoretical predictions, that is, having more preschool children in the family increases the opportunity costs

and also the *Hukou* costs of migratory OFE, thus decreasing participation in migratory OFE and increase the probability of selecting into the competing occupations (farming only).

The PLP results in column (4) of Table 2-5 show that having an additional female work force member in family significantly increases the probability of selecting into migratory OFE, as predicted. As shown in literature as well as in descriptive statistics, female workers are more likely to work in the farm sector than male workers. Therefore, workers with more female labour force members, even spouses, may have a lower opportunity cost of selecting into migratory OFE.

As for the estimates of local and migratory off-farm wage variables (indexed by $\omega_{c,t}^{i}$, D_{c}^{i}, and their interactive term, $\omega_{c,t}^{i}D_{c}^{i}$), the results of household spouse focal persons are consistent with the household head results. For example, the PLP results suggest that the coefficient of $\omega_{c,t}^{i}$ in farming only decision is negative and the coefficient of $\omega_{c,t}^{i}$ in local OFE decision is positive.

Additionally, the household spouse focal person results reveal some new findings. For example, the PLP results of spouses show that the coefficient of $\omega_{c,t}^{i}$ in migratory OFE decision is negative, indicating that $(\alpha_{ml} + \alpha_{mm})\rho < 0$ in the PLP model in (Eq. 2.11). In column (3) of Table 2-5, the estimate of the interactive term of distance and wage is not significant. To interpret these results, holding all else constant and D_{c}^{i} at its average (50km, shown in Appendix A), having an increase of 1000 yuan of $\omega_{c,t}^{i}$ increases the probability of self-selecting into migratory OFE, by about 0.3 percentage points.

2.6.2.3 Results for child focal persons

The results of child focal persons are also consistent with the previous findings. The results indicate that female, senior, and less educated workers are more likely to select into farming only and that the male and more educated are more likely to select into local or migratory OFE.

Moreover, the number of preschool children and female labour force members of the household, the land endowment, the number of enterprises of the local rural community are all playing expected roles.

Notably, the child focal person results also bring some interesting findings. Although still significant, the coefficient of the gender variable is much smaller. This result is consistent with the literature. Liang and Chen (2004) and Zhang, De Brauw, and Rozelle (2004) document reduced gender inequality in OFE in China's labour markets and find that women have participated in OFE at rates equaling or surpassing those of their male counterparts.

The PLP results in column (3) and (4) of Table 2-6 show that having higher education (high school or above) significantly increases the probability of selecting into migratory OFE, rather than local OFE, indicating that there might be a significant gap of net income returns to higher education between distant agglomerations and the local rural communities. This may be due both to wage differentials and to education-related migration costs. For example, Zhao (1997) argues that higher education plays a significant role in facilitating rural-urban migration in China as it raises the accessibility of urban formal employment to rural people.

As for the PLP estimates of $\omega_{c,t}^{i}$, the results of household youngest child focal persons are consistent with previous findings in the household head focal person results and spouse results . For example, The PLP results show that the coefficient of $\omega_{c,t}^{i}$ in local OFE decision is positive and in migratory OFE decision is negative, confirming that $(\alpha_{ll} + \alpha_{lm})\rho > 0$ and $(\alpha_{ml} + \alpha_{mm})\rho < 0$ in the PLP model in (Eq. 2.11).

Additionally, the FE results suggest that an increase of the urban wage $\omega_{c,t}^{i}$ increases the probability of selecting into migratory OFE, which is consistent with the household head focal person results, suggesting that $\left(\alpha_{ll}\rho + \alpha_{lm}\rho - \alpha_{ll}\rho\tau D_{c}^{i}\right) < 0$ in theoretical model (Eq. 2.10). To

interpret this result, holding all else constant, a 1000-yuan increase in $\omega_{c,t}^{i}$ increases the probability of selecting into migratory OFE by about 1 percentage points.

Last, as shown in the theoretical framework, I use the interaction term of distance and the nearest city's wage, $D_c^i \omega_{c,t}^{i}$, to approximate the wage gap between local and migratory OFE. In column (3) of Table 2-6, the results show that a larger wage gap between local and migratory OFE decreases the probability of self-selecting into local OFE, indicating that $-\alpha_{ll}\rho\tau < 0$ in equation (Eq. 2.11) which is equivalent to $\alpha_{ll} > 0$. The estimated result is consistent to the theoretical prediction shown in equation (2.1). To interpret this results, holding all else constant, if a worker's community is located 1km farther away from its nearest city, which has the average urban wage 18,000 yuan/per year (as shown in Appendix A), the probability of self-selecting into local OFE will decrease by about 2 percentage points.

2.6.2.4 Robustness checks

My first robustness check is to examine if the focal person results of PLP model are sensitive to different regression models. Specifically, for each type of focal persons, I estimate a pooled Logit and a pooled Probit model. The estimates are shown in Table B-1, Table B-2, and Table B-3. The results are very similar to those for the linear probability model. For example, the individual characteristics (gender, age, education) and the household characteristics (the number of young dependent and land entitlement) are consistent with those findings in PLP model. The regression results of urban wage and the intersection term of distance and urban wage are significant and also consistent with previous findings.

Second, to check whether the focal person results of PLP model and FE model are sensitive to different samples, I apply the PLP model and FE model to all household members. The estimates are shown in Table B-4. After the comparison to the results of focal person approach, I find that

the regression results for all household members are consistent with the previous findings, with a notable minor difference. Some variables are not significant in the regression results of all household members, while they are in the focal person approaches. For example, in the FE results of all household members, the household land entitlement and the number of preschool children are not significant factor for farming only and local OFE, while they were significant in the focal person results.

Last, I check whether our results are sensitive to alternative specifications of the Logit model and Probit model. Instead of using dichotomous Logit and Probit models, I use the pooled Multinomial Logit model and Multinomial Probit model for each type of focal persons. The estimates are shown in Table B-5, Table B-6, Table B-7. Generally, these results are completely consistent with those of the dichotomous Logit and Probit models.

2.7 Conclusions and Policy Implications

Using data collected from rural households in five provinces in China, this chapter examines the characteristics associated with rural Chinese workers' self-selection into farming only, local OFE, and migratory OFE for the years of 2004 and 2007.

My results show the importance of individual characteristics in different self-selection patterns. The highly educated, young, and male workers are more likely to select into migratory OFE, while the less educated, senior, and female workers are more likely to select into farming only. Moreover, the estimates also show that having higher educational attainment increases the probability of migratory OFE relative to local OFE, confirming that high educational attainments may yield higher net earnings in distant agglomerations than in local rural communities.

Household-level characteristics are important in the following ways. Having more preschool children or fewer female labour force members in the household reduces the probability of an individual's self-selection into migratory OFE. Additionally, the FE results of young workers

strongly confirm that having more preschool children in the family increases the probability of an individual's self-selection into local OFE, suggesting that providing care for young dependents may be the reason why some young rural workers choose local OFE over migration.

In the literature on China, connections to local political power have been proven to be significant determinants of local OFE participation (Cook 1998; Yao 1999b; Xia and Simmons 2004; Guang and Zheng 2005; Zhou 2011). However, these effects have not been found in this study. The results show that having CCP member in the family is not significant determinant of local OFE participation, suggesting that the local institutions may play a marginal role in off-farm labour allocation in rural China.

Lastly, consistent with the literature (De Brauw et al. 2002), I confirm that the market-based driving forces (e.g. average off-farm wages) play key roles in OFE growth. For example, the results show that an increase in off-farm wages increases the probability of selection into OFE and decreases the probability of selection into farming only. The larger the off-farm wage gap between local OFE and migratory OFE (reflected by the interactive term of distance variable and urban wage variable), the smaller is the probability of self-selection into local OFE. Most notably, FE results show different "total" or "net" marginal effects of the urban wage growth of the nearest city on the probability of selecting in migratory and local OFE participation—an increase of urban wage significantly increases the probability of selecting into migratory OFE and decrease the probability of selecting into local OFE.

This study contributes the literature of development economics by theoretically modelling and empirically characterizing the dynamics of rural labour use changes during China's transition to an industrial and urban based economy, improving our understanding of the nature of China's economic transformation. My findings have some policy implications for China's future

development and urbanization aspirations. First, as the young, highly educated, and male rural workers are continuously leaving from the rural areas and the agricultural sectors, China's rural and agricultural economy may face some challenges in the future, such as agricultural feminization, lack of knowledge, and lower investment.

Second, the results show that household domestic good provision is still a significant constraint to labour migration for China's rural young workers. Having a new-born child is a significant constraint that makes people stay home rather than participate in migratory OFE. Therefore, offering reliable social services in the rural areas as well as in migration destinations for them, e.g. providing more health services for elderly and disabled, building up more child care facilities, may help to stabilize and foster current progress in industrialization and urbanization.

Lastly, the empirical results confirm that a decrease in migration costs will significantly increase migratory OFE. The presence of the *Hukou* restrictions has created regulatory migration costs for rural-urban migrants, thus discouraging migration. Although the *Hukou* system may represent a barrier to the required rural-urban migration and an obstacle for urbanization, removing it may create other problems. Given the huge rural-urban income gap in China, eliminating the *Hukou* system would lead to a massive increase in population flows to urban areas, exacerbating the overpopulation problem of current cities and undermining China's social stability. To balance China's urbanization and stability goals, a gradual and selective reduction of *Hukou* barrier may hold promise. In practice, scholars and policy makers have suggested several possible ways of carrying out the *Hukou* reform. To find the best way of going forward, a careful cost-benefit analysis of all the options is needed. A cost benefit analysis should take into account the costs of expanding the urban-based social welfares (e.g. public school, health care, social

security) and the benefits of efficiency gains from effective allocation of labour. In addition the incidence of those costs and benefits must be articulated.

3. SELF-SELECTION INTO OFE LINKAGES TO LAND CONSOLIDATION

Urbanization, agricultural growth, and food self-sufficiency are all important for China's transportation. Chapter 2 shows that individual and household characteristics are important in the self-selection into of individuals into local OFE, migratory OFE, and farming only. For example, the highly educated, young, and male rural workers of China are more likely to select into migratory OFE, while the less educated, senior, and female rural workers of China are more likely to select into farming only. The disproportionate selection of highly educated young men into migratory OFE may present obstacles to the development of China's agricultural sector, as these migratory OFE participants are the most likely agricultural innovators.

The histories of developed countries show that rural-urban migration (analogous to the OFE of China) led to more mechanization and capital intensive farming, as well as land consolidation (Hathaway 1960). That is, due to the relatively high cost of labour, other factors, such as land and capital, were substituted for labour. This was evident in a "recombination" of land resources and increases in the land-labor ratio. Economies of scale were realized as farm operations became larger. Improvements in mechanization, technology, and management facilitated the transition to commercial and modernized agriculture. However, in the case of China, farm land consolidation cannot occur through the ownership transfers of land due to its collective land ownership, so it remains an open question whether larger farm operations will develop following the decline in agricultural labour force.

In China, agriculture is an economically, politically, and socially important sector that policymakers cannot afford to ignore. Agriculture plays an important role in the economic development of China. A modern and efficient agricultural sector can produce low cost food for industrial workers. Manufactured goods can then be produced and can be exported and earn

foreign exchange to help finance imports of the required key technology packages and capital equipment (Huang, Otsuka, and Rozelle 2008). Moreover, given China's population size and growing food demands, a decrease or stagnation in agricultural production would increase food prices and raise concerns about food security, negatively affecting economic development in general. In the future, if China's agriculture continues to consist of small-scale subsistence farming without major new investments, there is a risk of a widening income gap between farm and non-farm population, undermining the political and social stability. For a successful economic transformation, China must find a path where urban, rural non-farm and agricultural economies can grow together.

In Chapter 4, one aspect of the agriculture sector's structural change is addressed by explicitly examining the degree to which farm operations have become consolidated through rental arrangements, given that sales are not possible. Specifically, the impact of the urban wages on the consolidation of farm operations is examined, along with other potential determinants. In the absence of the ownership transfers of land, the market-based land use right transfers through land rental markets may be the way in which the farm households of China respond to the pull of rising urban wages. Evidence of the consolidation of farming operations will be a positive indication that modernization of agriculture, at least in the form of larger operations, can proceed in China even within the existing land tenure system.

4. URBAN WAGES AND CONSOLIDATION OF FARMS OPERATIONS IN CHINA

4.1 Introduction

China's agriculture has been dominated by a large number of small-scale farms since the egalitarian distribution of land beginning in the end of 1970s. In 2006, more than 80 percent of China's farms were less than 0.6 ha (Tan et al. 2013). Not being able to take advantage of economies of scale, small-scale farmers have difficulties making productivity-enhancing investments (Wan and Cheng 2001), such as specialized machines (Yang et al. 2013), and in using productive inputs such as financial services, technical assistance, and output marketing services (Hazel et al. 2007). Therefore, one may argue that China's agriculture has a great potential for growth through the consolidation of farm operations, that is, the concentration of agricultural land into larger operational units.

In currently developed countries, agricultural land consolidation historically occurred through existing farms buying up additional land from other farms (Hathaway 1960; Heady and Sonka 1974; Peterson and Brooks 1993). However, given the fact that agricultural land in China is collectively owned and is equally distributed as entitlements[1], consolidation of farm operations through land ownership transfers cannot occur. Thus, consolidation of farm operations in China can occur only through the transfer of land use rights through rental arrangements. For purposes of this study, then, "land consolidation" will be used to refer to the concentration of agricultural land into larger farm operations through market-based rental or leasing agreements among farmers.

[1] The Household Responsibility System (HRS) was gradually implemented between the late 1970s and early 1980s. According to the HRS, individual farmers have only land-use and residual income rights to their entitled land, while ownership remains with the collective (Dong 1996; Kung 2000). Collective ownership refers to the communal rights and equality in the agricultural land resources of a village for all its members (Wang et al. 2011b).

There is some evidence that the massive out-migration of China's rural labour from the agricultural sector has put pressure on agricultural productivity improvement (Rozelle, Taylor, and De Brauw 1999; Taylor, Rozelle, and De Brauw 2003). That is, agricultural labour out-migration implies a negative "lost labour" effect in agriculture. To overcome this negative effect, China's agricultural production must substitute capital for labour. That is, if labour becomes the relatively more expensive factor of production then mechanization should occur. Further, the needed mechanization imply a larger land base (land consolidation) to realize economies of scale. Moreover, from the demand side, the industrialization and urbanization of China has raised concerns about whether the country's small-scale agriculture can meet the food demands of an increasingly rich and urbanized population (Zhang, Mount, and Boisver 2004; Chen 2007). For a successful economic transformation, China needs to find a path where urban, rural non-farm and agricultural economies can grow together. Land consolidation may help achieve this balance through facilitating the realization of economies of scale in agriculture and the needed productivity-enhancing investment.

Beyond the important policy implications, it has been a long-standing academic interest of development economists to understand how China's agriculture may adjust to the competitive pressures from the industrial sector, given its non-market context. Increased land tenure security and greater tolerance of rental or leasing arrangements since the late 1990s may have facilitated the consolidation of farm operations. That is, while land entitlements cannot change, market forces are clearly operating through the rental market, opening up the possibility of land consolidation analogous to what has happened in developed market economies. Though there is an extensive and growing literature which analyses how China's agricultural sector is changing at the micro level (Wu and Meng 1997; Rozelle, Taylor, and De Brauw 1999; Taylor, Rozelle,

and De Brauw 2003; Zhang, De Brauw, and Rozelle 2004; De Brauw and Rozelle 2008; Zhu et al. 2012), relatively little is known about land consolidation at the village or regional level.

The objective of this chapter is to first provide empirical evidence of land consolidation in China's agriculture and, second, to investigate its determinants, with a particular emphasis on the role of the opportunity cost of farm labour (urban wage). The remainder of this chapter is organized as follows. Section 4.2 presents a literature review. Section 4.3 introduces the data, followed by Section 4.4, which provides of an overview of the consolidation of farm operations in China through rental arrangements. In Section 4.5, the theoretical model of the determinants of land consolidation is presented. The empirical implementation follows in Section 4.6 with results in Section 4.7, and conclusions and policy implications in Section 4.8.

4.2 Literature Review

4.2.1 The Land Institutions of China

Before the late 1970s, China's agriculture was organized in a communal system and farmland was operated collectively by production teams, usually consisting of a group of neighboring households (Dong 1996). Within a production team, all members worked collectively and claimed a share of the output. The production of a team is supervised by a monitor. It was expected that the more a member contributes to the team production, a higher share he/she can claim after.

Due to the high monitoring costs and the free-rider problem of the commune system, farm workers have low incentive for agricultural production (Lin 1988). In the early 1980s, the commune system was replaced by the household responsibility system (HRS). During the reform era of the HRS, production teams were abolished and the agricultural land was distributed to individual households as entitlements in a substantially egalitarian fashion. Though agricultural

land is still collectively owned, individual households have the land use and residual income rights to their entitled land.

Until the late 1990, this egalitarian distribution of agricultural land entitlement was reinforced by administrative land re-allocations, which were undertaken by the local officials. For example, due to the increasing nonfarm use of land and population change (death, birth, marriage, or migration), different households had different access to land resources. In order to maintain equal distribution of land entitlement among households, most Chinese villages redistributed land up to the late 1990s (Putterman 1992; Dong 1996; Liu, Carter, and Yao 1996; Kung 2000; Kung 2002). Through these administrative land re-allocations, families with lower land-to-labour ratios gained land, while families with higher land-to-labour ratios returned parts of their land to the village collective. This administrative land re-allocation has been described as a major threat to land tenure security (Brandt, Rozelle, and Turner 2004), and as retarding the development of China's rural land rental markets, since it raises the transaction costs in the land rental market (Turner, Brandt, and Rozelle 1998; Liu, Carter, and Yao 1998; Kimura et al. 2011; Deininger Jin, and Xia 2012).

In the late 1990s, China's central government gradually banned administrative land re-allocation and legalized private market-based farmland rental transfers (Prosterman, Schwarzwalder, and Ye 2000; Prosterman, Li, and Zhu 2006; Wang et al. 2011b). In 2003 China implemented the Rural Land Contracting Law (RLCL) and the administrative land re-allocation was officially banned. These institutional changes make land tenure more secure. Wang et al. (2011b) find that the frequency of agricultural land reallocation has decreased significantly in Chinese villages since 1998. Also more secure land tenure in China has considerably reduced the

transaction costs in the land rental market, thus improving its functioning (Deininger and Jin 2005).

4.2.2 Lewis Turning Point and Rising Farm Labour Costs

In the wake of China's market-oriented reforms starting in the late 1970s, the urban sector and rural non-farm sector have grown dramatically (Borensztein and Ostry 1996; Zhu 2012). The fast-growing non-agricultural sectors provide off-farm employment opportunities at wage rates higher than the returns to labour in agriculture (Yang and Zhou 1999; Yao 1999a; Fan, Zhang, and Robinson 2003; Cai and Du 2011), pulling hundreds of millions of rural workers out of agriculture (Zhao, 1999b; De Brauw et al. 2002; Dong, Bowles, and Chang 2009; Cai and Wang 2010; Chan Forthcoming).

The continuous labour out-migration from agriculture decreases the supply of rural labour, and the opportunity cost of farm labour begins to rise. In Lewis (1954), this stage of the economic development is called the Lewis turning point. For China, the literature shows the economy has passed the Lewis turning point since 2003 and the opportunity cost of farm labour (or off-farm wage) has increased dramatically (Zhang, Yang, and Wang 2010; Cai and Du 2011; Fleisher, Fearn, and Ye 2011; Li et al. 2012).

4.2.3 Determinants of Land Consolidation

While few studies have focused on land consolidation in Chinese agriculture, the literature is extensive for developed countries where most development trajectories are characterized by a transition from small-scale subsistence farming to consolidated large-scale farming. With industrialization and growth in the non-farm sectors, wages in manufacturing increased relative to what could be earned in farming (Lewis 1954). Alston and Hatton (1991) find that, in the early 1930s, the gap between farm and factory earnings in the U.S. increased dramatically. This gap between farm and non-farm sectors has been considered the major driver of agricultural labour

out-migration and the resulting increases in farm size (Lewis 1954; Hathaway 1960; Harris and Todaro 1970; Mundlak 1978; Mundlak and Strauss 1978; Barkley 1990). In regard to the U.S. in the1950s and 60s, Hathaway (1981, p. 780) writes that "as a result of low returns in agriculture, new entrants in commercial agriculture declined" and "the number of workers, both family and hired, employed in agriculture continued to decline." Further, Hathaway (1960, p. 386) finds that "the farms that have disappeared … were the smaller, less-productive farms", implying that the land consolidation as a result of out-migration was selective.

After 1980, despite reduced wage differentials between farm and nonfarm sector, the pace of land consolidation in U.S. agriculture continued, due to the increasing role of technological innovations and the supply-chain-based reductions in transaction costs (MacDonald, Korb, and Hoppe 2013). Innovations in equipment, chemical, seeds, tillage practice, and information technology reduce the amount of labour required for field operations, allowing larger operations (Olmstead and Rhode 2001, Bechdol, Gray, and Gloy 2010; MacDonald, Korb, and Hoppe 2013). Innovations that make labour supervision easier and reduce diseconomies of scale of large farm operations may continue to make large farms attractive (Deininger and Derek 2012).

A number of other factors have also contributed to larger farms. Drabenscott (1999) and Ahearn, Korb, and Banker (2005) argue that the supply chains play a critical role in the more recent wave of land consolidation in U.S agriculture. For example, supply chains are highly effective at ensuring high-quality consumer products and minimizing risk, and prefer to concentrate agriculture production in specific places and coordinating with fewer and larger rather than many small farm operations.

Land consolidation patterns and determinants in currently developed countries may not be directly transferable to China. First, the labour out-migration from agriculture in China is not the

same as that of U.S. where the exit is permanent and the migrant takes up full residence in the urban areas, without any continuing involvement in farming. Chinese farmers' participation in non-farm production, also termed "off-farm employment" (OFE), has been characterized as "partial" and "temporary" (Hare 1999; Zhao 1999b; Hare 2002; Chang, Dong, and MacPhail 2011). Since migrant retain their rural *Hukou* and cannot (with exceptions) obtain urban *Hukou*, they retain their land entitlements and are not able to access social services for themselves or their families in urban areas. As a result family members are often left behind in rural areas, ensuring that the 'migration' to urban areas is temporary or partial. Second, due the collective land ownership in China, land consolidation through the transfers of ownership cannot occur. Farmers cannot sell their entitlement of land as part of their exit from farming, and thus farms wishing to expand operations cannot buy up the land of those leaving the sector. Thus land consolidation in China, if it occurs at all, will have to be of a different form.

In China, as in other countries, relatively high urban wages are clearly a motivation for the massive, though temporary, rural to urban migration. Similarly, the loss of farm labour will decrease farm labour supply. As a result, in order to reduce costs of production, agricultural household may shift from labour-intensive production to more land-intensive and/or capital-intensive production. With more secure land tenure and more liberalized land rental markets after 1990s, farms may be able to respond to the increasing opportunity cost of farm labour (represented by off-farm wage) by consolidating farm operations through the rental market. As the off-farm wage outpaces the marginal value product of labour in agricultural production, farmers that can access OFE have an incentive to rent out their land (Kung 1995; Deininger and Jin 2005; Jin and Deininger 2009). To remain competitive, other farmers (with fewer OFE opportunities or higher productivity in farming) will expand their farm size by renting in land,

thereby increasing productivity with land resources concentrating into larger operational units (Deininger and Jin 2005; Jin and Deininger 2009).

4.3 Data

4.3.1 Source of Data

The primary data for this study were collected by the Centre for Chinese Agricultural Policy, Chinese Academy of Sciences in Beijing, China (CCAP). Two rounds of surveys[2] were conducted: one in April of 2005 and one in April of 2008. These surveys focused on the years 2004 and 2007, respectively.

The first survey (CCAP rural household survey, 2005) was conducted in a randomly selected, nationally representative sample of 101 rural communities in five provinces (Jiangsu, Sichuan, Shaanxi, Jilin, and Hebei). The sample provinces were randomly selected from each of China's major economic zones[3]. To reflect accurately varying income distributions within each province, one county was selected randomly from within each income quintile for the province, as measured by the per capita gross value of industrial output (Figure 4-1). The same procedure was used in the selection of the townships. Two townships were selected randomly within each county, and two communities were selected randomly within each township. Finally, the survey teams used community rosters to randomly choose eight households holding residency permits (*Hukou*) in each village. In total, 808 households were included in the survey (Table 4-1).

[2] The data collection involved students and staff from the Centre for Chinese Agricultural Policy and a group of masters and Ph.D. students from a number of other agricultural universities. Households were paid 20 yuan and given a gift in compensation for the time that they spent with the survey team. I participated in collecting the data in the second survey.

[3] Jiangsu was selected to represent China's most developed southeast coastal area (Jiangsu, Zhejiang, Shandong, Shanghai, Fujian and Guangdong); Sichuan represents the southwest area (Sichuan, Yunnan, Tibet, Guizhou and Guangxi); Shaanxi represents the northwest (Shaanxi, Gansu, Inner Mongolia, Qinghai, Ningxia and Xinjiang); Hebei represents north and central provinces (Hebei, Henan, Shanxi, Anhui, Hubei, Hunan and Jiangxi); Jilin represents the north-eastern provinces (Liaoning, Jilin and Heilongjiang).

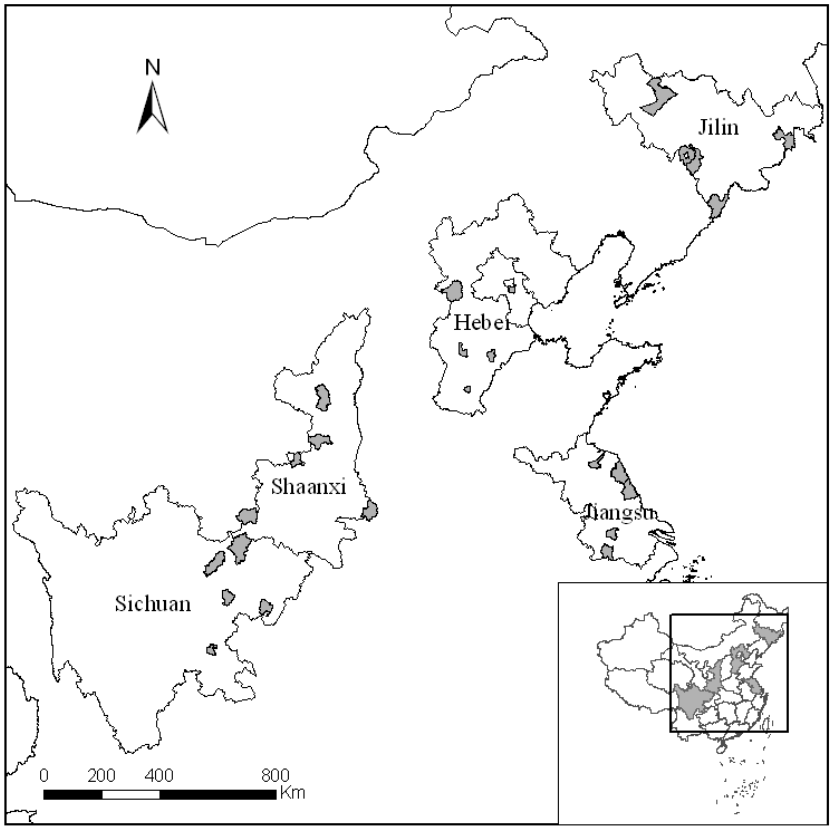


Figure 4-1. Sample provinces and counties

Table 4-1. Sample distribution

Province	County	Township	Village	2004		2007	
				Household	Individual	Household [a]	Individual
Jiangsu	5	10	20	160	644	401 (142)	1637
Sichuan	5	10	20	160	688	400 (125)	1752
Shaanxi	5	10	20	160	685	400 (129)	1765
Jilin	5	10	21	168	606	421 (137)	1550
Hebei	5	10	20	160	644	402 (149)	1623
Total	25	50	101	808	3267	2024 (682)	8327

[a] The number in the parentheses refer to the households which were visited by both survey years.
Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.

For the second survey (CCAP rural household survey, 2008), the same households that had been surveyed in 2005 were again visited. Following the same sampling technique, the survey team increased the household sample size to 20 per community (the original eight survey

households plus 12 other households randomly chosen from the 2008 community rosters). In total, I have observations on 682 households for both years. Including replacement, the second round survey included a total of 2,024 households and 8,328 individuals (Table 4-1).

During the survey, enumerators used pre-coded forms (consisting of two main parts: a multi-topic household survey and a community-level surveys) to collect a wide range of information about the communities, the households, and individuals. In the community survey form, enumerators mainly asked the respondents (usually party secretaries and/or the accountants of the communities) about community characteristics in 2004 and 2007, such as resource bases, labour use patterns, income sources, transportation conditions, and geographic characteristics.

In the household survey, household information was collected including demographics, education, production activities (farming and off-farm work), past off-farm work experience, on-farm labour, land endowments, and land rental transfers. For the household's past participation in off-farm work, an eight-year past off-farm work history between 1997 and 2004 was completed for each household labour force member in the 2005 survey; a two-year past off-farm work history for 2005 and 2006 was completed for each household labour force member in the 2008 survey.

The geographic/distance information was collected from Google Maps (2012). For each sample community, I find its nearest city by using the electronic map of Google Maps (2012) and measure the distance from the centre of the community to the centre of the city. The urban wage, collected from the China City Statistical Yearbook (CNBS 2005; 2008), is defined as "the average annual wage of the urban residents (with urban *Hukou*) who live in the core area of the community's nearest city".

4.3.2 Characteristics of Farm Operations and Farmland Rental Decisions

Table 4-2 presents the basic descriptive statistics for farm operations from the CCAP rural household survey, including their land entitlements, the size of their farm operations, and land rental transfers they were involved in. Almost all surveyed households (more than 96%) have some entitled land, that is, non-zero land entitlement. These rural households are synonymous with "household farm operators;" even households who have left farming and rent out all of their entitled land are still "household farm operators", as they still collect rents and earn incomes from their entitled land.

Table 4-2. Summary of land distribution and land rental transfers

	2004		2007	
	Mean	Std. dev.	Mean	Std. dev.
Number of hhld observations:	795		1942	
Land entitlement (mu)	7.488	6.268[a]	7.727	7.557[a]
With land entitlement %	97.61%		96.24%	
% of hhlds who rented in land	11.07%		19.58%	
a. from community (% hhlds)	6.04%		11.48%	
Area of rented-in land (mu)	7.065	10.003	5.750	6.674
b. from the other hhlds (% hhlds)	5.03%		8.65%	
Area of rented-in land (mu)	3.34	3.925	6.916	7.883
Percentage of rented-out hhlds %	4.15%		7.72%	
Area of rented out land (mu)	4.542	7.168	4.374	5.122
The size of land operation (mu)	7.894	6.885	8.648	8.720

[a] Note that the large value of standard deviation of land entitlement is largely caused by the large differences of households across communities. The land entitlement difference within communities is small.
Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.

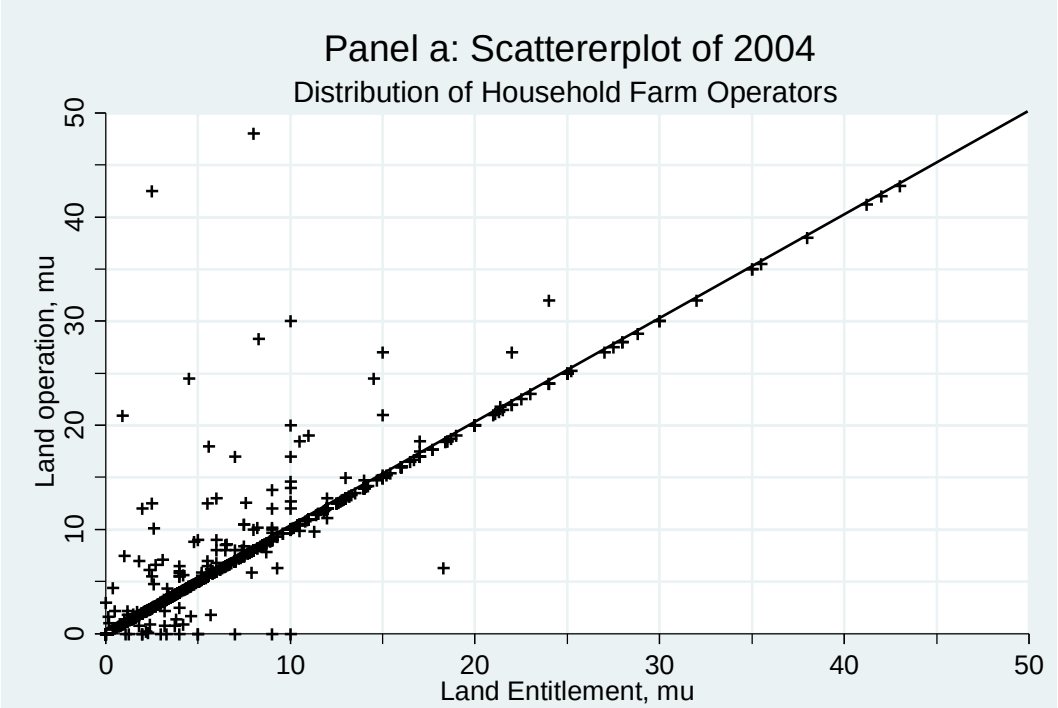
On average, the household farm operators have entitled land of 7.5-7.7 mu (approximately 0.5 hectares). Through land rental markets, the household farm operators can rent out their entitled land to other households or/and the village collectives, and they can rent in land from other households or/and the village collectives. From 2004 to 2007, the share of the household farm

operators who rented in land from village collectives increased from 6 to 11%, the share of the household farm operators who rented in land from other operators increased from 5 to 9%, and the share of the household farm operators who rent out land increased from 4 to 8%. Thus the rural land rental market was growing, which is consistent with the findings by Deininger and Jin (2005).

In Figure 4-2, Panels (a) and (b) show the scatterplots of the size of household land entitlement and the size of household farm operations for 2004 and 2007, respectively. Observations falling on the diagonal solid line represent the household farm operators who operate the same amount of land as their entitlement. The observations above the diagonal are the household farm operators who operate more land than their entitlements (the renting-in household farm operators), while observations below the diagonal are household farm operators who operate less land than their entitlements (the renting-out household farm operators). Note that both land entitlement and land operations are those of the household farms.

4.4 Measuring Land Consolidation

The Histogram in Figure 4-3 is a way of representing whether farm operations have become more consolidated from 2004 to 2007. Panel (a) shows that the share of the small-size household farm operations (with land operations less than 2 mu) increased from 12% to 16%, the share of the medium-size household farm operations (with land operations greater than or equal 2 mu but less than 18 mu) decreased from 80% to 61%, and the share of the large-scale household farm operations (with land operations greater than or equal 18 mu) increased from 8% to 13%. The increases in the share of the small household farm operations, the absence of medium-size household farm operations and the increases in the share of large household farm operations suggests that the agricultural land is concentrating into larger operational units, that is, land consolidation had occurred between 2004 and 2007.



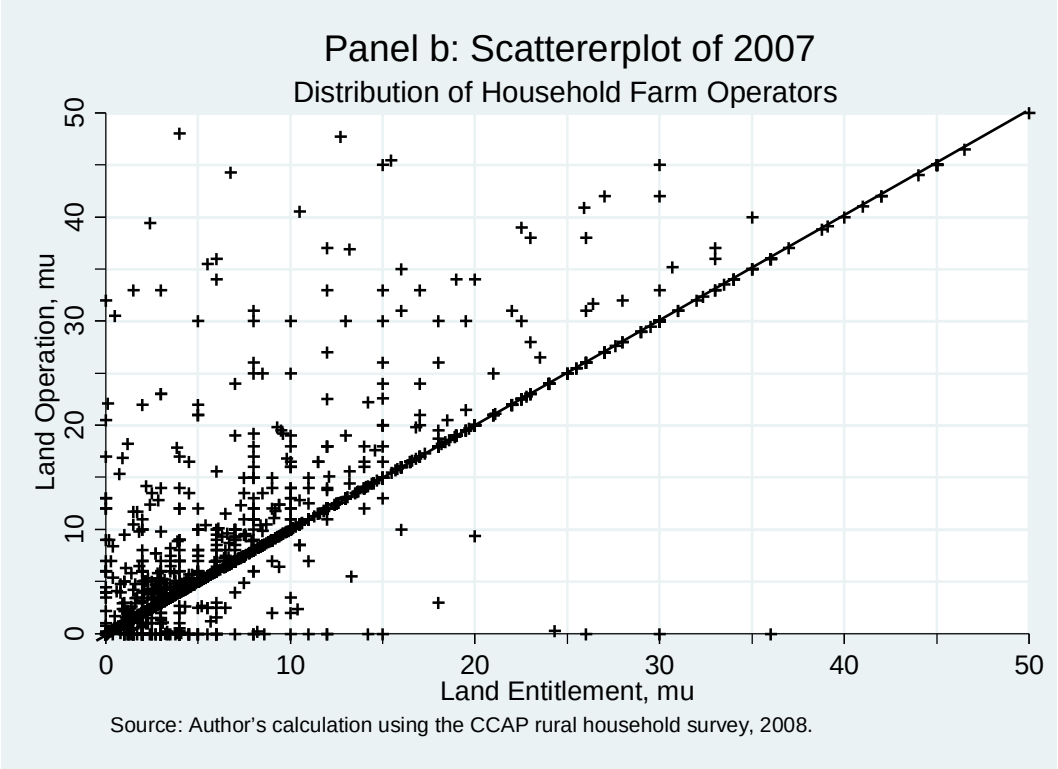
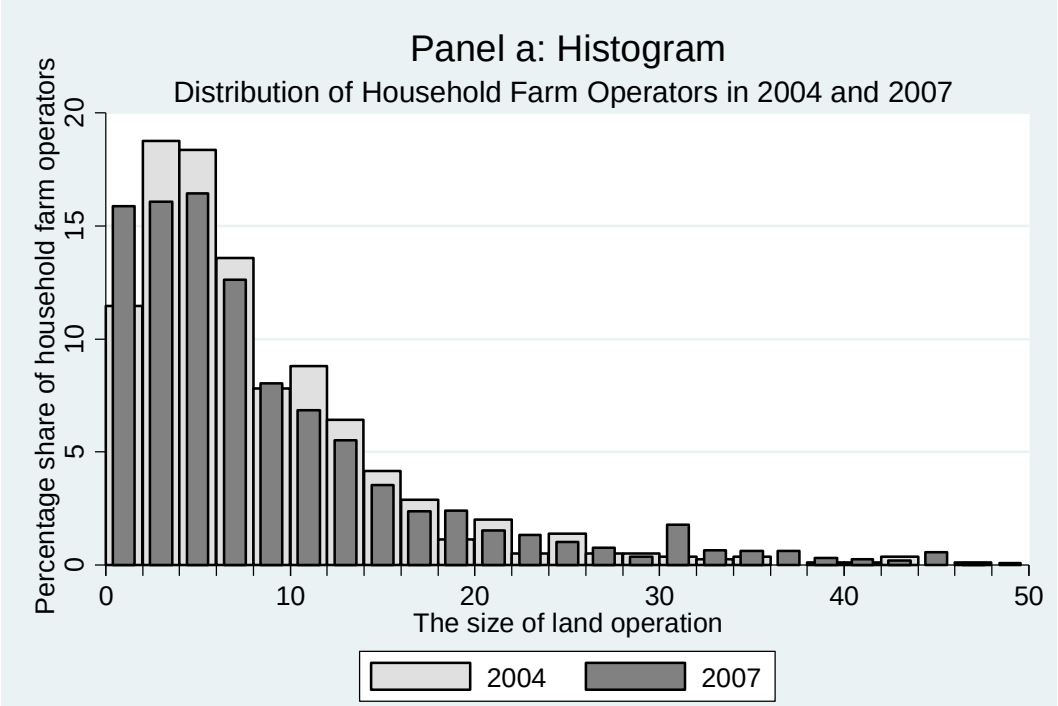
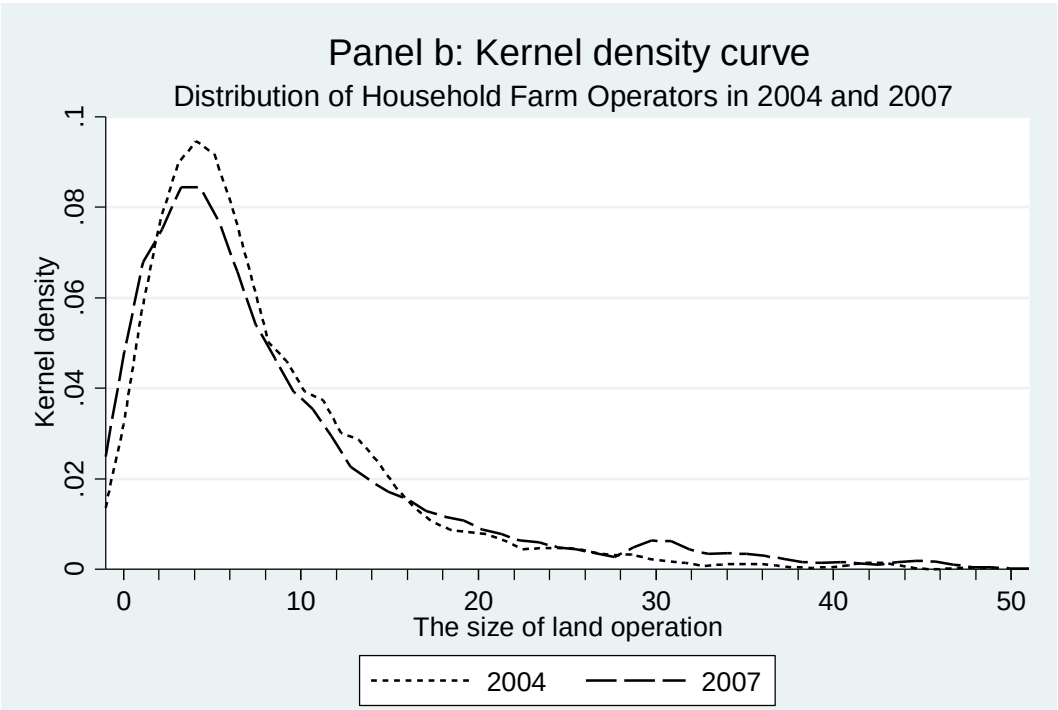


Figure 4-2. Household farmland operation and entitlement in 2004 and 2007



Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.



Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.

Figure 4-3. Distribution of farm operators in 2004 and 2007

Using the same data set, kernel density curves[4] for 2004 and 2007 respectively are shown in Panel (b) of Figure 4-3. The density curve of 2007 has a fatter tail on the right hand side than in 2004, reinforcing the evidence that the share of the large-size farms was increasing, confirming land consolidation.

Rather than using a household approach, I use village level approach, as the latter is a more direct way to examine how land consolidation develops. A household-approach may yield information about the participation rate of land rental transaction of individual households, and which kind of households is likely to rent out/in land. However, a household-level approach will not reveal the land distribution among households, which is a collective outcome. A village level study, on the other hand, can examine the collective outcomes of the net land rental transfers in a region. It can show whether and how the constituent renting in and out of agricultural land is resulting in the consolidation of agricultural operations in a village.

The Lorenz curve is a convenient summary graphical device to compare the divergence between the equal size of land entitlements (an egalitarian distribution) and the actual size of farm operations between 2004 and 2007. The Lorenz curve is constructed as follows. For a given year, one has the farmland data of *n* household farm operations. All of the household farm operators are ranked in increasing order by their land operations, $A_1 \leq A_2 \leq \cdots \leq A_n$, where A_i is the land operation of household farm operator h. The Lorenz curve is defined at the points h/n, $i = 0, \ldots, n$, by $L(0) = 0$ and $L(h/n) = S_h/S_n$, where $S_h = A_1 + \cdots + A_h$. Thus the Lorenz curve consists of a cumulative land operation share of sorted household farm operations on the y-axis plotted against a cumulative share of the farm households on the x-axis, also equal to the cumulative share of the land entitlements assuming equal entitlements.

[4] Kernel density estimation is a non-parametric way to estimate the probability density function of a random variable. I chose a bandwidth of 1 mu to produce the kernel density curves.

Figure 4-4 shows the Lorenz curves for the 2004 and 2007, where the diagonal solid line represents the situation where all households operate exactly the amount of land that is their entitlement. The more the Lorenz curve bows away from the line of perfect equality, the more unequal (consolidated) is the distribution of the farm operations. In Figure 4-4, the long dash Lorenz curve (2007) bows farther away from the diagonal line than the short dash one (2004), confirming that the distribution of land operations in 2007 is more distant from the perfectly equal (entitlement) benchmark than in 2004, signifying that more land consolidation has occurred.

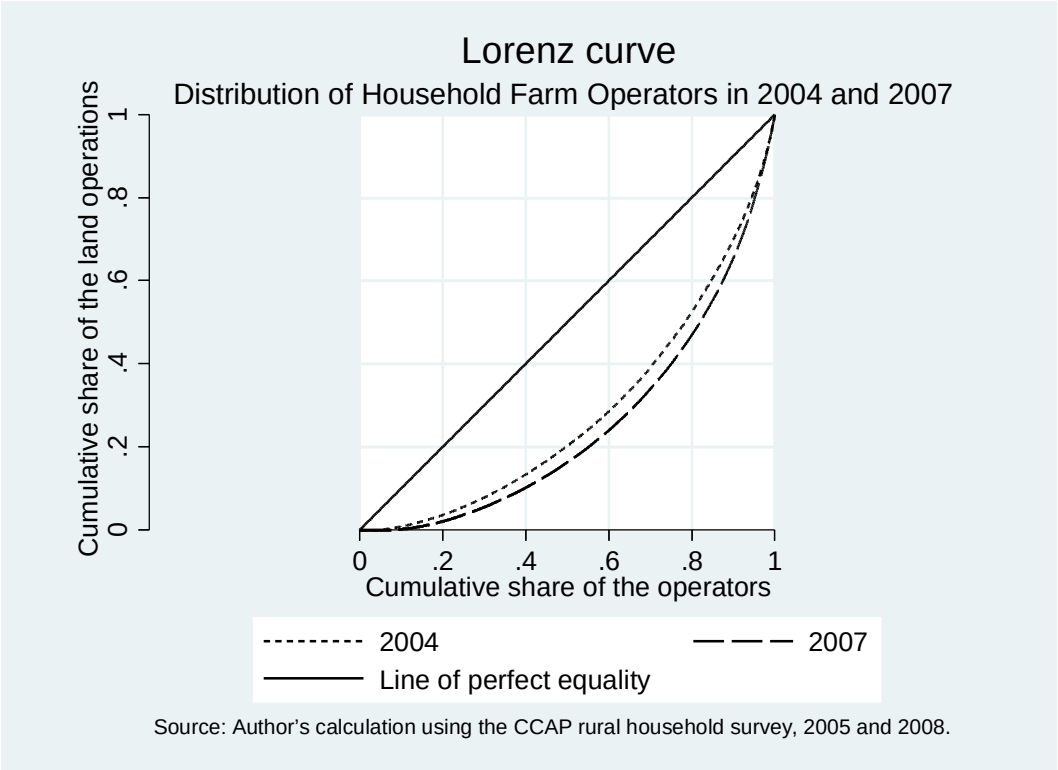


Figure 4-4. Consolidation of farm operations in 2004 and 2007: Lorenz curves

The degree of land consolidation in a community, shown by the Lorenz curves in Figure 4-4, can be summarised by a *Gini* index[5] (Wunderlich 1958). In this context, the *Gini* index is used to measure inequality of land operations relative to equal land entitlement. It varies between zero and one, where zero is a perfectly equal distribution of land among the household operators in a community (every household operates the same amount of land equalling to its entitlement). A value of one would indicate that all of the land in a community is operated by a single household, that is, complete consolidation.

In Figure 4-5, using a highly simplified depiction, I demonstrate how the Gini index is constructed and how it would reflect the level of land consolidation in China's setting. If each household farm operator operates the amount of land they are entitled to (an idealized perfectly egalitarian farming system), the Lorenz curve is the straight line AC in Figure 4-5. The more the actual Lorenz curve bows away from the line of perfect equality (AC), the more unequal is the distribution of the land operations in the community. The size of the area between the Lorenz curve and the line of perfect equality (AC) represents the degree of inequality of household farm operations. The Gini index is the ratio of the area between the Lorenz curve and the line of perfect equality, and the total area of the triangle formed by the two axes and the line of perfect equality (ABC). If land operations are perfectly equal to the households' (equal) entitlements, the Lorenz curve falls along AC, the Gini index is zero. If households AD rent out their land to group DB, the land operations in the community have become more consolidated, and the Lorenz curve shift from AC to ADC, and the Gini index is equal to the shaded area ADC/ABC. As more households rent out their land, D will shift to the right, leading to greater consolidation, and a larger *Gini* index.

[5] The *Gini* index dates back to 1912 when it was formulated by the Italian statistician Corrado Gini.

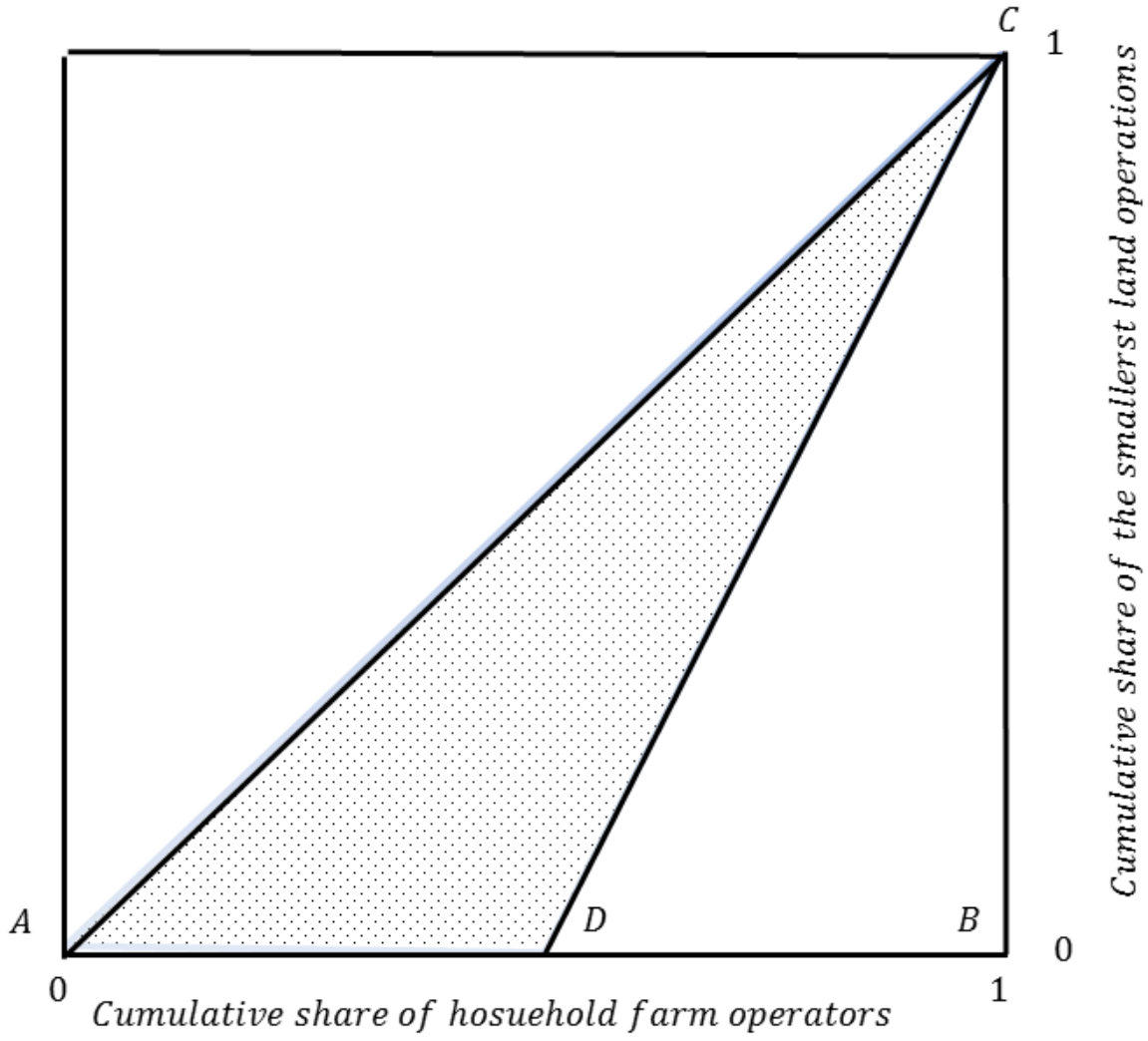


Figure 4-5. The *Gini* index of land consolidation within a community

Empirically, I construct the community-level *Gini* index as:

$$Gini^c = \frac{2\sum_{h=1}^{n^c} iA_h}{n^c \sum_{h=1}^{n^c} A_h} - \frac{n^c+1}{n^c} \quad (4.1)$$

where $Gini^c$ = *Gini* index for community *c*;

n^c = the total number of household farm operators in *c*;

h = the rank of a household farm operator. Household farm operators in *c* are ranked in increasing order by size of their land operations;

A_h = the size of the land operations of household farm operator *h*;

As shown in Eq. (4.1), to obtain an accurate *Gini* index for a community, one needs data for the land operations of all households in the community. Unfortunately, I do not have a complete data for the community. Instead, I have a randomly-selected and community-representative household data (Table 4-1). The community's *Gini* index is thus approximated by using the sample data. In 2004 survey, a community has 8 randomly selected household farm operators on average; in the 2007 survey, the average is 20. Based on the assumption that those selected 8 or 20 household farm operators are representative of all household farm operators in the community, Eq. (4.2) is used to approximate $Gini^c$. That is,

$$Gini_a^c = \frac{2\sum_{h=1}^{m^c} iA_h}{m^c \sum_{h=1}^{m^c} A_h} - \frac{m^c+1}{m^c} \quad (4.2)$$

where $Gini_a^c$ = approximated *Gini* index of land operations for community *c*;

m^c = the total number of surveyed and community representative household farm operators in *c*;

i = the rank of a household farm operator. Selected household farm operators in the community *c* are ranked in increasing order by the size of their land operations;

A_h = the size of the land operation of household farm operator *h*;

The approximated *Gini* index (as shown in Eq. 4.2) tends to be a downward-biased measure if the household sample size is small (Deltas 2003). A small sample adjustment is necessary. Following Deltas (2003), I use an adjusted *Gini* index, $Gini_{adj}^c$, which is defined as

$$Gini_{adj}^c = \frac{m^c}{m^c-1} Gini_a^c \quad (4.3)$$

Table 4-3 presents the summary statistics of adjusted *Gini* indexes. As shown in Table 4-3, the average value of $Gini_{adj}^c$ increases from 0.260 to 0.352 from 2004 to 2007, indicating that

the household farm operations became more dissimilar from the equal entitlements, evidence of land consolidation. The same trend is apparent for each of the five provinces.

Table 4-3. The community-level adjusted *Gini*, by provinces, 2004 and 2007

Province	Number of communities	2004		2007	
		Mean	Std. dev.	Mean	Std. dev.
Jiangsu	20	0.287	0.133	0.373	0.140
Sichuan	20	0.329	0.154	0.383	0.104
Shaanxi	20	0.289	0.095	0.352	0.096
Jilin	21	0.318	0.162	0.419	0.217
Hebei	20	0.267	0.087	0.328	0.072
Total	101	0.298	0.130	0.371	0.137

Source: Author's calculation using the CCAP rural household survey, 2005 and 2008.

4.5 Theoretical Model

In this section, I construct a theoretical model of land consolidation in a community. Considering a community *c* with n^c household farm operators (n^c is large), I assume that all household farm operators in *c* are equally endowed with household[6] labour time $\bar{L}^c$[7] and land entitlement $\bar{A}^c$.

The household farm operator can earn income from farming, land rental and off-farm work. Following Barnum and Squire (1979) and Singh, Squire, and Strauss (1986), I construct a neo-classical household model. In the model, all the family members' resources of a household, such as labour time, land, and income, are pooled within the household as constraints, and all household members follow a unitary decision-making process and act collectively to maximize joint family income subject to constraints.

Household farm operator *h* will choose l_a^h and A^h by solving the maximization problem:

[6] "Household" in the theoretical model refers to "combination of all household members".

[7] The household labour time refers to the sum of discretionary marketable labour time of all household labour force members after excluding time spent on necessary activities such as eating, sleeping and personal time, and time spent on non-market activities such as domestic work and leisure.

$$\max_{l_a^h, A^h} p^c f(l_a^h, A^h) + w(Z^h)(\bar{L}^c - l_a^h) + r^c(\bar{A}^c - A^h) \quad (4.4)$$

where p^c = the price of farm outputs of community *c*;

$f(l_a^h, A^h)$ = household agricultural production function;

$w(Z^h)$ = the off-farm wage rate of *h*'s household labour;

Z^h = *h*'s human capital endowment, related to average education and past off-farm work experience. For numerical convenience, it is assumed that Z^h in community *c* follows a uniform distribution between 0 and 1

l_a^h = labour used in farming;

A^h = land operation of *h*; and

r^c = the land rental rate of the local land rental market of community *c*.

The household farm operators are heterogeneous with respect to their off-farm income earning abilities. Specifically, I assume that, for household farm operator *h* with characteristics Z^h, its off-farm wage rate (or opportunity cost of household farm labour) is

$$w(Z^h) = \omega^c + \theta Z^h \quad (4.5)$$

where ω^c = the unskilled off-farm labour wage accessible to all farm households in rural community *c*.

The optimal choices of $l_a^{h^*}, A^{h^*}$ will either satisfy the first order conditions (FOC):

$$p^c f_{l_a^h}(l_a^h, A^h) = \omega^c + \theta Z^h \quad (4.6)$$

$$p^c f_{A^h}(l_a^h, A^h) = r^c$$

or locate at one of the following two boundary points:

$$l_a^{h^*} = 0 \text{ and } A^{h^*} = 0; \text{ or} \quad (4.7)$$

$$l_a^{h^*} = \bar{L}^c \text{ and } A^{h^*} = A(p^c, r^c, \omega^c, Z^h, \bar{L}^c) \quad (4.8)$$

Next, I nest the neo-classical agricultural household model (4.4) into a community-level land rental market equilibrium framework[8]. In the land rental market equilibrium framework, I assume that agricultural output prices, p^c, and input prices of labour, ω^c, are exogenously determined, while land rental rate r^c is endogenously determined within the community. That is, the land rental rate in *c* is an endogenous "equilibrium" price at which supply and demand of rental land in the local market are in balance. Note that, because n^c is large, the land rental rate r^c is still exogenous for individual household farm operators, and the assumptions of micro-level household model (4.4) still hold.

Each household farm operator has three alternative labour allocation choices: allocating household labour in farming only, allocating household labour in farming and off-farm work, allocating labour in off-farm work only. Therefore, without losing generality, I define the farming only household as the subgroup n_1^c, the farming and off-farm households as the subgroup n_2^c, and off-farm only household as the subgroup n_3^c. Therefore, one has:

$$n_1^c + n_2^c + n_3^c = n^c$$

For a farming only household, $h \in n_1^c$, its optimal labour allocation choice is at boundary point (4.7), indicating that its marginal labour income from farm production is higher than that from off-farm work. For farming and off-farm household, $h \in n_2^c$, its optimal labour allocation choice is at FOC (4.6), indicating that its marginal labour income from farm production equals that from off-farm employment. For the off-farm employment only household, $h \in n_3^c$, its optimal labour allocation choice is at boundary point (4.8), where the marginal labour income

[8] The neo-classical household model is limiting in that it assumes that all markets are perfect and all goods and factors are tradable between a community and the outside world (Taylor and Dyer 2009). However, land resources are highly localized, immobile, and with high geographic dispersion. Therefore, I assume that the land rental markets in rural China for each community are highly localized and that lessors and lessees are the residents of the same community.

from farm production is less than the off-farm employment wage.

Further, given p^c, ω^c, θ, r^c, and α, it is assumed that $n_2^c \neq \emptyset$. That is, there exists at least one household farm operator, h', with characteristics $Z^{h'} \in [0,1]$, in the community**,** satisfying FOC (6)[9]. That is,

$$p^c f_{l_a^h}\left(l_a^{h^*}, A^{h^*}\right) = \omega^c + \theta Z^{h'} \tag{4.9}$$

$$p^c f_{A^h}\left(l_a^{h^*}, A^{h^*}\right) = r^c \tag{4.10}$$

For sake of simplicity, I assume that all household farm operators in community *c* use the same agricultural technology, which in Cobb-Douglas function form:

$f(l_a^h, A^h) = l_a^{h^\alpha} A^{h^{1-\alpha}}$ where $0 < \alpha < 1$

Therefore, (4.9) and (4.10) implies that

$$p^c f_{l_a^h}\left(l_a^{h^*}, A^{h^*}\right) = p\alpha {l_a^h}^{*\alpha-1} {A^h}^{*1-\alpha} = \omega^c + \theta Z^{h'} \tag{4.11}$$

$$p^c f_{A^h}\left(l_a^{h^*}, A^{h^*}\right) = p(1-\alpha) {l_a^h}^{*\alpha} {A^h}^{*-\alpha} = r^c \tag{4.12}$$

From (4.9) and (4.10), one has

$$\frac{A^h}{l_a^h} = \left[\frac{\omega^c + \theta Z^{h'}}{p\alpha}\right]^{\frac{1}{1-\alpha}} = \left[\frac{(1-\alpha)p}{r^c}\right]^{\frac{1}{\alpha}} \tag{4.13}$$

Representing the model graphically (shown in Figure 4-6) is a useful starting point to illustrate how land consolidation occurs.

[9] There are two extreme cases in which $n_2^c = \emptyset$. One is that farming is so profitable that no household in community *c* participates in off-farm production or $p^c f_{l_a^h}(H^c \bar{L}^c, H^c \bar{A}^c) > \omega^c + \theta\, Z^h$ for any *h*. The other one is that the OFE wage is so high that no household in community *c* work on the farm, $p^c f_{l_a^h}(1, H^c \bar{A}^c) < \omega^c$ (that is, even if all the land of the community *c* were operated by one unit of labour, the marginal labour productivity still less than ω^c).

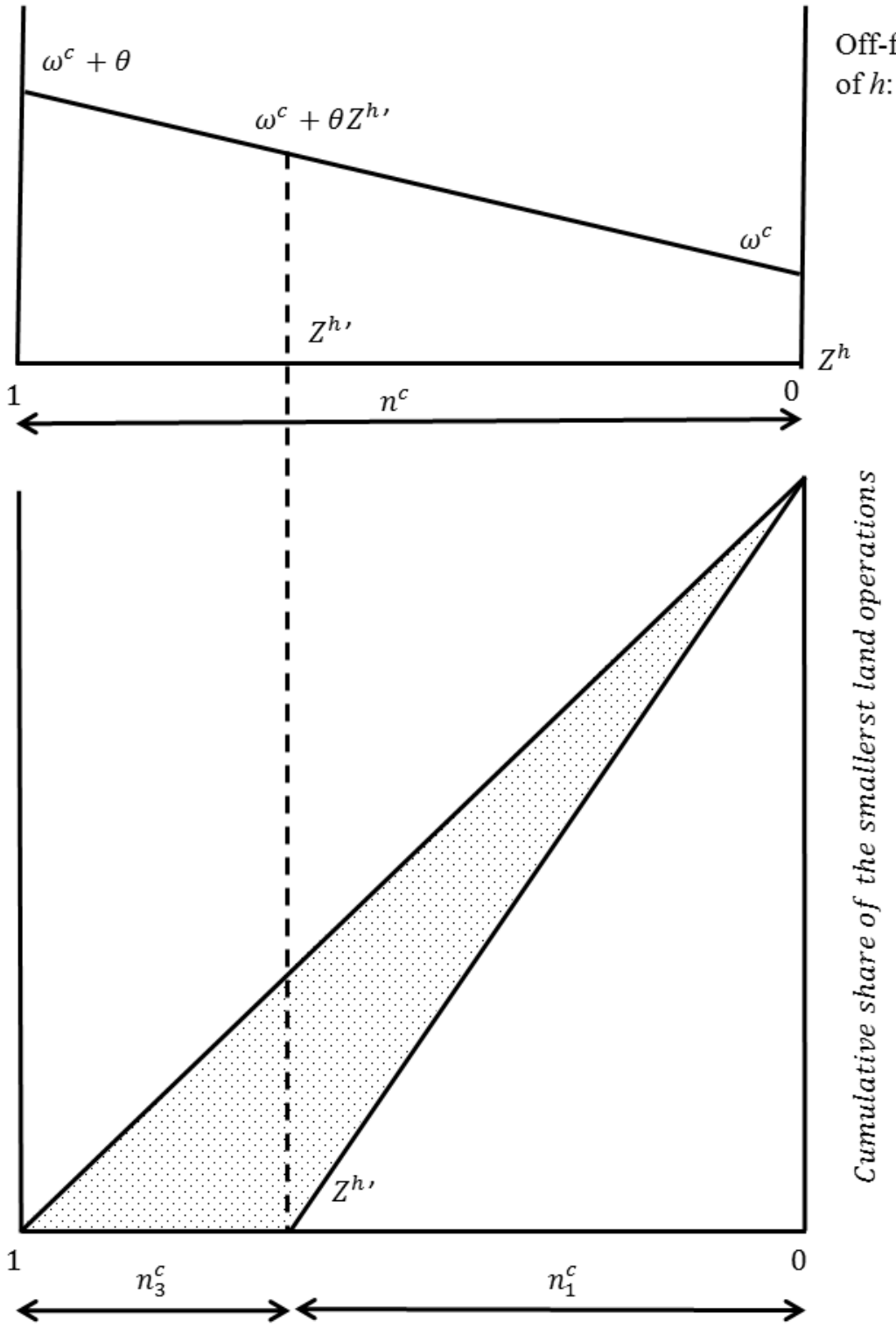


Figure 4-6. Theoretical model

First, the characteristics of household farm operators in community *c*, Z^h, follows a uniformly distribution between 0 and 1. As a result, their opportunity costs of farm labour (represented by their accessible off-farm wages), $w(Z^h)$, follows a uniformly distribution between ω^c and $\omega^c + \theta$. As discussed above, h' has equalized marginal labour income between farming and off-farm work. As all households use the same technology in farming, one has

Faming only household farm operator group: $n_1^c = \{h | 0 \leq Z^h < Z^{h'}\}$

Faming and off-farm household farm operator group: $n_2^c = \{h | Z^h = Z^{h'}\}$

Off-farm only household farm operator group: $n_3^c = \{h | Z^{h'} < Z^h \leq 1\}$

Therefore, the *Gini index* of community *c* is,

$$Gini^c = 1 - Z^{h'} \tag{4.14}$$

Next, to solve $Z^{h'}$, the market clearing condition of the local farmland rental market requires:

$$r^c = f_{A^h}\left(\sum_{h=1}^{H} l_a^{h^*}, n^c \bar{A}^c\right) = f_{A^h}\left(n^c Z^{h'} \bar{L}^c, H^c \bar{A}^c\right) \tag{4.15}$$

With Eq. (4.11), one has

$$\frac{n^c \bar{A}^c}{n^c Z^{h'} \bar{L}^c} = \left[\frac{(1-\alpha)p^c}{r^c}\right]^{\frac{1}{\alpha}} = \left[\frac{\omega^c + \theta Z^{h'}}{p^c \alpha}\right]^{\frac{1}{1-\alpha}} \tag{4.16}$$

With two equations and two unknowns ($Z^{h'}$ and r^c) in Eq. (4.16), one can solve

$$Z^{h'} = z(p^c, \omega^c, \theta, \frac{\bar{A}^c}{\bar{L}^c}, \alpha)$$

Further, combined with equation (4.14), one has

$$Gini^c = 1 - z(p^c, \omega^c, \theta, \frac{\bar{A}^c}{\bar{L}^c}, \alpha) \tag{4.17}$$

Based on the theoretical model above, the following propositions are submitted (the proof is shown in the Appendix C):

1. $\frac{dGini^c}{d\omega^c} > 0$. The higher the unskilled off-farm wage, the higher value of the *Gini*

index (more consolidation);

2. $\frac{dGini^c}{dp^c} < 0$. The higher p, the lower value of the *Gini* index (less consolidation);

3. $\frac{dGini^c}{d\frac{\bar{A}^c}{\bar{L}^c}} < 0$. The higher land-to-labour ratio, the lower value of the *Gini* index (less consolidation).

Based on the theoretical model (Eq. 4.17) and propositions (1), (2) and (3) above, for each time period *t*, the theoretical model can be written in a linear function:

$$Gini_t^c = \gamma_t + \gamma^c + \gamma_1 \omega_t^c - \gamma_2 p_t^c - \gamma_3 (\frac{\bar{A}^c}{\bar{L}^c})_t \quad (4.18)$$

where $Gini_t^c$ = the *Gini* index of community *c* in time period *t*;

γ_t = a time specific constant term;

γ^c = the community-specific constant term for community *c*. Note that this variable can remove the effect of all time-invariant characteristics from the independent variables, including observable and the unobservable characteristic;

ω_t^c = the unskilled off-farm wage rate of community *c* in time period *t*;

γ_1 = marginal effects of ω_t^c. Note that, $\gamma_1 > 0$;

p_t^c = the agricultural output price of community *c* in time period *t*;

γ_2 = marginal effects of p_t^c. Note that, $\gamma_2 > 0$;

$(\frac{\bar{A}^c}{\bar{L}^c})_t$ = the land-to-labour ratio of community *c* in time period *t*; and

γ_3 = marginal effects of $(\frac{\bar{A}^c}{\bar{L}^c})_t$. Note that, $\gamma_3 > 0$;

4.6 Empirical Implementation

4.6.1 A Change-to-Change Model of Land Consolidation

Our empirical model strictly follows the theoretical model (4.18). The empirical implementation involves obtaining data or estimates for theoretical variables in Eq. (4.18), including $Gini_t^c$, ω_t^c, p_t^c, and $(\frac{\bar{A}^c}{\bar{L}^c})_t$. Based on the data, these variables are constructed as follows.

The dependent variable, $Gini_t^c$, is constructed as

$$Gini_t^c = Gini_{adj,t}^c \tag{4.19}$$

where $Gini_{adj,t}^c$ = the adjusted *Gini* index of community *c* in time period *t*, as shown Eq. (4.3); and

t = year 2004 or 2007.

The independent variable ω_t^c, the unskilled off-farm wage that is accessible in *c* in year *t*, is constructed as:

$$\omega_t^c = \rho\omega_{u,t}^c - \varphi D_u^c + \pi E_t^c \tag{4.20}$$

where: $\omega_{u,t}^c$ = the average annual wage of the urban residents in community *c*'s nearest city in year *t*. "Urban resident" is defined by having urban *Hukou* status.. Considering that rural migratory off-farm workers in the cities do not have the urban *Hukou*, $\omega_{u,t}^c$ is treated as an exogenous variable;

D_u^c = the distance from *c* to its nearest city; and

E_t^c = the number of enterprises per 1,000 labourers of *c* in year *t* where enterprises refers to businesses in the non-farm sector, both manufacturing and services.

As shown in Eq. (4.20), the accessible unskilled off-farm labour wage for workers in community *c*, ω_t^c, is an increasing function of $\omega_{u,t}^c$ ($\rho > 0$). That is, if the urban wage of *c*'s nearest city increases by 1 unit, holding all other factors constant, ω_t^c is expected to increase by

ρ. Cai and Du (2011) find that the average wage rate of rural-urban migrant workers is 88.2% of the wage of the workers with urban *Hukou* in those cities. ω_t^c is a decreasing function of the distance between community *c* and its nearest city, $D_u^c(\varphi > 0)$. φ is used to index all forms of distance-related transaction costs, including information transfer costs about urban job opportunities, cultural and linguistic differences, psychic costs of migration, as well as simply transport costs from migration or commuting. Higher distance costs will erode the wage of the workers. $\omega_t^c$is an increasing function of E_t^c $(\pi > 0)$. That is, the accessible unskilled off-farm wage in a community increases with the number of enterprises.

The functional form of the agricultural output price of community *c* is defined as:

$$p_t^c = p_t - \delta D_u^c \tag{4.21}$$

where p_t= the average price of agricultural produce in year *t* (same for all communities);

As shown in Eq. (4.21), p_t^c is a decreasing function of D^c $(\delta > 0)$, showing that communities that are closer to cities have a higher farm output prices, due to lower transportation costs.

$(\frac{\bar{A}^c}{\bar{L}^c})_t$ is constructed as:

$$(\frac{\bar{A}^c}{\bar{L}^c})_t = a_t^c \tag{4.22}$$

where a_t^c= the average amount of agricultural land per labourer of c in year *t*;

Based on empirical implementation of (4.19), (4.20), (4.21), and (4.22), the theoretical model (4.18) can be written in a linear function:

$$Gini_{adj,t}^c = \gamma_t + \gamma^c + \gamma_1\left(\rho\omega_{u,t}^c - \varphi D_u^c + \pi E_t^c\right) - \gamma_2(p_t - \delta D_u^c) - \gamma_3 a_t^c + \varepsilon_{c,t} \tag{4.23}$$

Further simplifying (4.23), one has

$$Gini_{adj,t}^c = \beta_{0,t} + \beta^c + \beta_1\omega_{u,t}^c + \beta_2 E_t^c - \gamma_3 a_t^c + \varepsilon_{c,t} \tag{4.24}$$

where $\beta_{0,t} = \gamma_t + \gamma_2 p_t$;

$\beta^c = \gamma^c - \gamma_1 \varphi D_u^c + \gamma_2 \delta D_u^c$;

$\beta_1 = \gamma_1 \rho$, note that $\beta_1 > 0$;

$\beta_2 = \gamma_1 \pi$, note that $\beta_2 > 0$; and

$\varepsilon_{c,t}$ = the error term.

Further, given two waves of observations of years 2004 and 2007, one can transform (4.24) into a change-to-change model by taking the differentiation between these two years

$$\Delta Gini_{adj}^c = \Delta\beta_0 + \beta_1 \Delta\omega_u^c + \beta_2 \Delta E^c - \gamma_3 \Delta a^c + \varepsilon_c \quad (4.25)$$

where $\Delta Gini_{adj}^c = Gini_{adj,2007}^c - Gini_{adj,2004}^c$;

$\Delta\beta_0 = \beta_{0,2007} - \beta_{0,2004}$;

$\Delta\omega_u^c = \omega_{u,2007}^c - \omega_{u,2004}^c$;

$\Delta E^c = E_{2007}^c - E_{2004}^c$;

$\Delta a^c = a_{2007}^c - a_{2004}^c$; and

$\varepsilon_c = \varepsilon_{c,2007} - \varepsilon_{c,2004}$.

To interpret Eq. (4.25), according to propositions (1), it is expected that $\beta_1 > 0$ and $\beta_2 > 0$. That is, having higher urban wages in the nearest city ($\omega_{u,t}^c$), or having more enterprises (E_t^c) in community *c* imply higher accessible off-farm wages in c (ω_t^c), thus increasing $Gini_{adj,t}^c$, by way of increasing farm land consolidation through the rental market. According to the propositions (3), it is expected that $\gamma_3 > 0$. That is, having higher land-to-labour ratio in *c* decreases $Gini_{adj,t}^c$, as the incentive to consolidate will decrease where larger land tracts are already present.

Therefore, the main prediction of the theoretical model, which has been reflected in the empirical model, is that in communities with access to higher off-farm employment wages (higher wages in the nearest city, smaller distances to the nearest city more local OFE opportunities in village enterprises), land consolidation will occur to a greater extent. For

example, given higher wages in the non-farm sector, households with better access to OFE are likely to give up farming, rent out their land, and fully engage in non-farm production. To remain competitive, other households may rent in land and expand their farm size by renting in land, thereby increasing the labour productivity. As a result, land consolidation occurs. This is especially true in terms of responses to higher urban wages since migratory OFE (in the city) requires the absence of this labour from the farm and therefore provides the greatest incentive to rent out.

4.6.2 A Change-to-Change Model of Household Land Rental Decisions

As a robustness check to the main findings regarding community-level land consolidation, I also examine the individual household decisions regarding land rentals, which would lead to more or less land consolidation. In the theoretical model (shown in Figure 4-6), within a community, the difference among households is due to different household characteristics (Z^h) as shown as Eq. (4.5) above, which may affect their land rental decisions. Within a community, the development of the land rental market that is necessary for land consolidation relies on characteristics that differentiate households in their willingness to decrease or expand the size of their existing (entitled) operations. In Figure 4-6 households within the same village facing higher off-farm wages (greater Z^h) are more likely to rent out land, while households facing lower off-farm wage (lower Z^h) are more likely to rent in land. It is important to test the validity of this prediction, as it plays a key role in explaining how land consolidation of a community develops within a community.

The land input demand function of a household farm operator is shown in Eq. (D.2).

$$A^{h^*} = A(p^c, \omega^c, \frac{\bar{A}^c}{\bar{L}^c}, Z^h) \quad \text{(D.2)}$$

where $\frac{dA^{h^*}}{d(p^c)} > 0$, $\frac{dA^{h^*}}{d\left(\frac{\bar{A}^c}{\bar{L}^c}\right)} > 0$, and $\frac{dA^{h^*}}{d(Z^h)} < 0$.

The derivation of Eq. (D.2) is shown in Appendix D. Further the directions of marginal effects of variable $p^c, \omega^c, \frac{\bar{A}^c}{\bar{L}^c}, Z^h$ have been shown in Appendix D.

Given a fixed amount of land entitlement, $\overline{A^h}$, if the land input demand, A^{h^*}, is greater than $\overline{A^h}$, then household will rent in land. If A^{h^*} is less than $\overline{A^h}$, then household will rent out land. The amount of land transfers will be the difference between A^{h^*} and $\overline{A^h}$.

Using the same empirical implementation methods – shown in (4.20), (4.21), and (4.22) – into (D.2), I propose the following empirical model for land rental decisions:

$$Rentin_t^h = \gamma_{0,t}^{in} + \gamma_h^{in} + \gamma_1^{in}\omega_{u,t}^c + \gamma_2^{in}D_u^c + \gamma_3^{in}E_t^c + \gamma_4^{in}a_t^c - \gamma_5^{in}Z_t^h - \gamma_6^{in}\overline{A_t^h} + \mu_t^{in} \quad (4.26)$$

$$Rentout_t^h = \gamma_{0,t}^{out} + \gamma_h^{out} + \gamma_1^{out}\omega_{u,t}^c + \gamma_2^{out}D_u^c + \gamma_3^{out}E_t^c - \gamma_4^{out}a_t^c + \gamma_5^{out}Z_t^h + \gamma_6^{out}\overline{A_t^h} + \mu_t^{out} \quad (4.27)$$

where t= year 2004 or 2007;

$Rentin_t^h$ = rented-in land of h in period t as a share of total land operation;

$\gamma_{0,t}^{in}$ = time specific constant term for rent-in model;

γ_h^{in} = household-specific constant term for rent-in model. Note that this variable can remove the effect of all time-invariant characteristics from the independent variables, including observable and the unobservable characteristic;

Z_t^h = the household human capital characteristics, including the average years of education of household members; dummy variables of household's labour force members' experience in off-farm work (local or migratory) in past two years (= 1 if Yes, 0 if No). Note that, "local" refers to off-farm employment (OFE) in non-farm sectors while living at home, while "migratory" refers to off-farm employment in urban centre, thus not living at home (rural area).

Households with higher levels of average education or with local or migratory off-farm work experience (higher Z_t^h) are expected to be paid at higher wage rates in off-farm work;

μ_t^{in} = the error term;

$Rentout_t^h$ = rent-out land as a share of total entitled land for *h* in period *t*;

$\gamma_{0,t}^{out}$ = time specific constant term for rent-out model;

γ_h^{out} = household-specific constant term for rent-out model; and

μ_t^{out} = the error term.

After taking the differentiation between 2004 and 2007, one has:

$$\Delta Rentin^h = \Delta\gamma_0^{in} + \gamma_1^{in}\Delta\omega_u^c + \gamma_3^{in}\Delta E^c + \gamma_4^{in}\Delta a^c - \gamma_5^{in}\Delta Z^h - \gamma_6^{in}\Delta\overline{A^h} + \Delta\mu^{in} \quad (4.28)$$

$$\Delta Rentout^h = \Delta\gamma_0^{out} + \gamma_1^{out}\Delta\omega_u^c + \gamma_3^{out}\Delta E^c - \gamma_4^{out}\Delta a^c + \gamma_5^{out}\Delta Z^h + \gamma_6^{out}\Delta\overline{A^h} + \Delta\mu^{out} \quad (4.29)$$

where $\Delta Rentin^h = Rentin_{2007}^h - Rentin_{2004}^h$;

$\Delta Rentout^h = Rentout_{2007}^h - Rentout_{2004}^h$;

$\Delta\gamma_0^{in} = \gamma_{0,2007}^{in} - \gamma_{0,2004}^{in}$;

$\Delta\gamma_0^{out} = \gamma_{0,2007}^{out} - \gamma_{0,2004}^{out}$;

$\Delta Z^h = Z_{2007}^h - Z_{2004}^h$;

$\Delta\overline{A^h} = \overline{A_{2007}^h} - \overline{A_{2004}^h}$;

$\Delta a^c = a_{2007}^c - a_{2004}^c$;

$\Delta\mu^{in} = \mu_{2007}^{in} - \mu_{2004}^{in}$; and

$\Delta\mu^{out} = \mu_{2007}^{out} - \mu_{2004}^{out}$.

According to the theoretical model, the signs of γ_1^{in} and γ_3^{in} and the signs of γ_1^{out} and γ_3^{out} are undetermined. On the one hand, higher off-farm wages in a community (represented by high

$\omega_{u,t}^{c}$ or E_t^c) "directly" decrease the land input demand because of higher labour input cost in farming, thus decreasing $Rentin_t^h$ and increasing $Rentout_t^h$ (direct effect of wage). On the other hand, higher off-farm wages in a community (represented by high $\omega_{u,t}^{c}$ or E_t^c) "indirectly" decreasing the land rental rate (shown in Eq. 4.13), thus increasing $Rentin_t^h$ and decreasing $Rentout_t^h$ (indirect effect of wage).

In equations (4.28) and (4.29), it is expected that the coefficients of the community's land-to-labour ratio are positive for rent-in model and is negative for rent-out model, that is, $\gamma_4^{in} > 0$ and $\gamma_4^{out} > 0$. An increase of the land-to-labour ratio of a community decreases the land rental rate of the community. With a lower land rental rates, the households who want to increase their farm size may rent in more land, while the household who plan to rent out land may reduce their land rental supply to the market. Note that the proof is shown in proposition 6 in Appendix D.

It is expected that the coefficients of the household-level off-farm income-earning ability index (Z^h) are negative for rent-in model and is positive for rent-out model, that is, $\gamma_5^{in} > 0 \; and \; \gamma_5^{out} > 0$. Facing higher labour wage in OFE (higher value of Z^h), the households tend to send more labour for OFE and leave less labour for farming. As a result, with higher value of Z^h, the households who want to increase their farm size may rent in less land because of the lack of household farm labour, while the households who plan to rent out land may supply more land to the market. Note that the proof is shown in proposition 7 in Appendix D.

4.7 Results

4.7.1 Results of Land Consolidation Model

Column (2) of Table 4-4 presents the results of the change-to-change *Gini* model (Eq. 4.25). In general, the results support the theoretical predictions.

Table 4-4. Determinants of the community-level adjusted *Gini* index

	Change-to-change model	Pooled OLS 2004 & 2007	OLS 2004	OLS 2007
Urban wage in the nearest city, 1000¥/yr	0.01188***	0.01098***	0.00167	0.01304***
	(0.00196)	(0.00361)	(0.00723)	(0.00408)
Distance to the nearest city, 100km		0.09157***	0.12165***	0.0785*
		(0.03215)	(0.02736)	(0.04417)
# of enterprises per 1,000 labourers in community	0.00097*	0.00075	0.00142*	0.00045
	(0.00058)	(0.00047)	(0.00081)	(0.0005)
Land-to-labour ratio of the community, mu/person	-0.00776**	-0.02004***	-0.02057***	-0.02047***
	(0.00391)	(0.00417)	(0.00505)	(0.00505)
Provincial dummy: Sichuan		0.07731**	0.03578	0.09079**
		(0.03136)	(0.0539)	(0.03831)
Shaanxi		0.03066	-0.05215	0.05866
		(0.03679)	(0.05715)	(0.0474)
Jilin		0.14971***	0.09054*	0.17275***
		(0.03585)	(0.05221)	(0.04551)
Hebei		0.01317	-0.0043	0.02005
		(0.02561)	(0.04202)	(0.03217)
Year Dummy (year 2007)		0.00474		
		(0.02792)		
Constant	0.17808***	0.13152**	0.26649**	0.09426
	(0.03453)	(0.0596)	(0.11749)	(0.09102)
Sample size	101	202	101	101
R square	0.334	0.355	0.261	0.349

Robust standard errors in Parentheses;
* Significant at 10%; ** Significant at 5%; *** Significant at 1%;
All the OLS results have been weighted by the number of valid household observations that used to construct the *Gini index* of the community (Appendix E);
The descriptive statistics and the definition of variables are shown in Table F-1 in Appendix F;
I also ran models with the lagged wage as an explanatory variables but it was insignificant and therefore dropped, as there did not seem to be a long delay in the response to higher urban wages.

The coefficient of the urban wage growth of the community's nearest city from 2004 to 2007 is positive and highly statistically significant, suggesting that $\beta_1 > 0$ in Eq. (4.25). At the mean change in urban wages from 2004 to 2007 of 6.305 thousand yuan (shown in Table F-1 in Appendix F), the estimated coefficient of the wage change variable suggests that the predicted change in *Gini* would be 0.075. This is a very large impact since the mean *Gini* is 0.26 in 2004 (shown in Table F-1 in Appendix F). In Figure 4-5, having a 0.075 increase in *Gini* index in a

community means 7.5% more households in this community rented out their land and left agriculture from 2004 to 2007.

In addition, the results show that having one more enterprise per 1,000 labourers in the community increases the adjusted *Gini* index by 0.001, which indicates that $\beta_3 > 0$ in Eq. (4.25). At the mean change in the number of enterprises from 2004 to 2007 of 0.62 (shown in Table F-1 in Appendix F), the estimated coefficient suggests that the predicted change in *Gini* would be 0.00062. This is a small impact since the mean *Gini* is 0.26 in 2004 (shown in Table F-1 in Appendix F). Thus for both urban wages accessible to rural-urban migrants through migratory off-farm work, and for local OFE employment opportunities in village enterprises, these findings provide support for the theoretical prediction in proposition (1). Farm households respond to increased opportunity costs of labour through the land rental market with the result that farm land operations consolidate. Even if land consolidation cannot occur in the form of purchases and sales of land, the rental market functions to achieve increases in farm size (operated).

As expected, the change-to-change model results in column (2) of Table 4-4 show that the coefficient of the land-to-labour of the community is significant and negative. This result provides support for proposition (3) that having a higher land-to-labour ratio slows the land consolidation process. At the mean change in community land-to-labour ratio from 2004 to 2007 of 0.025 (shown in Table F-1 in Appendix F), the estimated coefficient of the wage change variable suggests that the predicted change in *Gini* would be -0.0002. However, this is a small impact since the mean *Gini* is 0.26 in 2004 (shown in Table F-1 in Appendix F).

While the change-to-change model necessarily removes all the time-invariant variables, their influences are nevertheless of interest. Based on the complete theoretical model of the (level) of the *Gini* index (Eq. 4.23), pooled OLS model and time-specific OLS models are estimated.

Column (3) in Table 4-4 presents the results of pooled OLS model, while column (4) and column (5) present the results of time specific OLS model for the years of 2004 and 2007, respectively.

In general, the pooled OLS results are consistent with the results of change-to-change model. Communities with higher levels of average urban wages in the nearest cities have higher *Ginis*. Higher land-to-labour ratio decreases the *Gini* index. The consistency of the pooled OLS results and change-to-change model's results suggests that the estimates of $\omega_{u,t}^{c}$ and a_t^c are robust whether or not I add controls for time-invariant characteristics[10].

The pooled OLS results also indicate that the *Gini* index is negatively affected by the community's distance to the nearest city. A one-standard-deviation (45.21 km) increase (shown in col. 3 of Table 4-4) in the distance, D_u^c, decreases *Gini* by 0.04. This is a large impact since the mean *Gini* is 0.26 in 2004 and 0.35 in 2007 (shown in Table F-1 in Appendix F). According to the theoretical model, the expected sign of D_u^c is undetermined. On the one hand, according to Eq. (4.20), the distance will erode the value of the urban wage to the village dweller, and a greater distance to the city lead to a lower urban wage accessible in the community. Given the proposition (1), having higher D_u^c decreases the *Gini* index. On the other hand, according to Eq. (4.22), having a greater distance to the city decreases the agricultural output price. Given the proposition (2), having higher D_u^c increases the *Gini* index. Clearly the positive distance effects are overwhelming negative influences, such that having greater distances leads to higher *Ginis* or greater land consolidation.

[10] In this chapter, the change-to-change model is equivalent to a fixed effects model (FE model). The FE model can remove the effect of all kinds of time-invariant characteristics from the dependent variables, assessing the net effects of variations in the independent variables within an entity (a community). Therefore, the estimated coefficients of the change-to-change models (FE model) are more consistent because the FE model can control for the bias caused by the omitted time-invariant unobservable characteristics.

There are several reasons why I construct a time-specific OLS model. The pooled OLS model and change-to-change model are based on the assumption that the marginal effects of the determinants stay the same through the period 2004 – 2007. However, as discussed in the literature review, China has experienced a number of changes since the late of 1990s in terms of its institutions and economic structure, and some of these will have continuing effects. Since 1998, land tenure has become more secure and the rural land rental markets more functional in land transfers (Deininger and Jin 2005). Since 2003 China has passed the Lewis turning point and the opportunity cost of farm labour (represented by the off-farm labour wage) across rural China has increased dramatically (Zhang, Yang, and Wang 2010; Cai and Du 2011; Fleisher, Fearn, and Ye 2011; Li et al. 2012). If the effects of these changes were not complete by 2004, one may expect to see different time-specific estimates for 2004 model and 2007 model.

As shown in the time-specific empirical results in column (4) and column (5), the 2007 OLS model does perform better than 2004. In the former, most determinants are significant and with the expected signs. The R-square of 2007 is higher than 2004. The results of 2007 OLS model show that if the urban wage of the nearest city of a community increases by a one-standard-deviation (4000 yuan/year), with all other variables held constant, the *Gini* index of this community of 2007 will increase by 0.052. This is a large impact since the mean *Gini* is 0.35 in 2007 (shown in Table F-1 in Appendix F). In contrast, the result for the urban wage in the 2004 OLS model is not significant, which suggests that the urban wage became more influential (on land consolidation) between 2004 and 2007. The insignificant estimation of urban wage in 2004 might due to the fact that in rural China there were still surplus labour, thus a given urban wage growth leads to smaller increase in rural off-farm wage than that of 2007, thereby yielding smaller increase in *Gini*.

As for other variables, the time-specific OLS results are consistent with the previous findings. The total effect of D_u^c on land consolidation is positive. Having more enterprises increases *Gini*. Having higher levels of land-to-labour ratio decreases *Gini*.

4.7.2 Results of Household Land Rental Model

Land consolidation will be the result of individual household decisions. More specifically, in the theoretical model, within a community, households with human capital characteristics that are consistent with higher wages are more likely to rent out land. Similarly, lower education, less experience, etc. will reduce the expected off-farm wage, making these households more likely to rent in land. These theoretical predictions are tested by the household models for renting in and renting out land.

Table 4-5 reports the estimated coefficients for household land rent-in decision model. Column (2) shows the change-to-change model for the rent-in decision (Eq. 4.27); column (3) presents the results of the corresponding pooled OLS model; and columns (4) and (5) present the results of time-specific OLS models for 2004 and 2007 respectively.

According to the change-to-change model results in column (2), having a 6.305 thousand yuan increase in urban wages from 2004 to 2007 (the mean change in urban wages), would increase the share of land rented in, $Rentin_t^h$, from 4.2% to 6.5%, with all other variables held constant. This is a large impact. Given the average household land operation as 7.9 mu in 2004, having a 6.305 thousand yuan increase in urban wages from 2004 to 2007 would increase the average rented-in land by 0.18 mu. As shown in proposition 5 of the Appendix D, the effect unskilled off-farm wage rate of the community is undetermined. First, higher wage decreases land rental rate, thereby increasing $Rentin_t^h$ (the indirect land-rent-rate effect). Second, higher wage driving up labour cost in farming, thereby decreasing $Rentin_t^h$ (the direct wage effect). The

empirical result suggests that, for land rent in model, the indirect land-rent-rate effect dominates the direct wage effect.

Table 4-5. Share of rented-in land of household, divided by total land operation

	Change-to-change model	Pooled OLS 2004 & 2007	OLS 2004	OLS 2007
Urban wage in the nearest city, 1000¥/yr	0.00356**	-0.00345	-0.0024	-0.00535
	(0.00141)	(0.00292)	(0.00374)	(0.00346)
Distance to the nearest city, 100km		0.00956	0.02519	0.01848
		(0.01768)	(0.02385)	(0.02013)
# of enterprises per 1,000 labourers in community	0.00084	0.00091	0.00014	0.00135
	(0.00098)	(0.00095)	(0.00052)	(0.00125)
Land-to-labour ratio of the community, mu/person	0.00831***	0.00661*	-0.00435	0.01014***
	(0.00254)	(0.00345)	(0.00508)	(0.00372)
Past local OFE experience in last 2 years (dummy)	-0.01266	-0.00694	-0.00719	-0.00559
	(0.01146)	(0.00948)	(0.00884)	(0.01343)
Past migratory OFE experience in last 2 years (dummy)	-0.00284	-0.01757	-0.00905	-0.02145
	(0.01145)	(0.01072)	(0.01472)	(0.01422)
The average years of education of household members (year)	-0.00132	-0.00135	0.0016	-0.00241
	(0.00246)	(0.00179)	(0.00196)	(0.00231)
Household land-to-labour ratio	-0.01087***	-0.01414***	-0.00607**	-0.01701***
	(0.00272)	(0.00311)	(0.00248)	(0.00352)
Provincial dummy: Sichuan		-0.04024	-0.01616	-0.06201
		(0.03333)	(0.02656)	(0.04123)
Shaanxi		-0.05685*	-0.04124	-0.08564*
		(0.03345)	(0.02723)	(0.04313)
Jilin		-0.00386	0.04283	-0.02765
		(0.03454)	(0.03767)	(0.03839)
Hebei		-0.04843*	-0.00067	-0.07552**
		(0.0284)	(0.02221)	(0.03488)
Year Dummy (year 2007)		0.07676***		
		(0.02217)		
Constant	0.02748	0.14424**	0.09215	0.27444***
	(0.02898)	(0.06311)	(0.06606)	(0.09544)
Sample size	569	2514	753	1761
R square	0.042	0.062	0.034	0.066

Robust standard and township-clustered standard errors in parentheses;
* Significant at 10%; ** Significant at 5%; *** Significant at 1%;
The descriptive statistics and the definition of variables are shown in Tables F-2 and F-2 in Appendix F;
Note that the households who rented out all of their entitled land (with land operation zero) were excluded from this model.

Column 2 also shows that having high land-to-labour ratio of the community increases $Rentin_t^h$. For example, if the land-to-labour ratio of a community increases by 0.025 mu/person (the mean change from 2004 to 2007), the value is of $Rentin_t^h$ would increase by 0.02%. Though this impact is small, it is consistent with the theoretical prediction. That is, having a higher land-to-labour ratio in a community is likely to yield a lower land rental rate, thereby increasing households' land input demand, which in turn increases $Rentin_t^h$. The pooled OLS result and the year-specific OLS results are generally supportive of the change-to-change model results.

Table 4-6 reports the estimated coefficients for household land rent-out decision model. Column (2) presents the results of change-to-change model (Eq. 4.28); column (3) presents the results of pooled OLS model; and columns (4) and (5) present the results of the OLS models for 2004 and 2007 respectively.

According to the change-to-change model results in column (2), having a 6.305 thousand yuan increase in urban wages from 2004 to 2007 (the mean change in urban wages from 2004 to 2007), would increases the share of land rented out, $Rentout_t^h$, from 2.8% to 5.5%, with all other variables held constant. This is a large impact. Given the average household land operation as 7.5 mu in 2004, having a 6.305 thousand yuan increase in urban wages from 2004 to 2007 would increase the average rented-out land by 0.2 mu. As shown in proposition 5 of the Appendix D, the effect unskilled off-farm wage rate of the community is undetermined. First, higher wage decreases land rental rate, thereby decreasing $Rentout_t^h$ (the indirect land-rent-rate effect). Second, higher wage driving up labour cost in farming, thereby increasing $Rentout_t^h$ (the direct wage effect). The empirical result suggests that, for land rent-out model, the direct wage effect dominates the indirect land-rent-rate effect. Notably, the urban wage has different

marginal impacts in land rent-in model and land rent-out model. That is, in land rent in model, the urban wage's indirect land-rent-rate effect dominates its direct wage effect. In land rent out model, the urban wage's direct wage effect dominates the indirect land-rent-rate effect.

Table 4-6. Share of rented-out land of household, divided by total land entitlement

	Change-to-change model	Pooled OLS 2004 & 2007	OLS 2004	OLS 2007
Urban wage in the nearest city, 1000¥/yr	0.00425**	0.00517	0.0026	0.00479
	(0.00210)	(0.00362)	(0.00415)	(0.00403)
Distance to the nearest city, 100km		0.04104**	0.03667	0.04586**
		(0.01682)	(0.02395)	(0.02181)
# of enterprises per 1,000 labourers in community	0.00180***	0.00138***	0.00068	0.00164***
	(0.00045)	(0.00036)	(0.0006)	(0.00035)
Land-to-labour ratio of the community, mu/person	-0.00242*	-0.00411*	-0.00277	-0.00435*
	(0.00125)	(0.00207)	(0.00382)	(0.00248)
Past local OFE experience in last 2 years (dummy)	0.02512**	0.02007*	0.01627	0.02316*
	(0.01018)	(0.01013)	(0.01318)	(0.01157)
Past migratory OFE experience in last 2 years (dummy)	0.00101	0.01675*	-0.00002	0.02397**
	(0.01026)	(0.00901)	(0.01088)	(0.01135)
The average years of education of household members (year)	0.00457*	0.00360**	0.00437**	0.00331
	(0.00255)	(0.00176)	(0.00199)	(0.00221)
Household land-to-labour ratio	0.00226	0.00098	-0.00065	0.00128
	(0.00198)	(0.00137)	(0.00154)	(0.00179)
Provincial dummy: Sichuan		0.03661	0.04864	0.02433
		(0.02854)	(0.0422)	(0.02808)
Shaanxi		-0.01622	-0.01182	-0.02724
		(0.02331)	(0.02963)	(0.02894)
Jilin		0.03907	0.02682	0.0358
		(0.02537)	(0.02593)	(0.0303)
Hebei		0.01124	0.00847	0.00568
		(0.01463)	(0.01963)	(0.01871)
Year Dummy (year 2007)		-0.01484		
		(0.02293)		
Constant	-0.08201**	-0.105*	-0.06517	-0.11326
	(0.03926)	(0.05446)	(0.06702)	(0.08295)
Sample size	1176	2557	764	1793
R square	0.061	0.051	0.038	0.055

Robust standard and township-clustered standard errors in parentheses;
* Significant at 10%; ** Significant at 5%; *** Significant at 1%;
The descriptive statistics and the definition of variables are shown in Tables F-1 and F-2 in Appendix F;
Note that the households with no land entitlement were excluded from this model.

In addition, the results show that having one more enterprise per 1,000 labourers in the community increases $Rentout_t^h$ by 0.0018, which indicates that $\gamma_3^{out} > 0$ in Eq. (4.28). As the mean change in the number of enterprises from 2004 to 2007 of 0.62, the estimated coefficient suggests that the predicted change in $Rentout_t^h$ would be 0.11%. This is a small impact since the mean $Rentout_t^h$ is 4.2% in 2004. The results above consistently show that household with higher urban wage growth of the nearest city and more community enterprises in the community tend to rent out more land entitlement.

Column 2 also shows that having higher land-to-labour ratio of the community decreases $Rentout_t^h$. For example, if the land-to-labour ratio of a community increases by 0.025 mu/person (the mean from 2004 to 2007), the value of $Rentout_t^h$ would decrease by 0.006%. Though this impact is small, it is consistent with the theoretical prediction. That is, having a higher land-to-labour ratio in a community is likely to yield a lower land rental rate, thereby increasing households' land input demand, which in turn decreases $Rentout_t^h$.

Results in column (2) also confirm the major prediction of the theoretical model–the households having higher off-farm wages within a community are more likely to rent out land. The change-to-change model results show that, if a household did not have local OFE experience in the year 2002 and 2003 but gained local off-farm work experience in year 2005 or 2006, $Rentout_t^h$ would increase by 2.5% from 2004 to 2007. With the average household land entitlement as 7.5 mu in 2004, a 2.5% increase would increase the average rent out land by 0.19 mu. In addition, having one more year of education would increase $Rentout_t^h$ by 0.46%. With the average household land entitlement as 7.5 mu in 2004, a 0.46% increase would increase the average rent out land by 0.035 mu, a significant though small impact.

The results of the pooled and time-specific OLS models are generally consistent with the results of change-to-change model. Having more enterprises in the community increases $Rentiout_t^h$. Having higher land-to-labour ratios in the community decreases $Rentout_t^h$. The households with local or migratory OFE experience or with higher levels of average household education are likely to rent out more of their entitled land.

Last, as a robust test, I also use linear probability models to investigate the household land rental decision, by using the same set of independent variables in Eqs. (4.26) and (4.27). The dependent variable, instead the share of rented-in or rented-out land, is a dummy variable of whether the household rented in land or rented out land in that year. The results of the linear probability models are consistent with previous results (shown in in Appendix G).

Consistent with the theoretical prediction and previous results, the empirical results of the pooled OLS and the 2007 models show a significant positive effect of greater distance to the nearest city on $Rentout_t^h$. As shown in Eq. (4.20), the unskilled off-farm wage accessible to community members is a decreasing function of the distance. As higher off-farm wages (represented by the urban wage) are expected to increase $Rentout_t^h$, because of higher opportunity costs of farm labour, one may expect a negative effect of distance on $Rentout_t^h$. Additionally, as shown in Eq. (4.22), farm output price is decreasing function of the distance to the nearest city. As higher farm output prices will drive up land input demand, decreasing $Rentout_t^h$, greater distances may also decrease land input demand, thereby increasing $Rentout_t^h$. The empirical results support this expectation. According to the results in column (3), having a one-standard-deviation (45.21 km) increase in the distance, D_u^c, increases $Rentout_t^h$ by 1.86%. This is a large impact since the mean $Rentout_t^h$ is 2.8% in 2004 and 4.8% in 2007.

The results of the household land rental model provides support for the theoretical model about the micro mechanism by which land rental markets are instrumental in land consolidation. That is, within a community, households with a higher opportunity cost, measured as having higher off-farm wages (higher average household education and more off-farm work experience) are more likely to rent out land. This finding has very important implications for China, indicating that within communities the households that are most involved in off-farm employment and are well-positioned to access OFE, are actively participating in the land rental market by renting out their farm land and therefore driving the consolidation of land operations. The characteristics and circumstances of the households on the other side of the transaction, that is, renting in are less clear. Note that, these findings appear consistent with a recent study by Huang, Gao, and Rozelle (2012). Based on a panel data of a national representative sample from 2000 and 2008, Huang, Gao, and Rozelle (2012) find that the OFE participation has significant and positive impacts on stimulating household to rent out cultivated land, while the effect is less prominent for renting-in decisions.

4.8 Conclusions and Policy Implications

Based on survey data from 101 communities in rural China in 2004 and 2007, I examine the nature and determinants of the consolidation of farm operations. Using community-level adjusted *Gini* coefficients, I show that, despite the absence of private land ownership, the land consolidation has occurred in China, through rental arrangements. Further, I investigate the causes of land consolidation using a localized land rental market model, with a particular emphasis on understanding the role of the urban wage and off-farm work opportunities. The results provide support for the hypotheses that land consolidation occurs at faster rates in communities with higher urban wages, with more local off-farm work opportunities, and with

lower per capita land resources. A time-specific analysis reveals that urban wage growth was more important in 2007 than it was in 2004.

I also develop and test a theoretical model of the household participants in the land rental market underlying the land consolidation process. One of the primary theoretical predictions of the household model, that households with a higher opportunity cost, that is, with more education and with off-farm work experience are likely to be the households that rent out land, is supported by the results.

This study has a number of implications for China's agricultural policy. First, the empirical results confirm the theoretical prediction that the growth of the accessible off-farm wage in a rural community facilitates agricultural land consolidation. If the urban/rural wage gap persists as China's urban-based economic development proceeds, land consolidation is likely to continue. Additionally, there is some evidence of this in that the growth of urban wage rates in China had significant and larger effects on land consolidation in 2007 than in 2004, signifying that urban wage growth may have played an increasing important role in facilitating agricultural land consolidation recently.

Second, in the literature, rural-urban migration drives the land consolidation process as those permanently re-locating to urban areas sell their land to those remaining, resulting in an increase in farm size for the latter. In the absence of being able to buy and sell their land, the results for China show that households with more education and previous experience in off-farm employment are most likely to rent out their land. However, the motivation of the households renting in is less clear. If land consolidation is a policy objective then supporting land rental market and making land resources more transferable might be attractive. It will also be important

to facilitate the expansion of farm operations by those renting in, possibly through improving their productivity in agriculture through specific training and assisting access to financial capital.

5. SUMMARY, IMPLICATIONS, AND FURTHER STUDY

5.1 Summary and Conclusions

In this dissertation, I examine how China's rural labour and farmland use changes during the economic transformation, recognizing the uniqueness of China's residence registration system (the *Hukou* system) and collective land ownership systems. This study contributes to development economics literature by examine the development process of China in its unique context, improving our understanding of the nature of economic transformation.

Neoclassical models of labour migration argue that free movement of labour (migration) will eventually lead to the convergence of wages between farm and non-farm sectors. Further the rising opportunity costs of farm labour (or off-farm wages) are predicted to lead to an increase in farm size. Using data collected from rural households in five provinces in China, this study shows that, the increase of OFE in China is largely consistent with market-driven expectations, and that in recent years, the attraction of a higher urban wage has begun to produce consolidation of farming operations through rental arrangements.

Chapter 2 examines the self-selection of individuals into OFE. The results show that individual and household characteristics are important in the self-selection into local and migratory/urban OFE versus farming. More educated, young, and male workers are more likely to select into migratory OFE, while the less educated, senior, and female workers are more likely to select into farming only. Having more preschool children in the family increases the probability of self-selection into local OFE and decreases the probability of self-selection into migratory OFE. Moreover, I also confirm that the market-based driving forces (e.g. average off-farm wages) play key roles in OFE growth. An increase in off-farm wages increases the probability of selection into OFE and decreases the probability of selection into farming only.

The larger the off-farm wage gap between local OFE and migratory OFE (reflected by the interactive term of distance variable and urban wage variable), the smaller is the probability of self-selection into local OFE.

Chapter 4 examines the trend of consolidation of farming operations and its determinants, with special attention to the effect of the urban wage. Using a *Gini* coefficient to measure the inequality between land operations and land entitlements, the results show that farm operations become more consolidated from 2004 to 2007. That is, the amounts of agricultural land operated by farm households become less unlike the amounts of their land entitlements. Land concentration develops at faster rates in communities with higher urban wages in the nearest urban center, and in communities with fewer per capita land resources. Additionally, a more refined time-specific analysis reveals that the urban wage growth of the community's nearest city becomes the major contributor of land concentration in 2007. The primary theoretical predictions were also tested in a micro-level household model, showing that the households that are most involved in OFE are active players and the driving forces of the consolidation of farm operations.

5.2 Implications

The *Hukou* system and the HRS were initially designated to address particular problems in another era. For example, the *Hukou* system was initially designated to control the rural-urban migratory labour flows of the Big Push industrialization approach in 1950s. The HRS was initially designated to address the lack of production incentives within the commune system. As the nature of China's economy has changed and new challenges have risen, there may be a disconnect between these long-standing institutions and modern goals and objectives. For example, at present, urbanization and agricultural land consolidation have been designated national priorities for China (Johnson 2013). The *Hukou* system and the land tenure structure may present obstacles to reaching these development goals as they may have made the labour

and land less mobile and thus impede efficient resource allocation. To make effective urbanization policies and agricultural policies, one must understand the development process of China, such as the nature of OFE growth and agricultural land consolidation, given China's unique institutional context.

Research findings in this dissertation have policy implications for policy makers. First, successful urbanization may require more than simply increasing the number of people that work in urban areas. Successful urbanization may also entail a means for urban workers to settle down and live in urban areas with their families. Chapter 2 of this dissertation suggests gender differences in the selection into OFE. For all focal-person groups, male workers are more likely to participate in migratory OFE, while females (spouses of male workers) are more likely to participate in farming only. This family separation experienced by migratory OFE workers may result in an incomplete, temporary, and partial urbanization. For successful urbanization, government may pursue means of ensuring security and stability for rural-urban migrants and their families to settle down in cities. For example, the governments of migrant-receiving cities could make available affordable housing and school enrolment for the children for the selected migrants. Moreover, to facilitate the participation of more rural females in OFE, local rural government could make education for girls as well as boys more affordable. Adult rural female workers might be given greater opportunities to receive education and training, so that they can meet the minimum requirement for OFE.

Second, land consolidation following agricultural labour out-migration that is occurring through land rental transactions will increase the land-to-labour ratio. In order to make the recombined land resources more productive, new technology, new investment, and new management skills are also required. Chapter 2 of this dissertation finds that the farming

population is less educated and older than the rural population employed off the farm. The older age and lower education profile of China's farmers may hinder future land consolidation because of the limits of their knowledge and their more limited lifespan for realizing returns on large investments. A successful and smooth land consolidation may also require policies to attract private investment and human capital to agriculture. Government could facilitate access to credit from formal financial institutions for farmers. To broaden the knowledge and skills base of agricultural sector, agricultural business development services may be instrumental in facilitating the adoption of new practices and technologies.

Third, chapter 4 of this dissertation suggests that urban wage growth is the engine of land consolidation of the hinterlands. As long as the urban wage growth continues, consolidation of farming operations is likely to be the response. To sustain the required rate of growth in land consolidation to realize economies of size and scale, additional measures may be considered. There may be ways to reduce the legal and other institutional barriers that impede consolidation, for example, making land use right more secure, improving the land rental market, and making land resources more transferable.

5.3 Directions for Further Study

This study contributes to the urbanization and the land consolidation literature for China. However, there are a number of areas that can be further pursued.

First, this dissertation focuses on exclusively the agricultural labour out-migration and its induced "lost labour" effects in agriculture. However, coincident with the growth of labour out-migration, financial remittances generate positive "remittance effects". That is, agricultural out-migrants may contribute to agricultural production of their labour-sending households through their remittances. Moreover, off-farm work experience may enable agricultural out-migrants to accumulate human capital and mobilize their social capital. When the migrants return to their

origin, these characteristics may make them the prime candidates of agricultural innovators, which may contribute land consolidation. The size and determinants of these feedback effects to the agriculture sector and to rural areas warrant further research.

Second, it is still unclear what makes households rent in land and expand farms. Do they have superior agricultural production abilities and knowledge? Or do they have better access to market information, financial services, or local political powers? The answer to these questions holds special importance for China's agricultural development, as the renting-in households today are likely to become the innovators in the future. Further research is needed to determine how the decision to expand farm operations occurs.

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APPENDIX A: VARIABLE SUMMARY OF CHAPTER 2

Table A-1. Variable definition and data sources

Variables	Variables	Unit	Data source
Individual-level variables:			
Male	Male 1, female 0	dummy	CCAP[a]
Age[b] between 16-20	If age was between 16 and 20 1, otherwise 0	dummy	CCAP
Age between 21-30	If age was between 21 and 30 1, otherwise 0	dummy	CCAP
Age between 31-40	If age was between 31 and 40 1, otherwise 0	dummy	CCAP
Age between 41-50	If age was between 41 and 50 1, otherwise 0	dummy	CCAP
Primary school[c]	If personal highest educational attainment is primary school 1, otherwise 0	dummy	CCAP
Mid school	If personal highest educational attainment is mid school 1, otherwise 0	dummy	CCAP
High school	If personal highest educational attainment is high school 1, otherwise 0	dummy	CCAP
College or higher	If personal highest educational attainment is college, university or higher 1, otherwise 0	dummy	CCAP
Household-level variables:			
Number of Children	Number of preschool children in the household	person	CCAP
Hhld female labour	Additional female labour force members in household (excluding individual him/herself)	person	CCAP
Hhld male labour	Additional male labour force members in household (excluding individual him/herself)	person	CCAP
Hhld entitled land	Household entitled land from the village in the beginning of the year	mu	CCAP
Having CCP member	If household has CCP member 1, otherwise 0	dummy	CCAP
Community-level variables:			
Village enterprises	The number of village enterprises per 1000 population	#/1000 persons	CCAP
Distance to city	Distance from the village to its nearest city	10km	Google Maps (2012)
Wage of nearest city	Average annual urban wage of the village's nearest city	1000 yuan/year	CNBS (2005; 2008)

[a] CCAP rural household survey, 2005 and 2008.
[b] The left-out category (reference variable) of age dummies is "age between 51-65".
[C] The left-out category (reference variable) of education dummies is "illiterate or primary school not finished".

Table A-2. Descriptive statistics of household head focal persons in 2004

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	724		334 (46%)		296 (41%)		94 (13%)	
Male %	0.98	0.13	0.98	0.15	0.99	0.12	1.00	0.00
Age years	47.67	9.39	50.70	8.60	45.47	9.60	43.86	8.10
Primary school	0.32	0.47	0.35	0.48	0.31	0.46	0.27	0.44
Mid school	0.38	0.49	0.33	0.47	0.42	0.49	0.45	0.50
High school	0.10	0.30	0.06	0.24	0.15	0.36	0.09	0.28
College or higher	0.01	0.08	0.00	0.00	0.01	0.08	0.03	0.18
Number of Children	0.23	0.47	0.25	0.49	0.22	0.45	0.21	0.46
Hhld female labour	1.30	0.63	1.31	0.67	1.31	0.60	1.26	0.57
Hhld male labour	0.53	0.66	0.61	0.70	0.47	0.62	0.40	0.59
Hhld entitled land	7.94	7.18	9.50	7.53	6.08	6.15	8.27	7.62
Having CCP member %	0.06	0.23	0.06	0.24	0.05	0.22	0.06	0.25
Village enterprises	2.60	7.58	1.39	3.65	4.43	10.87	1.12	2.28
Distance to city	5.18	4.34	5.30	4.70	4.98	4.03	5.41	3.96
Wage of nearest city	11.97	2.63	11.56	2.33	12.55	2.90	11.57	2.36

Source: CCAP 2005 survey; Google Maps (2012); National Bureau of Statistics of China (2005).

Table A-3. Descriptive statistics of household head focal persons in 2007

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	1738		808 (46%)		645 (37%)		285 (16%)	
Male %	0.95	0.22	0.92	0.27	0.96	0.19	0.99	0.10
Age years	49.14	9.09	52.23	8.27	47.36	8.98	44.41	8.42
Primary school	0.32	0.46	0.34	0.47	0.29	0.45	0.30	0.46
Mid school	0.41	0.49	0.35	0.48	0.46	0.50	0.46	0.50
High school	0.12	0.33	0.08	0.28	0.16	0.37	0.13	0.34
College or higher	0.01	0.08	0.00	0.05	0.01	0.09	0.01	0.10
Number of Children	0.22	0.47	0.24	0.48	0.21	0.45	0.22	0.45
Hhld female labour	1.36	0.71	1.38	0.74	1.33	0.70	1.34	0.63
Hhld male labour	0.63	0.70	0.72	0.71	0.55	0.68	0.56	0.65
Hhld entitled land	8.73	9.56	10.01	9.87	7.47	9.96	7.93	6.99
Having CCP member %	0.08	0.27	0.08	0.27	0.08	0.27	0.06	0.24
Village enterprises	2.75	7.04	1.97	5.35	4.28	9.48	1.53	3.07
Distance to city	5.16	4.15	5.32	4.62	4.78	3.52	5.53	3.98
Wage of nearest city	18.28	4.01	17.71	3.34	19.26	4.73	17.70	3.52

Source: CCAP 2008 survey; Google Maps (2012); National Bureau of Statistics of China (2008).

Table A-4. Descriptive statistics of household head's spouse in 2004

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	708		535 (76%)		143 (20%)		30 (4%)	
Male %	0.01	0.11	0.01	0.07	0.03	0.17	0.07	0.25
Age years	45.96	9.27	46.51	9.31	44.20	9.08	44.50	8.62
Primary school	0.28	0.45	0.29	0.45	0.31	0.46	0.13	0.35
Mid school	0.25	0.43	0.22	0.41	0.31	0.47	0.40	0.50
High school	0.05	0.21	0.03	0.17	0.08	0.28	0.17	0.38
College or higher	0.01	0.08	0.00	0.04	0.02	0.14	0.00	0.00
Number of Children	0.23	0.47	0.24	0.47	0.21	0.46	0.10	0.40
Hhld female labour	0.40	0.58	0.40	0.58	0.36	0.59	0.50	0.73
Hhld male labour	1.42	0.68	1.44	0.70	1.34	0.59	1.40	0.67
Hhld entitled land	7.86	6.88	8.57	7.17	5.52	5.61	6.49	3.94
Having CCP member %	0.14	0.34	0.14	0.35	0.14	0.35	0.03	0.18
Village enterprises	2.61	7.66	1.80	5.35	5.58	12.80	2.91	6.61
Distance to city	5.17	4.36	4.98	3.82	5.34	4.75	7.72	8.78
Wage of nearest city	12.01	2.65	11.76	2.46	12.94	3.24	11.94	1.87

Source: CCAP 2005 survey; Google Maps (2012); National Bureau of Statistics of China (2005).

Table A-5. Descriptive statistics of household head's spouse in 2007

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	1613		1186 (74%)		349 (22%)		78 (5%)	
Male %	0.03	0.18	0.02	0.14	0.05	0.22	0.15	0.36
Age years	47.75	8.98	48.87	8.84	44.72	8.71	44.15	8.11
Primary school	0.32	0.47	0.34	0.47	0.30	0.46	0.27	0.45
Mid school	0.25	0.44	0.21	0.40	0.39	0.49	0.37	0.49
High school	0.06	0.24	0.04	0.20	0.12	0.32	0.15	0.36
College or higher	0.00	0.07	0.00	0.03	0.01	0.12	0.03	0.16
Number of Children	0.22	0.47	0.25	0.48	0.16	0.43	0.18	0.39
Hhld female labour	0.51	0.68	0.54	0.68	0.37	0.62	0.68	0.73
Hhld male labour	1.51	0.71	1.57	0.71	1.33	0.66	1.50	0.80
Hhld entitled land	8.74	9.50	9.48	9.78	6.75	8.64	6.47	6.94
Having CCP member %	0.18	0.39	0.18	0.39	0.20	0.40	0.13	0.34
Village enterprises	2.67	6.72	2.00	5.15	4.95	10.21	2.72	6.00
Distance to city	5.18	4.24	5.04	3.85	5.27	4.57	6.84	7.11
Wage of nearest city	18.33	4.04	17.83	3.58	20.17	5.00	17.68	3.50

Source: CCAP 2008 survey; Google Maps (2012); National Bureau of Statistics of China (2008).

Table A-6. Descriptive statistics of head's youngest working-age child in 2004

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	403		88 (22%)		71 (18%)		244 (61%)	
Male %	0.50	0.50	0.33	0.47	0.49	0.50	0.56	0.50
Age years	24.13	5.59	25.27	6.65	26.03	5.76	23.17	4.89
Primary school	0.28	0.45	0.39	0.49	0.20	0.40	0.26	0.44
Mid school	0.45	0.50	0.41	0.49	0.58	0.50	0.43	0.50
High school	0.16	0.37	0.06	0.23	0.15	0.36	0.20	0.40
College or higher	0.04	0.20	0.00	0.00	0.03	0.17	0.06	0.23
Number of Children	0.29	0.53	0.40	0.58	0.44	0.65	0.20	0.45
Hhld female labour	1.10	0.57	0.98	0.66	1.14	0.62	1.14	0.51
Hhld male labour	1.34	0.65	1.47	0.64	1.37	0.78	1.29	0.60
Hhld entitled land	8.02	7.27	9.20	9.09	5.82	4.23	8.24	7.12
Having CCP member %	0.15	0.36	0.08	0.27	0.20	0.40	0.16	0.37
Village enterprises	2.37	7.02	1.89	6.73	4.76	12.37	1.84	4.38
Distance to city	5.15	4.81	5.27	4.67	4.64	4.39	5.26	4.98
Wage of nearest city	11.90	2.55	11.32	1.98	12.75	3.08	11.86	2.51

Source: CCAP 2005 survey; Google Maps (2012); National Bureau of Statistics of China (2005).

Table A-7. Descriptive statistics of head's youngest working-age child in 2007

Variables	All		Farm only		Loc. OFE		Mig. OFE	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Sample size	1063		194 (18%)		217 (20%)		652 (61%)	
Male %	0.51	0.50	0.35	0.48	0.53	0.50	0.55	0.50
Age years	25.53	6.75	26.31	7.84	28.49	7.51	24.31	5.72
Primary school	0.20	0.40	0.30	0.46	0.18	0.38	0.18	0.38
Mid school	0.53	0.50	0.46	0.50	0.63	0.48	0.52	0.50
High school	0.15	0.35	0.09	0.28	0.11	0.31	0.18	0.38
College or higher	0.07	0.25	0.01	0.10	0.05	0.22	0.09	0.28
Number of Children	0.28	0.52	0.33	0.53	0.34	0.56	0.25	0.49
Hhld female labour	1.17	0.61	1.05	0.60	1.13	0.65	1.23	0.60
Hhld male labour	1.37	0.69	1.52	0.71	1.29	0.73	1.36	0.67
Hhld entitled land	8.92	9.19	11.61	9.42	6.95	8.35	8.78	9.22
Having CCP member %	0.20	0.40	0.18	0.38	0.21	0.41	0.21	0.41
Village enterprises	2.63	6.77	1.82	5.07	5.20	10.54	2.02	5.24
Distance to city	4.91	3.95	5.45	4.53	4.08	3.52	5.03	3.86
Wage of nearest city	18.29	4.01	17.54	3.13	20.38	4.68	17.82	3.77

Source: CCAP 2008 survey; Google Maps (2012); National Bureau of Statistics of China (2008).

Table A-8. Summaries of the first differences between 2004 and 2007

Variables	Head		Spouse		Youngest child	
	mean	Std. Dev.	mean	Std. Dev.	mean	Std. Dev.
Sample size	556		532		260	
Age between 16-20					-0.2077	0.4158
Age between 21-30	-0.0288	0.1673	-0.0263	0.1602	0.0692	0.5854
Age between 31-40	-0.0486	0.3224	-0.0639	0.3357	0.1269	0.3666
Age between 41-50	-0.0288	0.4277	-0.0451	0.4732	0.0115	0.1070
Number of children	-0.0180	0.5265	-0.0132	0.5151	-0.0038	0.6056
Hhld female labour	0.1061	0.6476	0.1090	0.5977	0.2115	0.6674
Hhld male labour	0.1043	0.5198	0.0733	0.5921	0.0500	0.4985
Hhld entitled land	0.5827	7.0812	0.7367	6.9822	0.2315	6.8606
Having CCP member %	0.0126	0.2282	0.0301	0.2658	0.0154	0.2775
Village enterprises	0.2812	5.3536	0.3588	5.4652	0.4583	4.6733
Wage of nearest city	6.4069	1.7621	6.4151	1.7648	6.4388	1.7724

Source: CCAP 2005 and 2008 survey; National Bureau of Statistics of China (2005, 2008).

APPENDIX B: ALTERNATIVE MODEL RESULTS OF CHAPTER 2

Table B-1. Marginal effects of Logit & Probit models for household head

	Pooled Logit Model			Pooled Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.222***	0.048	0.116***	-0.222***	0.048	0.126***
	(0.067)	(0.069)	(0.017)	(0.066)	(0.068)	(0.015)
Age between 21-30	-0.312***	0.206***	0.210***	-0.315***	0.200***	0.196***
	(0.034)	(0.069)	(0.067)	(0.035)	(0.069)	(0.061)
Age between 31-40	-0.345***	0.168***	0.224***	-0.342***	0.165***	0.219***
	(0.029)	(0.04)	(0.04)	(0.03)	(0.039)	(0.037)
Age between 41-50	-0.228***	0.121***	0.125***	-0.223***	0.117***	0.123***
	(0.028)	(0.032)	(0.026)	(0.028)	(0.031)	(0.025)
Primary school	-0.144***	0.154***	0.009	-0.142***	0.149***	0.011
	(0.038)	(0.04)	(0.024)	(0.037)	(0.037)	(0.024)
Mid school	-0.178***	0.181***	0.011	-0.175***	0.175***	0.015
	(0.038)	(0.039)	(0.025)	(0.038)	(0.036)	(0.026)
High school	-0.231***	0.247***	0.012	-0.232***	0.240***	0.016
	(0.046)	(0.058)	(0.035)	(0.046)	(0.056)	(0.037)
College or higher	-0.423***	0.291*	0.243	-0.418***	0.275*	0.252
	(0.038)	(0.152)	(0.172)	(0.045)	(0.144)	(0.166)
Number of children	-0.006	-0.002	0.008	-0.008	0.0001	0.009
	(0.026)	(0.026)	(0.019)	(0.025)	(0.025)	(0.02)
Hhld female labour	-0.006	0.004	0.003	-0.004	0.003	0.001
	(0.019)	(0.018)	(0.011)	(0.019)	(0.017)	(0.012)
Hhld male labour	-0.02	0.003	0.014	-0.021	0.004	0.015
	(0.02)	(0.022)	(0.013)	(0.019)	(0.022)	(0.014)
Hhld entitled land	0.011***	-0.008**	-0.003**	0.010***	-0.006**	-0.003**
	(0.004)	(0.003)	(0.001)	(0.004)	(0.003)	(0.001)
Having CCP member	-0.018	-0.005	0.018	-0.016	-0.002	0.025
	(0.053)	(0.047)	(0.032)	(0.05)	(0.045)	(0.035)
Village enterprises	-0.006	0.010**	-0.009*	-0.006	0.010**	-0.008
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
Distance to city	-0.01	0.004	0.003	-0.01	0.004	0.004
	(0.014)	(0.012)	(0.004)	(0.014)	(0.012)	(0.005)
Wage of nearest city	-0.023***	0.025***	-0.004	-0.023***	0.025***	-0.004
	(0.008)	(0.006)	(0.004)	(0.007)	(0.007)	(0.004)
Interaction term of distance and wage	0.001	-0.001	0.0001	0.001	-0.001	0.0002
	(0.001)	(0.001)	(0.0003)	(0.001)	(0.001)	(0.0003)
Year 2007	0.112**	-0.198***	0.073***	0.108**	-0.195***	0.078***
	(0.045)	(0.038)	(0.022)	(0.046)	(0.038)	(0.023)
Obs.	1882	1882	1882	1882	1882	1882
Pseudo-R2	0.13	0.094	0.087	0.129	0.093	0.087

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table B-2. Marginal effects of Logit & Probit models for head's spouse

	Pooled Logit Model			Pooled Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.299***	0.091	0.127**	-0.303***	0.110*	0.146**
	(0.096)	(0.065)	(0.054)	(0.088)	(0.063)	(0.058)
Age between 21-30	-0.190**	0.126	0.057	-0.175***	0.119	0.059
	(0.078)	(0.08)	(0.047)	(0.073)	(0.079)	(0.048)
Age between 31-40	-0.130***	0.091*	0.031*	-0.122***	0.088**	0.034*
	(0.042)	(0.037)	(0.018)	(0.041)	(0.037)	(0.019)
Age between 41-50	-0.106***	0.086***	0.015	-0.099***	0.082***	0.016
	(0.035)	(0.032)	(0.014)	(0.034)	(0.031)	(0.015)
Primary school	-0.056	0.046	0.009	-0.054	0.045	0.008
	(0.037)	(0.031)	(0.014)	(0.035)	(0.031)	(0.014)
Mid school	-0.147***	0.107***	0.031*	-0.147***	0.108***	0.03*
	(0.034)	(0.028)	(0.018)	(0.033)	(0.027)	(0.018)
High school	-0.370***	0.255***	0.103**	-0.360***	0.249***	0.100***
	(0.064)	(0.051)	(0.042)	(0.061)	(0.048)	(0.039)
College or higher	-0.522**	0.485**	0.019	-0.496**	0.457**	0.012
	(0.215)	(0.21)	(0.052)	(0.179)	(0.188)	(0.053)
Number of children	0.022	0.005	-0.020**	0.016	0.011	-0.023**
	(0.031)	(0.029)	(0.01)	(0.03)	(0.029)	(0.01)
Hhld female labour	0.021	-0.039**	0.011**	0.024	-0.040**	0.012**
	(0.019)	(0.018)	(0.005)	(0.02)	(0.018)	(0.005)
Hhld male labour	-0.003	-0.018	0.014***	-0.002	-0.019	0.017***
	(0.015)	(0.015)	(0.005)	(0.015)	(0.016)	(0.006)
Hhld entitled land	0.010***	-0.007**	-0.002***	0.007**	-0.005*	-0.002***
	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)
Having CCP member	0.015	0.001	-0.012	0.018	-0.002	-0.014*
	(0.023)	(0.021)	(0.008)	(0.023)	(0.022)	(0.008)
Village enterprises	-0.005***	0.005***	0.0003	-0.006***	0.005***	0.0002
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Distance to city	-0.005	0.001	0.001	-0.006	0.003	0.0004
	(0.011)	(0.009)	(0.002)	(0.011)	(0.009)	(0.002)
Wage of nearest city	-0.017***	0.018***	-0.002*	-0.018***	0.020***	-0.003**
	(0.005)	(0.004)	(0.001)	(0.005)	(0.004)	(0.001)
Interaction term of distance and wage	-0.0001	0.00001	0.0001	0.00001	-0.0001	0.0002
	(0.0004)	(0.0004)	(0.0001)	(0.0005)	(0.0005)	(0.0001)
Year 2007	0.099***	-0.109***	0.012	0.100***	-0.114***	0.013
	(0.028)	(0.03)	(0.01)	(0.03)	(0.031)	(0.011)
Obs.	1787	1787	1787	1787	1787	1787
Pseudo-R2	0.138	0.127	0.127	0.133	0.123	0.127

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table B-3. Marginal effects of Logit &Probit models for youngest child

	Pooled Logit Model			Pooled Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.067***	0.009	0.057*	-0.069***	0.011	0.055*
	(0.022)	(0.022)	(0.031)	(0.023)	(0.023)	(0.03)
Age between 16-20	0.012	-0.248***	0.403**	0.02	-0.264***	0.419**
	(0.15)	(0.072)	(0.16)	(0.174)	(0.082)	(0.162)
Age between 21-30	0.01	-0.277**	0.411*	0.018	-0.292**	0.422*
	(0.145)	(0.127)	(0.215)	(0.166)	(0.145)	(0.216)
Age between 31-40	0.007	-0.134	0.268	0.015	-0.15*	0.281
	(0.152)	(0.061)	(0.167)	(0.176)	(0.077)	(0.173)
Age between 41-50	0.201	-0.085	-0.098	0.218	-0.095	-0.041
	(0.274)	(0.068)	(0.364)	(0.275)	(0.086)	(0.325)
Primary school	-0.071**	0.099	0.07	-0.082**	0.099	0.068
	(0.028)	(0.074)	(0.062)	(0.033)	(0.069)	(0.062)
Mid school	-0.187***	0.130**	0.160***	-0.204***	0.135**	0.156***
	(0.038)	(0.057)	(0.059)	(0.041)	(0.054)	(0.058)
High school	-0.156***	0.072	0.245***	-0.173***	0.074	0.247***
	(0.021)	(0.077)	(0.052)	(0.022)	(0.072)	(0.054)
College or higher	-0.179***	0.021	0.307***	-0.188***	0.03	0.314***
	(0.015)	(0.087)	(0.044)	(0.015)	(0.088)	(0.046)
Number of children	0.016	0.067***	-0.104***	0.014	0.070***	-0.104***
	(0.022)	(0.024)	(0.039)	(0.023)	(0.025)	(0.038)
Hhld female labour	-0.060***	-0.02	0.097***	-0.064***	-0.023	0.094***
	(0.02)	(0.017)	(0.027)	(0.02)	(0.018)	(0.026)
Hhld male labour	0.035*	-0.039*	0.003	0.038*	-0.038*	0.002
	(0.02)	(0.02)	(0.029)	(0.021)	(0.02)	(0.029)
Hhld entitled land	0.003***	-0.003	-0.002	0.004***	-0.003	-0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Having CCP member	-0.026	0.031	0.002	-0.027	0.028	0.004
	(0.023)	(0.029)	(0.035)	(0.025)	(0.03)	(0.034)
Village enterprises	0.0001	0.004***	-0.007**	0.0001	0.005***	-0.007**
	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.003)
Distance to city	-0.003	0.012	-0.017	-0.003	0.012	-0.016
	(0.008)	(0.01)	(0.013)	(0.009)	(0.01)	(0.013)
Wage of nearest city	-0.006	0.022***	-0.026***	-0.006	0.023***	-0.025***
	(0.005)	(0.004)	(0.007)	(0.005)	(0.005)	(0.007)
Interaction term of distance and wage	0.0004	-0.001	0.001	0.00036	-0.0009	0.00106
	(0.0005)	(0.0006)	(0.0009)	(0.00051)	(0.00063)	(0.00078)
Year 2007	0.018	-0.138***	0.145***	0.017	-0.140***	0.141***
	(0.031)	(0.038)	(0.048)	(0.032)	(0.038)	(0.047)
Obs.	1185	1185	1185	1185	1185	1185
Pseudo-R2	0.119	0.128	0.098	0.118	0.126	0.097

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.

Table B-4. Regression results for all working-age household members

	Pooled Linear Probability Model[a]			Fixed Effects Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.196***	0.102***	0.114***			
	(0.017)	(0.018)	(0.021)			
Age between 16-20	-0.464***	-0.124***	0.543***	-0.100	-0.187*	0.302***
	(0.025)	(0.022)	(0.032)	(0.096)	(0.101)	(0.093)
Age between 21-30	-0.410***	-0.042*	0.436***	-0.040	-0.113	0.132*
	(0.024)	(0.021)	(0.026)	(0.080)	(0.086)	(0.076)
Age between 31-40	-0.300***	0.080***	0.219***	-0.103*	0.031	0.053
	(0.027)	(0.021)	(0.03)	(0.053)	(0.063)	(0.044)
Age between 41-50	-0.147***	0.089***	0.059***	-0.086**	0.057*	0.028
	(0.021)	(0.021)	(0.016)	(0.038)	(0.034)	(0.025)
Primary school	-0.085***	0.074***	0.011			
	(0.019)	(0.017)	(0.014)			
Mid school	-0.176***	0.123***	0.045**			
	(0.023)	(0.017)	(0.018)			
High school	-0.255***	0.132***	0.124***			
	(0.028)	(0.029)	(0.026)			
College or higher	-0.346***	0.080	0.224***			
	(0.029)	(0.051)	(0.05)			
Number of children	0.025*	0.025	-0.045**	0.018	0.027	-0.042**
	(0.015)	(0.016)	(0.018)	(0.020)	(0.020)	(0.019)
Hhld female labour	-0.042***	-0.017	0.052***	0.035*	-0.015	-0.005
	(0.009)	(0.011)	(0.009)	(0.018)	(0.015)	(0.014)
Hhld male labour	-0.006	-0.026**	0.033***	-0.008	-0.006	-0.003
	(0.009)	(0.012)	(0.010)	(0.026)	(0.027)	(0.02)
Hhld entitled land	0.007***	-0.004*	-0.003***	0.002	0.0002	-0.002
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Having CCP member	-0.037**	0.013	0.024	-0.019	0.0001	0.020
	(0.014)	(0.02)	(0.019)	(0.04)	(0.056)	(0.034)
Village enterprises	-0.004***	0.008***	-0.004***	-0.002	0.003	-0.003*
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Distance to city	-0.005	0.006	-0.001			
	(0.009)	(0.008)	(0.007)			
Wage of nearest city	-0.013***	0.023***	-0.009**	-0.004***	-0.003**	0.004***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.001)
Interaction term of distance and wage	0.0004	-0.0005	0.0003			
	(0.0005)	(0.0004)	(0.0004)			
Year 2007	0.041	-0.150***	0.083***			
	(0.0281)	(0.027)	(0.022)			
Obs.	5934	5934	5934	3196	3196	3196
Pseudo-R2	0.293	0.132	0.281	0.012	0.012	0.017

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.

[a] the repeated individual observations in 2007 have been excluded.

Table B-5. Marginal effects of Multinomial Logit & Probit models for head

	Pooled M. Logit Model			Pooled M. Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.201***	0.075	0.127***	-0.204***	0.068	0.136***
	(0.071)	(0.071)	(0.018)	(0.068)	(0.068)	(0.016)
Age between 21-30	-0.322***	0.138*	0.184***	-0.323***	0.151**	0.172***
	(0.035)	(0.076)	(0.066)	(0.036)	(0.073)	(0.061)
Age between 31-40	-0.349***	0.134***	0.215***	-0.347***	0.137***	0.210***
	(0.029)	(0.043)	(0.041)	(0.03)	(0.041)	(0.037)
Age between 41-50	-0.229***	0.106***	0.123***	-0.225***	0.105***	0.121***
	(0.028)	(0.033)	(0.027)	(0.028)	(0.032)	(0.026)
Primary school	-0.151***	0.152***	-0.001	-0.145***	0.145***	0.0003
	(0.038)	(0.04)	(0.025)	(0.037)	(0.037)	(0.026)
Mid school	-0.186***	0.183***	0.004	-0.18***	0.173***	0.007
	(0.038)	(0.039)	(0.026)	(0.038)	(0.036)	(0.027)
High school	-0.244***	0.247***	-0.003	-0.241***	0.238***	0.003
	(0.047)	(0.057)	(0.036)	(0.047)	(0.055)	(0.038)
College or higher	-0.434***	0.272*	0.163	-0.426***	0.243*	0.183
	(0.04)	(0.155)	(0.159)	(0.047)	(0.148)	(0.158)
Number of children	-0.006	-0.002	0.007	-0.008	-0.001	0.009
	(0.026)	(0.027)	(0.02)	(0.025)	(0.026)	(0.021)
Hhld female labour	-0.007	0.004	0.003	-0.004	0.003	0.001
	(0.019)	(0.018)	(0.012)	(0.019)	(0.018)	(0.013)
Hhld male labour	-0.019	0.003	0.015	-0.019	0.004	0.015
	(0.021)	(0.023)	(0.014)	(0.019)	(0.022)	(0.015)
Hhld entitled land	0.011***	-0.008**	-0.003**	0.010***	-0.007**	-0.003**
	(0.004)	(0.004)	(0.001)	(0.004)	(0.003)	(0.001)
Having CCP member	-0.018	-0.003	0.020	-0.022	-0.004	0.026
	(0.053)	(0.049)	(0.035)	(0.051)	(0.046)	(0.037)
Village enterprises	-0.003	0.011**	-0.009*	-0.003	0.011**	-0.008*
	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Distance to city	-0.009	0.005	0.004	-0.010	0.005	0.005
	(0.014)	(0.013)	(0.005)	(0.014)	(0.013)	(0.005)
Wage of nearest city	-0.024***	0.026***	-0.003	-0.023***	0.025***	-0.003
	(0.007)	(0.007)	(0.004)	(0.007)	(0.007)	(0.005)
Interaction term of	0.001	-0.001	0.0002	0.001	-0.001	0.0002
distance and wage	(0.001)	(0.001)	(0.0003)	(0.001)	(0.001)	(0.0003)
Year 2007	0.122***	-0.194***	0.072***	0.114***	-0.191***	0.077***
	(0.044)	(0.04)	(0.023)	(0.044)	(0.04)	(0.024)
Obs.	1882	1882	1882	1882	1882	1882

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table B-6. Marginal effects of Multinomial Logit & Probit models for head's spouse

	Pooled M. Logit Model			Pooled M. Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.267***	0.126*	0.141**	-0.288***	0.133**	0.155***
	(0.093)	(0.067)	(0.059)	(0.087)	(0.062)	(0.06)
Age between 21-30	-0.188**	0.126	0.062	-0.175**	0.114	0.062
	(0.075)	(0.08)	(0.05)	(0.071)	(0.08)	(0.05)
Age between 31-40	-0.127***	0.093**	0.034*	-0.123***	0.087**	0.037*
	(0.041)	(0.038)	(0.019)	(0.041)	(0.037)	(0.02)
Age between 41-50	-0.105***	0.088**	0.017	-0.101***	0.083***	0.018
	(0.034)	(0.033)	(0.015)	(0.033)	(0.032)	(0.016)
Primary school	-0.054	0.045	0.008	-0.052	0.046	0.006
	(0.036)	(0.032)	(0.015)	(0.035)	(0.031)	(0.015)
Mid school	-0.141***	0.110***	0.031*	-0.141***	0.111***	0.030*
	(0.034)	(0.028)	(0.018)	(0.032)	(0.027)	(0.018)
High school	-0.360***	0.259***	0.101**	-0.353***	0.255***	0.098***
	(0.065)	(0.05)	(0.041)	(0.062)	(0.047)	(0.038)
College or higher	-0.538***	0.508**	0.030	-0.505***	0.480***	0.025
	(0.202)	(0.208)	(0.068)	(0.174)	(0.182)	(0.067)
Number of children	0.018	0.003	-0.021*	0.014	0.011	-0.025**
	(0.031)	(0.03)	(0.01)	(0.03)	(0.029)	(0.01)
Hhld female labour	0.027	-0.037**	0.011**	0.026	-0.039**	0.013**
	(0.019)	(0.019)	(0.005)	(0.019)	(0.018)	(0.006)
Hhld male labour	0.002	-0.017	0.015***	0.001	-0.019	0.018***
	(0.015)	(0.015)	(0.005)	(0.015)	(0.016)	(0.006)
Hhld entitled land	0.009***	-0.008**	-0.002***	0.007**	-0.005*	-0.002***
	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)
Having CCP member	0.014	-0.001	-0.013	0.018	-0.004	-0.014
	(0.022)	(0.021)	(0.008)	(0.023)	(0.022)	(0.009)
Village enterprises	-0.005***	0.005***	0.000	-0.006***	0.005***	0.0002
	(0.001)	(0.002)	(0)	(0.002)	(0.002)	(0.0005)
Distance to city	-0.003	0.002	0.001	-0.005	0.004	0.0005
	(0.011)	(0.01)	(0.002)	(0.011)	(0.01)	(0.002)
Wage of nearest city	-0.016***	0.018***	-0.002	-0.017***	0.020***	-0.003*
	(0.004)	(0.004)	(0.001)	(0.005)	(0.004)	(0.001)
Interaction term of	0.0001	0.00003	0.0001	0.00002	0.0001	0.0002
distance and wage	(0.0005)	(0.0005)	(0.0001)	(0.0005)	(0.0005)	(0.0001)
Year 2007	0.100***	-0.110***	0.010	0.102***	-0.114***	0.012
	(0.027)	(0.029)	(0.01)	(0.029)	(0.031)	(0.012)
Obs.	1787	1787	1787	1787	1787	1787

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.
The dummy of "Age between 16-20" is omitted, as there is no observation with age between 16-20.

Table B-7. Marginal effects of Multinomial Logit &Probit models for youngest child

	Pooled M. Logit Model			Pooled M. Probit Model		
	Farm only	Loc. OFE	Mig. OFE	Farm only	Loc. OFE	Mig. OFE
Male	-0.069***	0.008	0.061**	-0.071***	0.012	0.059*
	(0.023)	(0.024)	(0.03)	(0.024)	(0.024)	(0.03)
Age between 16-20	-0.057	-0.278***	0.335**	-0.061	-0.294***	0.356**
	(0.125)	(0.083)	(0.16)	(0.139)	(0.088)	(0.168)
Age between 21-30	-0.041	-0.314**	0.355*	-0.039	-0.333**	0.372*
	(0.137)	(0.145)	(0.203)	(0.154)	(0.155)	(0.209)
Age between 31-40	-0.054	-0.155**	0.21	-0.054	-0.172**	0.227
	(0.13)	(0.07)	(0.164)	(0.146)	(0.079)	(0.176)
Age between 41-50	0.261	-0.06	-0.202	0.224	-0.083	-0.141
	(0.343)	(0.107)	(0.369)	(0.305)	(0.114)	(0.33)
Primary school	-0.074**	0.068	0.006	-0.086**	0.072	0.015
	(0.031)	(0.074)	(0.073)	(0.035)	(0.068)	(0.068)
Mid school	-0.192***	0.098*	0.094	-0.209***	0.108**	0.102*
	(0.039)	(0.059)	(0.062)	(0.042)	(0.055)	(0.059)
High school	-0.165***	0.015	0.151**	-0.183***	0.019	0.163**
	(0.023)	(0.069)	(0.074)	(0.024)	(0.065)	(0.069)
College or higher	-0.191***	-0.036	0.227***	-0.200***	-0.030	0.230***
	(0.016)	(0.071)	(0.073)	(0.015)	(0.071)	(0.072)
Number of children	0.021	0.073***	-0.095**	0.017	0.077***	-0.094**
	(0.024)	(0.026)	(0.037)	(0.024)	(0.027)	(0.037)
Hhld female labour	-0.068***	-0.026	0.094***	-0.067***	-0.029	0.096***
	(0.022)	(0.018)	(0.026)	(0.021)	(0.019)	(0.025)
Hhld male labour	0.036*	-0.038*	0.002	0.038*	-0.037	-0.001
	(0.022)	(0.021)	(0.028)	(0.022)	(0.021)	(0.028)
Hhld entitled land	0.004***	-0.003	-0.001	0.004***	-0.003	-0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Having CCP member	-0.027	0.03	-0.003	-0.028	0.028	-0.0003
	(0.025)	(0.03)	(0.034)	(0.027)	(0.031)	(0.034)
Village enterprises	0.001	0.004***	-0.006**	0.001	0.005***	-0.006**
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Distance to city	-0.001	0.013	-0.012	-0.001	0.013	-0.012
	(0.009)	(0.011)	(0.011)	(0.01)	(0.01)	(0.012)
Wage of nearest city	-0.004	0.024***	-0.019***	-0.004	0.024***	-0.02***
	(0.005)	(0.004)	(0.007)	(0.005)	(0.005)	(0.007)
Interaction term of distance and wage	0.0003	-0.001	0.001	0.0003	-0.001	0.001
	(0.0005)	(0.001)	(0.001)	(0.0005)	(0.001)	(0.001)
Year 2007	0.015	-0.148***	0.133***	0.014	-0.145***	0.131***
	(0.031)	(0.04)	(0.046)	(0.033)	(0.039)	(0.046)
Obs.	1185	1185	1185	1185	1185	1185

* Sig. at 10%; ** sig. at 5%; *** sig. at 1%; Robust & township-clustered S. E. in Parentheses.

APPENDIX C: PROOF OF PROPOSITIONS OF CHAPTER 4

Proof of Proposition (1):

Using (4.14) of Chapter 4, I have:

$$\left[\frac{\omega^c+\theta Z^{h'}}{p^c\alpha}\right]^{\frac{1}{1-\alpha}} = \frac{H^c\bar{A}^c}{H^c Z^{h'}\bar{L}^c}$$

Therefore $\frac{\bar{A}^c}{\bar{L}^c}[p^c\alpha]^{\frac{1}{1-\alpha}} - Z^{h'}\left[\omega^c + \theta Z^{h'}\right]^{\frac{1}{1-\alpha}} = 0$

Totally differentiating the equation I have

$$\{[\omega^c + \theta Z^{h'}]^{\frac{1}{1-\alpha}} + \theta Z^{h'}\frac{1}{1-\alpha}[\omega^c + \theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}\}dZ^{h'} + Z^{h'}\frac{1}{1-\alpha}[\omega^c + \theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}d\omega^c = 0$$

Therefore $\frac{dZ^{h'}}{d\omega^c} = -\frac{Z^{h'}\frac{1}{1-\alpha}\left[\omega^c+\theta Z^{h'}\right]^{\frac{\alpha}{1-\alpha}}}{[\omega^c+\theta Z^{h'}]^{\frac{1}{1-\alpha}}+\theta Z^{h'}\frac{1}{1-\alpha}\left[\omega^c+\theta Z^{h'}\right]^{\frac{\alpha}{1-\alpha}}}$

Given that $0 \le Z^{h'} \le 1$, $\theta > 0$, $\omega^c > 0$, and $0 < \alpha < 1$, I have $\frac{dZ^{h'}}{d\omega^c} < 0$

Further, using Eq. (4.12) of Chapter 4, I have $\frac{dGini^c}{d\omega^c} > 0$

Proof of Proposition (2):

Using (4.14) of Chapter 4, I have:

$$\left[\frac{\omega^c+\theta Z^{h'}}{p^c\alpha}\right]^{\frac{1}{1-\alpha}} = \frac{H^c\bar{A}^c}{H^c Z^{h'}\bar{L}^c}$$

Therefore $\frac{\bar{A}^c}{\bar{L}^c}[p^c\alpha]^{\frac{1}{1-\alpha}} - Z^{h'}\left[\omega^c + \theta Z^{h'}\right]^{\frac{1}{1-\alpha}} = 0$

Totally differentiating the equation I have

$$\frac{\bar{A}^c}{\bar{L}^c}\frac{\alpha}{1-\alpha}[p^c\alpha]^{\frac{\alpha}{1-\alpha}}dp^c - \{[\omega^c + \theta Z^{h'}]^{\frac{1}{1-\alpha}} + \theta Z^{h'}\frac{1}{1-\alpha}[\omega^c + \theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}\}dZ^{h'} = 0$$

Therefore $\frac{dZ^{h'}}{dp^c} = \frac{\frac{\bar{A}^c}{\bar{L}^c}\frac{\alpha}{1-\alpha}[p^c\alpha]^{\frac{\alpha}{1-\alpha}}}{[\omega^c+\theta Z^{h'}]^{\frac{1}{1-\alpha}}+\theta Z^{h'}\frac{1}{1-\alpha}[\omega^c+\theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}}$

Given that $0 \le Z^{h'} \le 1$, $\frac{\bar{A}^c}{\bar{L}^c} > 0$, $p^c > 0$, $\omega^c > 0$,$\theta > 0$, and $0 < \alpha < 1$, I have $\frac{dZ^{h'}}{dp^c} > 0$.

Further, using Eq. (4.12) of Chapter 4, I have $\frac{dGini^c}{dp^c} < 0$.

Proof of Proposition (3):

Using (4.14) of Chapter 4, I have:

$$[\frac{\omega^c+\theta Z^{h'}}{p^c\alpha}]^{\frac{1}{1-\alpha}} = \frac{H^c\bar{A}^c}{H^c Z^{h'}\bar{L}^c}$$

Therefore $\frac{\bar{A}^c}{\bar{L}^c}[p^c\alpha]^{\frac{1}{1-\alpha}} - Z^{h'}\left[\omega^c + \theta Z^{h'}\right]^{\frac{1}{1-\alpha}} = 0$

Totally differentiating the equation I have

$$[p^c\alpha]^{\frac{1}{1-\alpha}} d\frac{\bar{A}^c}{\bar{L}^c} - \{[\omega^c + \theta Z^{h'}]^{\frac{1}{1-\alpha}} + \theta Z^{h'}\frac{1}{1-\alpha}[\omega^c + \theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}\}dZ^{h'} = 0$$

Therefore $\frac{dZ^{h'}}{d\frac{\bar{A}^c}{\bar{L}^c}} = \frac{[p^c\alpha]^{\frac{1}{1-\alpha}}}{[\omega^c+\theta Z^{h'}]^{\frac{1}{1-\alpha}}+\theta Z^{h'}\frac{1}{1-\alpha}[\omega^c+\theta Z^{h'}]^{\frac{\alpha}{1-\alpha}}}$

Given that $0 \leq Z^{h'} \leq 1$, $p^c > 0$, $\omega^c > 0$,$\theta > 0$, and $0 < \alpha < 1$, I have $\frac{dZ^{h'}}{d\frac{\bar{A}^c}{\bar{L}^c}} > 0$.

Further, using Eq. (4.12) of Chapter 4, I have $\frac{dGini^c}{d\frac{\bar{A}^c}{\bar{L}^c}} < 0$.

APPENDIX D: HOUSEHOLD LAND INPUT DEMAND

As shown in the household model (Eq. 4.5 of Chapter 4), the optimal scale of land operation of a household farm operator is determined by the land rental rate in community *c*, the household off-farm labour wage, household labour endowment, and farm output price. That is, the agricultural land input demand is

$$A^{h^*} = A(p^c, r^c, \omega^c, Z^h) \tag{D.1}$$

Note that, as shown in Eq. (4.13), r^c is a function of p^c and $\frac{\bar{A}^c}{\bar{L}^c}$, with $\frac{dr^c}{d(\omega^c)} < 0$ and $\frac{dr^c}{d\left(\frac{\bar{A}^c}{\bar{L}^c}\right)}$<0.

Therefore, Eq. (4.25) can be transforms into

$$A^{h^*} = A(p^c, \omega^c, Z^h, \frac{\bar{A}^c}{\bar{L}^c}) \tag{D.2}$$

One can reach following propositions:

4. $\frac{dA^{h^*}}{d(p^c)} > 0$. The higher the agricultural output price, the higher land demand A^{h^*}.

5. $\frac{dA^{h^*}}{d(\omega^c)} = \frac{\partial A^{h^*}}{\partial(\omega^c)} + \frac{\partial A^{h^*}}{\partial r^c}\frac{dr^c}{d(\omega^c)}$ is undetermined. The household model show that $\frac{\partial A^{h^*}}{\partial(\omega^c)} < 0$, while community-level regional equilibrium model shows that $\frac{dr^c}{d(\omega^c)} < 0$, implying that $\frac{\partial A^{h^*}}{\partial r^c}\frac{dr^c}{d(\omega^c)} > 0$.

6. $\frac{dA^{h^*}}{d\left(\frac{\bar{A}^c}{\bar{L}^c}\right)} > 0$. The higher the land-to-labour ratio of the community, the lower r^c ($\frac{dr^c}{d\left(\frac{\bar{A}^c}{\bar{L}^c}\right)}$<0), and the higher A^{h^*}.

7. $\frac{dA^{h^*}}{d(Z^h)} < 0$. The higher Z^h, the lower A^{h^*}.

APPENDIX E: REGRESSION WEIGHT OF CHAPTER 4

One of the assumptions of OLS model is that each observation of dependent variable provides equally precise information. That is, it assumed that the standard deviation of the error term is constant over all observations of the dependent variable. However, in 2004, the *Gini* index is calculated through 8 household observations. In 2007, the *Gini* index is calculated through 20 household observations. More household observations are included in the computation of *Gini*, the more precise measurements of *Gini* index will be. Therefore, in a weighted OLS regression, less weight is given to the less precise measurements and more weight to more precise measurements when estimating the unknown parameters in the model. Empirically I construct the weight as

$$weight_t^c = n_t^c$$

where $weight_t^c$ =weighting factor for the community c in period t;

n_t^c =the number of valid household observations that used to construct the *Gini* index of the community c in period t.

APPENDIX F: VARIABLE SUMMARY OF CHAPTER 4

Table F-1. Variable definitions and descriptive statistics (community)

Variable	Description	Source	Mean	St. dev.
Adjusted *Gini* 2004	The adjusted *Gini* index of a community c in 2004, Using Eqs. (4.2) and (4.3)	CCAP[a]	0.260	0.113
Adjusted *Gini* 2007	*Gini* in 2007	CCAP	0.352	0.130
Change of *Gini*	Adjusted *Gini* 2004 minus *Gini* 2007		0.092	0.112
Urban wage 2004	The average annual wage in 2004 of the urban residents (with urban *Hukou*) who live in the core area of the community's nearest city, 1,000 yuan/year	CNBS (2005)	11.967	2.633
Urban wage 2007	1,000 yuan/year	CNBS (2008)	18.271	4.000
Change of wage	Urban wage 2007 minus urban wage 2004		6.305	1.728
Enterprises 2004	The number of enterprises per 1000 labourers[b] of the community in 2004, #/1000 persons	CCAP	4.774	12.474
Enterprises 2007	#/1000 persons	CCAP	5.394	14.628
Change of enterprises	Numbers of enterprises 2007 minus numbers of enterprises 2004		0.620	14.249
Community land-to-labour ratio 2004	The average agricultral land entitlement per labourerb in a community in 2004, mu/person	CCAP	3.582	3.572
Community land-to-labour ratio 2007	mu/person	CCAP	3.606	3.938
Change of land-to-labour ratio	Community land-to-labour ratio 2007 minus community land-to-labour ratio 2004		0.025	2.698
Distance to city	Distance from the community to of the nearest city,100km	Google Map (2012)	0.524	0.452

[a] CCAP rural household survey, 2005 and 2008;
[b] Community labourers consist of all residents of a rural community with local *Hukou* and age between 16 and 65.

Table F-2. Variable definitions and descriptive statistics (household)

Variable	Description	Mean	St. dev.
$Rentin_{2004}^{h}$	Rented-in land in 2004 as a share of total land operation, share	0.042	0.146
$Rentin_{2007}^{h}$	Share	0.084	0.200
Change of $Rentin_{t}^{h}$	$Rentin_{2007}^{h} - Rentin_{2004}^{h}$	0.044	0.245
$Rentout_{2004}^{h}$	Rented-out land of in 2004 as a share of total land entitlement, share	0.028	0.153
$Rentout_{2007}^{h}$	share	0.048	0.198
Change of $Rentout_{t}^{h}$	$Rentout_{2007}^{h} - Rentout_{2004}^{h}$	0.028	0.224
Local OFE experience 2004	A household has at least one member working in local OFE within last 2 years 1, otherwise 0.	0.515	0.500
Local OFE experience 2007	Dummy	0.494	0.500
Change of local OFE experience	Local OFE experience of 2007 minus local OFE experience of 2004	-0.004	0.527
Migratory OFE experience 2004	A household has at least one member working in local OFE within last 2 years 1, otherwise 0.	0.386	0.487
Migratory OFE experience 2007	Dummy	0.461	0.499
Change of migratory OFE experience	Migratory OFE experience 2007 minus migratory experience 2004	0.065	0.548
Hhld education 2004	The average years of education of household labour force members[a] in 2004, years/person	6.687	2.518
Hhld education 2007	years/person	7.102	2.450
Change of hhld education	Household education 2007 minus household education 2004	-0.322	1.563
Household land-to-labour ratio 2004	The average land entitlement per household labour force member[a], mu/person	6.654	2.512
Hhld land-to-labour ratio 2007	mu/person	7.063	2.441
Change of hhld land-to-labour ratio	Hhld land-to-labour ratio 2007 minus hhld land-to-labour ratio 2004	0.316	1.582

Data Source: CCAP rural household survey, 2005 and 2008;

[a] Household labour force member consists of every family member in a household of working age, between 16 and 65, except for those in schooling, military and prison, those who do not participate in farm production or off-farm work due to health consideration (e.g., too old and ill) and those who only do domestic work at own home.

APPENDIX G: ALTERNATIVE MODEL RESULTS OF CHAPTER 4

Table G-1. Linear probability model of household rental decision model (rented-in)

	Change-to-change model	Pooled OLS 2004 & 2007	OLS 2004	OLS 2007
Average urban wage of the nearest city, 1000¥/yr	0.00294	-0.00705	-0.00939	-0.00803
	(0.00285)	(0.00456)	(0.01036)	(0.00487)
Distance to the nearest city, 100km		0.00381	0.01053*	0.01625
		(0.03169)	(0.03634)	(0.03627)
# of enterprises per 1000 labourers of the community	0.00002	0.00039	-0.00016	0.0008
	(0.00127)	(0.00126)	(0.0013)	(0.0016)
Land-to-labour ratio of a community, mu/person	0.01875***	0.01620***	0.00284	0.02000**
	(0.00455)	(0.00563)	(0.00674)	(0.00652)
Past local OFE experience in last 2 years (dummy)	-0.01593	0.00262	0.00055	0.00578*
	(0.0168)	(0.01795)	(0.02188)	(0.02418)
Past migratory OFE experience in last 2 years (dummy)	0.00235	-0.00282	-0.02367	0.00517
	(0.02083)	(0.01905)	(0.02479)	(0.02388)
The average years of education of household labour force members	-0.00554	-0.00225	0.00104	-0.00367
	(0.00419)	(0.00285)	(0.00406)	(0.00358)
Household land-to-labour ratio	-0.01489***	-0.01580***	-0.00832*	-0.01775***
	(0.00332)	(0.0034)	(0.00407)	(0.00399)
Provincial dummy: Sichuan		-0.00187	-0.0113	-0.01056
		(0.04542)	(0.06879)	(0.05376)
Shaanxi		-0.07234	-0.07408	-0.09702
		(0.04704)	(0.06203)	(0.06089)
Jilin		-0.02778	0.05803	-0.06866
		(0.03991)	(0.06386)	(0.04382)
Hebei		-0.03121	0.03047	-0.06451
		(0.03899)	(0.05542)	(0.0432)
Year Dummy (year 2007)		0.13656***		
		(0.03565)		
Constant	0.12559**	0.22475**	0.2367	0.38978***
	(0.05976)	(0.08622)	(0.16868)	(0.12415)
Sample size	616	2638	780	1858
R square	0.028	0.036	0.027	0.031

Robust standard and township-clustered standard errors in parentheses;
* Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table G-2. Linear probability model of household rental decision model (rented-out)

	Change-to-change model	Pooled LP 2004 & 2007	LP 2004	LP 2007
Average urban wage of the nearest city, 1000¥/yr	0.00516**	0.0061	0.00576	0.00525
	(0.00227)	(0.0045)	(0.00587)	(0.00502)
Distance to the nearest city, 100km		0.05626***	0.05314**	0.05544**
		(0.02045)	(0.02477)	(0.02698)
# of enterprises per 1000 labourers of the community	0.00175***	0.00149***	0.00138	0.00156***
	(0.00043)	(0.00035)	(0.00095)	(0.0004)
Land-to-labour ratio of a community, mu/person	-0.00266	-0.00563*	-0.00173	-0.00648*
	(0.00156)	(0.00286)	(0.00239)	(0.0038)
Past local OFE experience in last 2 years (dummy)	0.02525**	0.01952	0.01972	0.02005
	(0.01103)	(0.01181)	(0.01533)	(0.01342)
Past migratory OFE experience in last 2 years (dummy)	0.00639	0.02667**	0.01009	0.03371**
	(0.01135)	(0.0107)	(0.01602)	(0.01237)
The average years of education of household labour force members	0.00328	0.00463**	0.00409*	0.00505
	(0.00265)	(0.00202)	(0.00235)	(0.00268)
Household land-to-labour ratio	0.00285	0.00179	0.00022	0.0021
	(0.00244)	(0.00144)	(0.00186)	(0.00187)
Provincial dummy: Sichuan		0.03617	0.09009	0.00784
		(0.03635)	(0.05178)	(0.03972)
Shaanxi		-0.03569	-0.00132	-0.05479
		(0.035)	(0.03836)	(0.04502)
Jilin		0.03245	0.02843	0.02711
		(0.03594)	(0.02909)	(0.04696)
Hebei		-0.00834	0.0039	-0.01914
		(0.02104)	(0.02346)	(0.02849)
Year Dummy (year 2007)		-0.01681		
		(0.03141)		
Constant	-0.07677*	-0.10919	-0.12144	-0.10243
	(0.04309)	(0.06712)	(0.0912)	(0.10798)
Sample size	1232	2638	780	1858
R square	0.040	0.047	0.049	0.048

Robust standard and township-clustered standard errors in parentheses;
* Significant at 10%; ** Significant at 5%; *** Significant at 1%.