Land Rental Market and Off-farm Employment:

Rural Households in Jiangxi Province, P.R. China

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Abstract

In rural China, agricultural production factor markets, particularly land and labour, face many institutional obstacles and remain largely underdeveloped. Further growth in agricultural productivity and rural household incomes, and thus a reduction in rural-urban income inequality are likely to depend on increases in rural land and labour productivity, and therefore require the development of land and labour markets. Previous research regarding factor market development and agricultural production in rural China has often focused on either the land or the labour market. However, the recent increases of both land rental transactions and off-farm employment suggest that households may make simultaneous decisions on land and labour market participation. Analysing these phenomena therefore requires a simultaneous approach.

This study provides a quantitative analysis of the factors determining the participation of farm households in rural land and off-farm labour markets, and the consequences of participation in these markets for allocative efficiency and agricultural productivity in Southeast China. It contributes to the previous literature by analysing the inter-relationship of household land and labour market participation, investigating the determinants of joint household land and labour market participation, examining the allocative efficiency and separability of household decision making for different land and labour market participation regimes, and exploring the implications of participation in land and labour markets for short-term land investment, input use and land productivity.

A farm household model approach is applied, using data collected from 329 rural households in three villages of Northeast Jiangxi province. The empirical analysis indicates that participation in the land rental market improves allocative efficiency and land productivity, while off-farm employment improves allocative efficiency but not land productivity. These findings suggest that reforming the household registration system and land tenure system, building local institutions, and implementing pro-poor policy interventions are likely to facilitate land rental market development, stimulate off-farm employment, thereby increasing agricultural productivity and rural household incomes and reducing rural-urban income inequality.

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CHAPTER 1   Introduction

1.1 Problem statement

Since the economic reforms of 1978, China has achieved spectacular economic growth. The annual growth rate of real GDP averaged 9.4% between 1979 and 2004. China's economic reforms started from agriculture. During the period 1979-1984, agriculture was the driving force of economic growth, showing an average annual growth of 7.1%. Even though the relative importance of agriculture in China's economy has decreased, in 2004 agriculture still contributed 15.2% to overall GDP and employed 46.9% of the total labour force. In the same year the rural population was still very high, 58.2% of the total (National Bureau of Statistics of China, 2005a).

Rural economic growth over the past 25 years was jointly driven by growth in agricultural productivity and rural industrialisation. The growth in agricultural productivity during the reform period can be attributed to a number of factors. The first is the switch from collective farming to the Household Responsibility System (HRS), which closely linked farm households' income to their own performance, and brought about a rapid growth of agricultural productivity in the early reform years (1978-84) (Fan, 1991; Lin, 1992; McMillan *et al.*, 1989). The second is the liberalisation of agricultural prices and marketing, which increased output to input price ratios and contributed to the growth in agricultural productivity (Huang *et al.*, 1999; McMillan *et al.*, 1989). The third is technological change, which further increased agricultural productivity (Fan, 1991; Fan and Pardey, 1997; Huang and Rozelle, 1996; Nyberg and Rozelle, 1999).

In 1978, agriculture employed almost the entire rural labour force. However, rising agricultural productivity decreased the demand for labour in agriculture, providing a strong incentive for rural labourers to shift to off-farm employment. In order to employ the surplus labour from agriculture and avoid migration to urban areas, the owners and managers of Township and Village Enterprises (TVEs) and local government officials were encouraged to foster rural industrialisation (Nyberg and Rozelle, 1999). Improved incentives for managers, the rise of private rural firms, and access to cheap labour stimulated a rapid growth in rural

industries between 1985 and 1995 (Nyberg and Rozelle, 1999). In 1996, TVEs absorbed 135.1 million rural labourers (19.6% of the total labour force, or 27.6% of the rural labour force), and contributed to 26% of GDP (National Bureau of Statistics of China, 2003).

The growth of TVEs, however, was not sufficient to fully employ the labour surplus from agriculture. The slower growth of TVEs in the second half of the 1990s and the increasing demand for labour in coastal regions experiencing industrial growth triggered the migration of rural labour to work in private enterprises in these regions. Of more than 200 million rural labour force members that worked off-farm, more than half had jobs in urban areas in 2000 (de Brauw *et al.*, 2002). In fact, in 2000 almost 85% of rural households had at least one member working off-farm (Zhang *et al.*, 2003).

Rapid growth in agricultural productivity and rural industry have been an important engine for China's economic growth, which have changed the face of rural China, and stimulated a dramatic increase in rural incomes and a reduction in rural poverty. In 2004, farmers' per capita net income was 367 US$, 5.9 times more than in 1978 (National Bureau of Statistics of China, 2005a). The number of rural poor fell from 250 million in 1978 to 26.1 million in 2004[1] (National Bureau of Statistics of China, 2005b). The percentage of people in rural areas that are classified as poor has fallen from more than 30% to less than 3% in just over 25 years. China has gradually embarked on a transition from a poor rural economy towards a modern society.

However, many of the conditions that facilitated earlier rural economic growth no longer apply. The institutional reforms (particularly the HRS) only provided a one-time incentive (Nyberg and Rozelle, 1999). The rate of the use of modern inputs, such as fertilisers, pesticides and herbicides, is already one of the highest in the world (OECD, 2005a). Since the mid-1990s the development of TVEs has been constrained by growing competitive pressures and financial difficulties (OECD, 2005b). Agricultural productivity and rural industrial growth have slowed dramatically in recent years[2], and rural China still faces great challenges ahead.

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[1] These figures are based on China's official poverty line, which was 83.5 US$ (1US$ =8 RMB) per capita per year in 2004 (National Bureau of Statistics of China, 2005b).

[2] Grain production has increased greatly since 2004 due to the implementation of a series of policies aimed at directly promoting grain production and raising farmers' incomes.

China is the world's largest developing economy, with a total population of 1.3 billion (2005 figures). Even though China's land area is vast, there is only 130.04 million hectares of cultivated land, accounting for 13.6% of the total land area. This provides just 0.10 hectare of cultivated land per capita (National Bureau of Statistics of China, 2005a). With only 10% of the world's cultivated land, China succeeds in feeding 21% of the world's population. According to predictions, China's population will increase to 1.6 billion by around 2035. The country therefore faces enormous challenges in sustaining growth in agricultural productivity in order to secure enough food to feed its population.

The structure of rural incomes has evolved more slowly. Although the share of agricultural income as a proportion of total income has declined, agriculture is still the main source of income for rural households, accounting for 47.6% of total income in 2004 (National Bureau of Statistics of China, 2005a). Income inequality between rural and urban areas has increased rapidly. In 2003 the urban-rural income gap showed the highest ratio (3.23:1) for 25 years (National Bureau of Statistics of China, 2005a). Increasing rural household incomes and closing the rural-urban income gap have become top priorities for the Chinese authorities.

Chinese agriculture is characterised by a scarcity of land, abundant labour and small-scale production using little mechanisation (OECD, 2005a). There are currently 250 million farm households, cultivating an average of 0.52 hectares of land (National Bureau of Statistics of China, 2005a). Future increases in agricultural productivity and rural incomes and a slowing down or reversal of the rural-urban income gap are likely to depend on increases in land and labour productivity (Nyberg and Rozelle, 1999), and therefore on the development of land and labour markets.

The development of land rental markets plays a very important role in improving agricultural productivity and rural household incomes for a number of reasons (Carter and Olinto, 1998; Carter and Yao, 1999, 2002; Deininger, 2003; Deininger and Feder, 1998; Deininger and Jin, 2002; Deininger *et al.*, 2003b; Deininger and Zegarra, 2003; Faruqee and Carey, 1997; Yao, 2003). First, a land rental market allows the marginal product of land to be equalised across farm households with different land-labour endowment ratios, thereby increasing allocative efficiency and agricultural productivity. Second, a land rental market allows households with a comparative advantage in agricultural production or off-farm

employment to specialise, hence boosting both farm production and off-farm incomes. Third, a land rental market also increases households' investment incentives, because households making such investments can reap the benefits through higher rental prices should they participate in off-farm employment in the future.

The development of off-farm employment also plays a very important role in improving agricultural productivity and rural household incomes (OECD, 2005b; Reardon *et al.*, 2001; Rozelle *et al.*, 1999b; Taylor *et al.*, 2003). First, off-farm employment can absorb surplus labour from agriculture. The remaining households can consolidate their farmland, extend the scale of farming, specialise in (labour-intensive and high-value) agricultural production, and hence increase the productivity of both land and labour. Second, off-farm employment can supplement household income and reduce poverty, increasing households' ability to invest in agricultural inputs and human capital development. This is especially the case for households facing credit or liquidity constraints. Third, off-farm employment can diversify household incomes and reduce the risks resulting from relying solely on agricultural production.

Most of the literature concerning land and labour market development and agricultural production in rural China has focused on either the land or the labour market. Empirical evidence shows that agricultural factor markets in rural China, particularly land and labour, face many institutional obstacles and remain underdeveloped (Bowlus and Sicular, 2003; Carter and Yao, 2002). Faced with land and labour market imperfections, households may make simultaneous decisions on land and labour market participation. So far as can be ascertained, there has been no research that analyses households' joint decisions on land and labour market participation, and the effect of land and labour market participation on allocative efficiency and agricultural productivity in rural China.

1.2 Objectives and research questions

The general objective of this study is to improve understanding of the factors determining the participation of farm households in rural land and off-farm labour markets, and the consequences of rural land and off-farm labour market participation on allocative efficiency and agricultural productivity in Southeast China. These insights will be used for formulating policy recommendations for increasing agricultural productivity and farmers' incomes and reducing the rural-urban income gap.

To fulfil this objective, this study uses data[3] from three villages in Northeast Jiangxi province to address the following specific questions:

1. What is the state of development of rural land rental and labour markets in Northeast Jiangxi province? How does participation in one influence the other?

2. What are the most important factors determining differences in decision making regarding joint land and labour market participation by rural households operating under imperfect market conditions?

3. What is the effect of joint land and labour market participation on the allocative efficiency and (non-)separability of household decision making?

4. What are the effects of land rental market participation, and the resulting alternative land tenure contracts, and off-farm labour market participation on agricultural production?

1.3 Analytical framework

These four specific research questions will be addressed within the analytical framework shown in Figure 1.1. This figure provides a schematic representation of the major relationships between the determinants of land and labour market participation and the consequences for allocative efficiency and agricultural productivity.

1.3.1 Do land rental market participation and off-farm employment influence each other?

Economic reforms in rural China have led to the emergence of land and labour markets. Off-farm employment has become a significant phenomenon since the mid-1980s. More than 200 million rural labourers now work off-farm (de Brauw *et al.*, 2002; Zhang *et al.*, 2002). Recent studies also show a rapid increase in land rental activities (Deininger and Jin, 2002; Kung, 2002b; Lohmar *et al.*, 2001). The fact that both the land rental market and off-farm employment have been growing in recent years suggests that the two factor markets might be closely inter-related. Therefore, it is important to investigate how participation in one market influences the other.

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[3] For details of the data, see Chapter 2.

Figure 1.1 Analytical framework
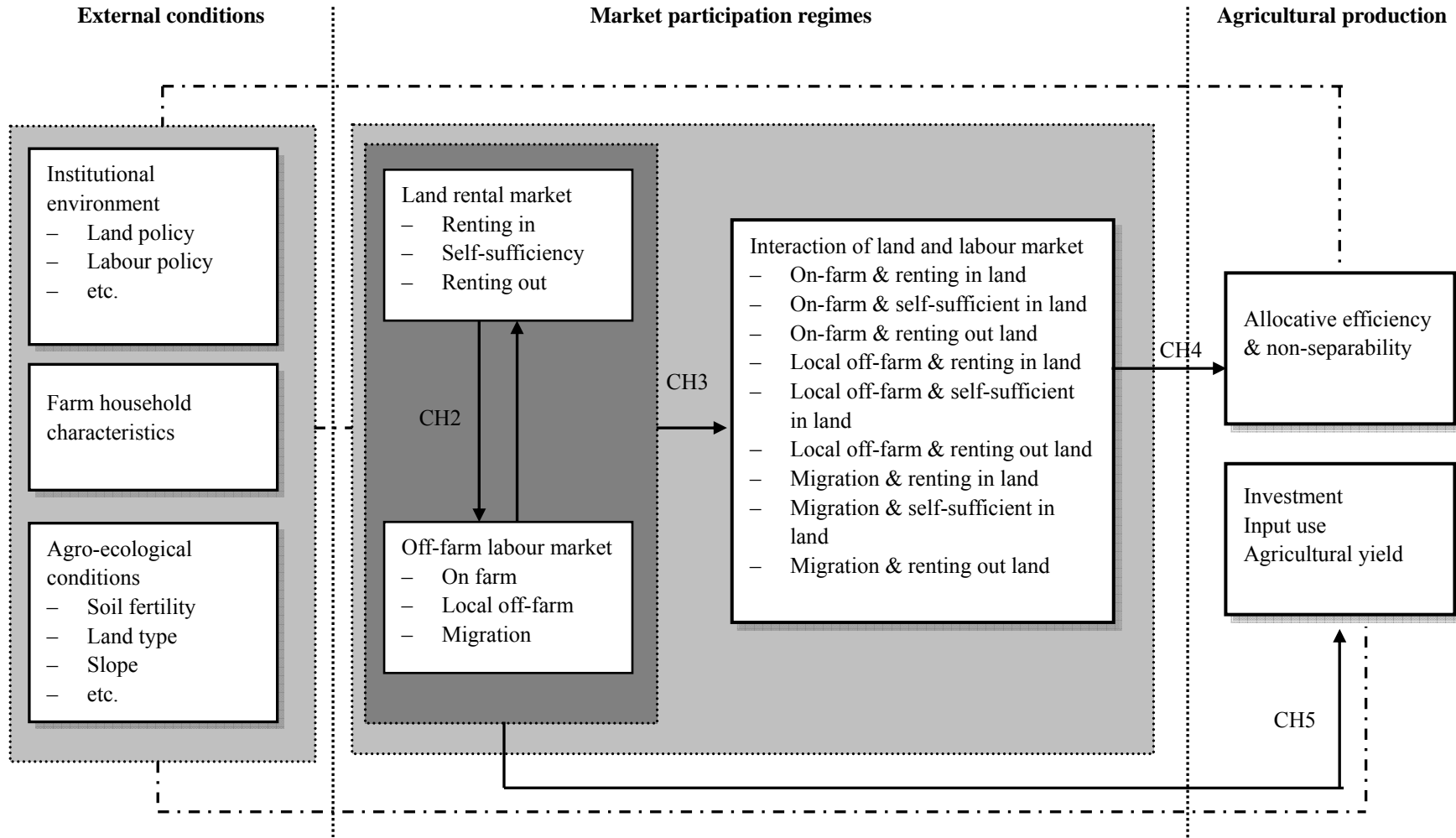
The inter-relationship between land and labour market participation has not been widely investigated. Land market participation is usually considered as an exogenous variable in studies explaining labour market participation, and the same holds for labour market participation in studies explaining land rental decisions (see Chapter 2 for details). However, land and labour market participation decisions may be mutually related where there are land and labour market imperfections. This study explicitly seeks to consider this relationship. Off-farm employment includes both local off-farm employment and migration[4]. People involved in local off-farm employment usually live at home and they normally combine local off-farm work with agricultural production. Yet, only those households that migrate tend to rent out their land. Therefore this study mainly investigates the inter-relationship between migration and land rental market participation.

1.3.2 Determinants of joint land and labour market participation

Imperfections in factor markets are a typical feature of the rural economy in many developing countries. Exchange of land and engagement in labour markets are two major decisions faced by rural households. When land and labour market imperfections exist, decisions about land and labour use are made jointly and therefore need to be analysed within a non-separability framework. Household characteristics, fixed factors and farm characteristics, household land and labour endowments, and transaction costs in land and labour markets, may therefore affect households' participation in land and labour markets.

In terms of land rental markets, this study divides households into households that rent out, those that only use their own land, and those that rent in. With respect to the labour market, households are categorised into households that are self-sufficient and those involved in off-farm employment[5]. Off-farm employment is further sub-divided into local off-farm work and migration. The reason for making this distinction is that local off-farm employment and migration may subject to different constraints and face different wages. In addition,

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[4] Migrants are family members working off-farm and not living together with other household members. Households categorised as involved in migration have at least one family member working as a migrant. Those classified as involved in local off-farm employment have no household members involved in off-farm employment working as migrants.

[5] As will be discussed in section 2.4, hiring of additional labour only takes place in peak seasons and is done in small quantities in the research area. Hiring in of labour is therefore left out of the analysis.

people involved in local off-farm employment usually live and consume at home, and they can combine local off-farm employment with working on-farm. The effects of migration and local off-farm employment on agricultural production will differ given the non-separability of household decision making. Nine typical combinations with respect to land and labour market participation can therefore be distinguished (see 'Market participation regimes' in Figure 1.1).

1.3.3 Allocative efficiency and (non-)separability under different rural land and labour regimes

According to economic theory, if households are allocatively efficient, marginal returns are equalised, and factor productivity converges across households. If households' production and consumption decisions are non-separable, they tend to be self-sufficient in agricultural production, with a tendency to overuse their resources and finally fall into the poverty trap. Therefore, it is important to examine the allocative efficiency and (non-)separability of household decision making under different rural land and labour regimes.

Imperfections in land and labour markets imply that the integration of farm households in these markets depends on their endowments and the transaction costs that they face (de Janvry and Sadoulet, 2006; Sadoulet and de Janvry, 1995). Well functioning land rental and labour markets allow the marginal products of land and labour to be equalised across farm households with different land-labour endowments and thus increase allocative efficiency.

When farm households participate in both land and labour markets, the marginal value product of land and labour are equal to the effective land rent and wage rate[6]. If there are no other market imperfections, the households are allocatively efficient, and their production and consumption decisions are separable. When farm households participate in either the land or the labour market, the marginal value product of land or labour is equal to the effective land rent or wage rate in that market. If there are no other market failures, households are also allocatively efficient, and their production and consumption decisions are separable. However if households are self-sufficient in both land and labour markets, the marginal value product of land and labour is determined by their own land and labour endowments. These households are allocatively inefficient and their production and consumption decisions are non-separable

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[6] This thesis only deals with the variable transaction costs, which are proportional to the quantity of land rented or labour hired. However, the marginal value product of land and labour can also differ from the effective land rent and wage rate (see Pender and Fafchamps (2006) for details).

(Hoff *et al.*, 1993; Sadoulet and de Janvry, 1995; Sadoulet *et al.*, 1998; Singh *et al.*, 1986).

Studies that test for separability generally apply global tests (Benjamin, 1992; Bowlus and Sicular, 2003; Gavian and Fafchamps, 1996; Jacoby, 1993; Kuiper, 2005; Sadoulet and de Janvry, 1995; Skoufias, 1994), i.e. these tests are applied to all households in the sample. However, in the context of land and labour market imperfections, a global test is considered less appropriate. The heterogeneity in endowments and transaction costs and the resulting heterogeneity in market participation regimes may have important implications for farm household behaviour and for allocative efficiency (Carter and Yao, 2002; Sadoulet *et al.*, 1998). In this study, a regime-specific test is applied based on the distinctions made in market participation regimes (see section 1.3.2).

1.3.4 Land rental market, off-farm employment and agricultural production

Land rental market participation has several effects on agricultural production. A well functioning land rental market increases aggregate agricultural production because households that rent in land have a higher marginal product from the land that they use (Deininger and Jin, 2002; Lohmar *et al.*, 2001). However, land rental activities in China are still limited, and land rental arrangements are generally informal, short term, and between households within the same village. Rented in plots are therefore subject to tenure insecurity, which may discourage land investment (e.g. use of organic manure) and reduce agricultural productivity.

Off-farm employment may affect agricultural production in many ways. The first is the lost-labour effect. Off-farm employment reduces the labour available for agricultural production, especially if hiring agricultural labour involves transaction costs and the hired labour is not as efficient as family labour. There is also an income effect: off-farm employment enables farm households to overcome credit or insurance constraints by eliminating liquidity constraints in agricultural production (Rozelle *et al.*, 1999b; Taylor *et al.*, 2003). The third is the reduced-consumption effect. If farm household production and consumption decisions are non-separable then a reduction in domestic food consumption by absent household members who are working off-farm (e.g. those who migrate) will have an impact on agricultural production decisions (Burger, 1994; Wouterse, 2006). The effects of off-farm employment on agricultural production are therefore ambiguous.

The above discussion requires a careful investigation into the effect of land and labour market participation on agricultural production, making use of a non-separable farm

household model. Again, a distinction between local off-farm employment and migration needs to be made. As mentioned, people involved in local off-farm employment usually live and consume food at home and they normally combine local off-farm work with agricultural production. Local off-farm employment may therefore only have an income effect, while migration may have all three effects.

1.4 Outline of the thesis

This study contains six chapters. Chapter 1 provides a general introduction.

Chapter 2 separately analyses factors that determine the participation of farm households in land rental markets and migration, and examines whether participation in land rental markets and off-farm employment influence each other. Both a single-equation model and a simultaneous-equation model are estimated to investigate the inter-relationship between participation in land rental markets and off-farm employment. A dataset for 278 farm households in three villages in Northeast Jiangxi province is used for estimating the model.

Chapter 3 explores the factors that influence households' joint land and labour market participation decisions, taking into account prevailing factor market imperfections. A multinomial probit model is used to examine the determinants of the different combinations of land and labour market participation that farm households can choose between, using the same dataset as in Chapter 2. The specification of the probit model is derived from a theoretical farm household model that allows for decision making on joint land and labour market participation.

Chapter 4 analyses the allocative efficiency and (non-)separability of rural household decision making, taking into account the diversity in endowments and transaction costs, and the resultant diversity in market participation regimes. A farm household model, that takes into account the existence of imperfect land and labour markets, is used to derive the testable hypotheses of land and labour regime-specific allocative efficiency and (non-)separability. An endogenous switching regression model is estimated to explain farm households' labour intensity under different land and labour market participation regimes, again using the same dataset from chapter 2.

Chapter 5 examines the effects of land rental market participation and off-farm employment on agricultural production. A plot level model is estimated to investigate the

consequences of land and labour market participation for land investment, input use and land productivity. This model is estimated with an instrumental variable technique. Data used in this chapter is from a plot-level dataset collected from a subset of the 278 farm households. In total 215 rice plots from the three villages in Northeast Jiangxi province are used for estimating the model.

Chapter 6 discusses the main findings of the previous chapters and puts the findings of this study into a policy perspective. Additionally, the innovations and shortcomings of this study are highlighted.

1.5 Relevance of the study

By investigating the factors determining the participation of farm households in rural land and off-farm labour markets, and the consequences of rural land and off-farm labour market participation for allocative efficiency and agricultural production, the present study contributes to the existing literature in a number of ways.

First, this study investigates the inter-relationship of participation in land rental markets and off-farm employment. It extends previous work about the relationship between rural land and labour market development by allowing for the endogenous decision making over land and labour market participation. In the context of land and labour market imperfections, land rental market participation and off-farm employment decisions are jointly made by rural households. Testing this inter-relationship is highly appropriate in rural China, which is generally characterised by surplus of labour and consequent underemployment and a thin land rental market (Brandt *et al.*, 2002; Brandt *et al.*, 2004).

Second, this study develops a theoretical framework to investigate the interaction of land and labour markets and to examine the determinants of joint land and labour market participation. Previous studies on the determinants of land and labour market participation in rural China have generally focused on either the land or the labour market. As pointed out previously, it is crucial to take joint land and labour market participation into account, given land and labour market imperfections. The insights gained from such an analysis may lead to conclusions and policy recommendations that differ significantly from those obtained from studies focusing on each of these two markets separately.

Third, this study analyses the allocative efficiency and (non-)separability of household

decision making for households classified according to land and labour market participation regimes. By allowing for joint consumption and production decision making, and by distinguishing households according to land and labour market participation regimes, it extends previous research by Carter and Yao (2002) on allocative efficiency and separability for different land participation regimes in China. This distinction also enables identification of the effects on allocative efficiency of both the development of land rental markets and off-farm employment.

Finally, this study examines households' agricultural production decisions, taking into account their decisions about land rental market participation and off-farm employment. Previous studies on the effect of land rental market development and off-farm employment on agricultural production in China have focused mostly on off-farm employment, but only few studies have focused on land rental market development. This study provides a comprehensive investigation into the effects of land rental market participation and off-farm employment on household land investment, input use, and land productivity.

CHAPTER 2   Do Land Rental Market Participation and Off-farm Employment Influence Each Other?[7]

2.1 Introduction

The development of land rental markets plays an important role in improving agricultural productivity and rural household incomes (Carter and Olinto, 1998; Carter and Yao, 1999, 2002; Deininger, 2003; Deininger and Feder, 1998; Deininger and Jin, 2002; Deininger *et al.*, 2003b; Deininger and Zegarra, 2003; Faruqee and Carey, 1997; Yao, 2003). It does so through several mechanisms. First, a land rental market allows the marginal product of land to be equalised across households with different land-labour endowments and thus increases allocative efficiency. Second, a land rental market allows households that have a comparative advantage in agricultural production or off-farm employment to specialise, and hence boosts both farm and off-farm incomes. Third, a land rental market increases households' investment incentives because households can reap the benefits through higher rental prices if they chose to participate in off-farm employment in the future.

The development of off-farm employment also plays an important role in improving agricultural productivity and rural household incomes (OECD, 2005b; Reardon *et al.*, 2001; Rozelle *et al.*, 1999b; Taylor *et al.*, 2003; Wouterse, 2006). First, off-farm employment can absorb surplus labour from agriculture. Households remaining in agriculture can consolidate farmland, extend farming operations, and specialise in (labour-intensive and high-value) agricultural production and hence increase both land and labour productivity. Second, off-farm employment can supplement rural household incomes and reduce poverty, thereby increasing households' investment in agricultural inputs and human capital development, especially for those households with credit or liquidity constraints. Third, off-farm employment can diversify rural household incomes and reduce the income risks of households.

The emergence of land and labour markets in China are the result of economic reforms. In the past off-farm employment was constrained by the household registration system (*hukou*)

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[7] An earlier version of this chapter has been presented at the 7th European Conference on "Agriculture and Rural Development in China (ECARDC)" held on September 8-10, 2004 in Greenwich, U.K.

and collective farming. Since the mid-1980s, however, it has become a significant phenomenon in rural China. By 2000, more than 200 million rural labourers worked off-farm (de Brauw *et al.*, 2002; Zhang *et al.*, 2002). While the land rental market was thin in the past, surveys of 215 villages in eight provinces in 1995 showed that less than 3% of total land was rented (Brandt *et al.*, 2002; Brandt *et al.*, 2004), recent studies show an increasing incidence of land rental activities (Deininger and Jin, 2002; Kung, 2002b; Lohmar *et al.*, 2001). The fact that both land rental market participation and off-farm employment have been rising in recent years suggests that these two markets might be closely inter-related.

Many studies have analysed labour migration decisions in rural China, either at the individual level (Kung and Lee, 2001; Li and Yao, 2002; Shi *et al.*, 2006; Zhang *et al.*, 2002; Zhao, 1997, 1999b, 2002, 2003), or at the farm household level (Lohmar, 1999; Rozelle *et al.*, 1999b; Taylor *et al.*, 2003; Zhao, 1999a). However, the effect of land rental market participation on migration decisions has only been examined by Kung and Lee (2001) and Shi *et al.* (2006). They find that the development of land rental markets encouraged off-farm employment, with the land market participation decision being exogenously determined in their studies.

While the development of land rental markets has recently attracted attention, empirical analyses of the factors determining land market participation in rural China are still rare (Deininger and Jin, 2002; Feng *et al.*, 2004; Kung, 2002b; Lohmar *et al.*, 2001; Yao, 2000; Zhang *et al.*, 2004). All of these studies include the effect of off-farm employment, especially migration, on land rental market participation decisions. However only a few of these studies consider the endogenous character of off-farm employment decisions (Kung, 2002b; Yao, 2000). They all find that off-farm employment has a positive effect on households' land rental market participation decisions.

However, the estimation of the inter-relationship of land and labour market participation will be biased if household decisions on land and labour market participation are jointly determined. Therefore, the effect (if any) that household decisions on land rental market participation and off-farm employment have on each other remains an unresolved issue. This chapter analyses the factors determining land rental market participation and off-farm employment, and examines empirically whether land rental market participation and off-farm employment influence each other. The insights obtained from this chapter can provide an

important input into the design of appropriate policies to improve the functioning of land and labour markets.

The remainder of this chapter is organised as follows. Section 2.2 provides a theoretical model of the determinants of households' decisions on land or labour market participation. Section 2.3 gives a brief description of the study area and data. Section 2.4 describes recent trends in land rental market development and off-farm employment in Jiangxi province. Section 2.5 discusses model specification and estimation methods. Section 2.6 presents the results of a single-equation model and a simultaneous-equation model explaining household land and labour market participation decisions. The chapter ends with conclusions and policy implications, presented in section 2.7.

2.2 Theoretical model of land and labour market participation

A theoretical model of household decision making can be developed to examine the determinants of land rental market participation and off-farm employment. Suppose the household is endowed with labour $\overline{L}$, cultivated land $\overline{A}$, household characteristics Z^h, and fixed factors Z^q. Assume that there is no agricultural labour market, that the household can allocate its labour between agricultural production l^a, off-farm employment l^o, and leisure l at a given wage w, and that the household can rent in land A^{in} and rent out land A^{out} at a given rent r. Hence, the household can have income from on-farm agricultural production, off-farm employment and land rental activities. The household chooses l^a, l^o, l, A^{in} and A^{out} to maximise utility:

$$\underset{\substack{l^a, l^o, l \\ A^{in}, A^{out}}}{Max} \quad U(y, l, Z^h) \tag{2.1}$$

Subject to:

$$y = f(l^a, A, Z^q) + wl^o - (A^{in} - A^{out})r \tag{2.2}$$

$$l^a + l^o + l = \overline{L} \tag{2.3}$$

$$A = \overline{A} + A^{in} - A^{out} \tag{2.4}$$

$$l^o \le l^o_{max}(Z) \tag{2.5}$$

$$A^{out} \le A^{out}_{max}(Z) \tag{2.6}$$

$$A^{in} \le A^{in}_{max}(Z) \tag{2.7}$$

$$l^a, l^o, l, A^{in}, A^{out} \geq 0 \tag{2.8}$$

where y is the household income. $f(l^a, A, Z^q)$ is the household agricultural production function that satisfies the standard assumptions. l^o_{max}, A^{out}_{max} and A^{in}_{max} are the institutional constraints that limit household participation in the land and labour markets, where Z are the institutional factors, such as tenure security, transfer rights and having a social network, that affect land rental market participation and off-farm employment. The price of the agricultural product is set at one; all other prices are expressed relative to this agricultural product price.

The Lagrangian of the utility maximisation problem can be formulated as:

$$\begin{aligned} L &= U[f(l^a, A, Z^q) + wl^o - (A^{in} - A^{out})r, l, Z^h] \\ &\quad + \mu^o[l^o_{max} - l^o)] + \mu^{Ain}[A^{in}_{max} - A^{in}] + \mu^{Aout}[A^{out}_{max} - A^{out}] \end{aligned} \tag{2.9}$$

where μ^o, μ^{Ain}, and μ^{Aout} are the Lagrange multipliers for the constraints on l^o, A^{in} and A^{out}.

Household optimal labour allocation can be represented by the following first-order condition (Kuhn-Tucker condition):

$$\begin{cases} \partial L / \partial l^o = U_y(-f_{l^a} + w) - \mu^o \leq 0 \\ l^o \geq 0 \quad and \quad l^{o*}(U_y(-f_{l^a} + w) - \mu^o) = 0 \end{cases} \tag{2.10}$$

where superscript * indicates the optimum level.

The first-order condition can be rearranged as (assuming an interior solution with $l^o > 0$):

$$f_{l^a} = w - \mu^o / U_y \tag{2.11}$$

Equation (2.11) shows that the marginal value product of agricultural labour is smaller than the market wage rate when the off-farm employment constraint is binding.

Household optimal land allocation can be represented by the following first-order conditions:

$$\begin{cases} \partial L / \partial A^{in} = U_y(f_A - r) - \mu^{Ain} \leq 0 \\ A^{in} \geq 0 \quad and \quad A^{in*}(U_y(f_A - r) - \mu^{Ain}) = 0 \end{cases} \tag{2.12}$$

$$\begin{cases} \partial L / \partial A^{out} = U_y(-f_A + r) - \mu^{Aout} \leq 0 \\ A^{out} \geq 0 \quad and \quad A^{out*}(U_y(-f_A + r) - \mu^{Aout}) = 0 \end{cases} \tag{2.13}$$

These first-order conditions can be rearranged as (assuming an interior solution for either

$A^{in} > 0$ or $A^{out} > 0$)[8]:

$$f_A = r + \mu^{Ain} / U_y \qquad (2.14)$$

$$f_A = r - \mu^{Aout} / U_y \qquad (2.15)$$

Equation (2.14) shows that the marginal value product of land is greater than the market land rent when the land renting in constraint is binding, and equation (2.15) states that the marginal value product of land is less than the market land rent when the land renting out constraint is binding.

Based on these first-order conditions, the reduced-form equations for land rental and off-farm labour market participation can be derived:

$$l^o = l^o(Z^h, Z^q, \overline{L}, \overline{A}, w, r, Z) \qquad (2.16)$$

$$A^{in} = A^{in}(Z^h, Z^q, \overline{L}, \overline{A}, w, r, Z) \qquad (2.17)$$

$$A^{out} = A^{out}(Z^h, Z^q, \overline{L}, \overline{A}, w, r, Z) \qquad (2.18)$$

2.3 Research area and data description

This study uses data from a farm household survey that was held in three villages in Northeast Jiangxi province[9] which is located in the Southeast of China (see Figure 2.1). Agriculture plays an important role in the economy of this province. In 2004, 20.4% of its GDP was from agriculture, 5.2% more than the average for the whole country. Its GDP per capita was 77% of the national average (National Bureau of Statistics of China, 2005a).

The villages were selected using a series of criteria including economic development level, market access and geographical conditions. Local researchers and policy makers were consulted and several site visits were made as part of this process. The three villages are considered representative of the diversity of rural conditions that can be found in Northeast Jiangxi Province and in the much larger hilly area of Southeast China with rice-based production systems (Kuiper *et al.*, 2001). The three villages selected are Banqiao in Yujiang

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[8] The non-negativity constraints for land renting in and out cannot both hold in our model, unless both variables are zero.

[9] The data were collected for a research project on economic policy reforms, agricultural incentives and soil degradation in Southeast China. This was jointly carried out by Nanjing Agricultural University, Wageningen University and the Institute of Social Studies, The Hague, and was financed by the Netherlands Ministry of Development Cooperation (SAIL programme) and the European Union (INCO-DC programme).

County, Shangzhu in Guixi City and Gangyan in Yanshan County (see Figure 2.1).

Figure 2.1 Location of Jiangxi province and the three villages

Table 2.1 shows the main characteristics of the three villages. Banqiao is the smallest village, and is located in a hilly area. Market access is good, with a major city located within 10 km. Shangzhu is a middle-sized village located in a mountainous area. The transport infrastructure is bad. It takes about two hours by car from the county capital to the hamlet where the village offices are located. Gangyan is the most populous village. It is located in a flat area, 20 km away from a major market. Road conditions are good.

Table 2.1 Summary description of the three villages

		Banqiao	**Shangzhu**	**Gangyan**
Location	Prefecture	Yingtan	Yingtan	Shangrao
	County	Yujiang	Guixi	Yanshan
	Township	Honghu	Tangwan	Wang-er
	Distance	10 km from city	Remote	20 km from city
	Road quality	Poor	Bad	Sand & tarmac
Population	People	900	2028	3200
	Households	220	472	730
	Hamlets[a]	4	16	7
Income	Net income per capita[b] (*yuan*)	1700	1600	1600
Land (*mu*)	Farmland	1700	2759	3880
	Paddy land	1234	2359	3780
	Dryland	500	400	100
	Farmland/capita	1.89	1.36	1.21
	Upland/total land	60-70%	97%	'Plain'
Agriculture	Main crops	Rice, peanut, fruit trees	Rice, bamboo, fir	Rice, vegetables
	Farm infrastructure condition	Good	Rain-fed or irrigated with conserved water	Good
	Rice yield[c] (kg/ha)	5099	3950	4629
Land tenure	Quality/distance classes[d]	4	3	3 or 4
	Allocation criterion	Family size & labour force	Family size	Family size
	Frequency of adjustment	For some hamlets: never adjusted	Small adjustments	Small: 3-5 years; large: 5-10 years (depends on hamlet)
	Collective management	-	-	Hamlet management of some forest

Note: 1 *mu*=1/15 hectare.

[a]: Administrative villages in China usually consist of several natural villages. In this study the term 'village' is used to refer to administrative villages, and the term 'hamlet' to refer to natural villages.

[b]: Net income per capita for Jiangxi province and China were 2135.3 and 2253.4 respectively in 2000 (National Bureau of Statistics of China, 2001).

[c]: Average rice yield for Jiangxi province and China were 5268 and 6272 respectively in 2000 (National Bureau of Statistics of China, 2001).

[d]: Land is divided into different classes depending on soil quality and distance from a hamlet. Each household has equal rights to each of these land classes, taking into account family size and/or number of labours in a family.

Source: Kuiper *et al.*(2001)

The farm household survey was carried out in 2000 and the beginning of 2001. The questions in the survey referred to the entire year of 2000. In each village, 23% of the households were interviewed. A stratified random sample was used for selecting the households, with the hamlets within each village forming the strata (Kuiper *et al.*, 2001). In total 329 farm households were interviewed, 54 in Banqiao, 108 in Shangzhu and 167 in

Gangyan. The information collected includes demographic characteristics, assets, land tenure, and participation in factor markets. These data provide the basis for the analysis used in this and the next two chapters.

2.4 Participation in land and labour markets in Northeast Jiangxi province

2.4.1 Land rental market

Since the introduction of the HRS at the end of the 1970s, land use rights have been assigned to farm households based on family size, labour force, or a combination of both. Land transfers were initially not allowed, because policy makers believed that land transfers will lead to a concentration of land within a few households, leaving most households landless. Instead, frequent administrative reallocations of land by village leaders have been used to correct for changes in the land-labour ratios of households caused by demographic changes. However, administrative reallocations are normally slow, involve high transaction costs, and are possibly subject to bureaucratic inefficiencies and rent-seeking behaviour (Johnson, 1995). Due to the absence of a rural social security system, rural households in China consider land as a form of social insurance. When households become involved in off-farm employment, they do not usually give up their land, giving them the option of returning to farming in case of losing their off-farm jobs. Administrative reallocation cannot replace land market transfers in solving these problems.

Since the mid-1980s, however, the authorities have permitted land rentals. An overview of land rental market participation in the three surveyed villages, sub-divided into irrigated and dryland[10], is presented in Table 2.2. Land rental activities are mostly restricted to irrigated land. Of all the households in the three villages, 46% rent in irrigated land, while only 6% rent in dryland. In Banqiao village, the village with a relative large area of dryland, 20% of the households rent additional dryland.

Large differences exist between the proportion of households that rent in land and the proportion of households that rent out land, especially for irrigated land. Of all the households in the sample, 46% rent in additional irrigated land, while only 8% rent out irrigated land. One reason for this large discrepancy may be that those farm households who rent out their land do

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[10] Forestland renting is negligible in the research area. For the sake of simplicity, it is not considered in this analysis.

so to more than one household at the same time. But part of the discrepancy may also be caused by the fact that some farm households who rent their land out have migrated, but still retain their land use rights, and could not be interviewed during the survey. In addition, some farm households may not report renting out because they fear losing their land in the next round of land reallocations.

Table 2.2 Land rental market in three villages in 2000

Village	No. of farm households	Percentage of households involved in:									
		Renting in		Self-sufficient		Renting Out		Renting in and out		Total	
		I	D	I	D	I	D	I	D	I	D
Banqiao	54	54	20	35	76	11	2	0	2	100	100
Shangzhu	108	48	3	46	96	6	1	0	0	100	100
Gangyan	167	41	4	48	93	8	2	2	0	100	100
Total	**329**	**46**	**6**	**45**	**91**	**8**	**2**	**1**	**0**	**100**	**100**

Note: I = Irrigated land, D = Dryland
Source: Farm household survey

A few farm households rented land in and out at the same time. Of all the farm households in the three surveyed villages, only one rented dryland in and out, while four farm households rented irrigated land in and out simultaneously.

2.4.2 Labour market

Off-farm employment

China's population recently reached 1.3 billion, with about 60% still living in rural areas. The average size of landholdings is only around 0.52 hectares per family (National Bureau of Statistics of China, 2005a), and normally cannot fully employ a family's labour force. An off-farm economy, consisting of jobs in TVEs, in urban centres and more recently private enterprises, has emerged since the early 1980s and has accelerated its growth since 1995 (de Brauw *et al.*, 2002).

Local off-farm employment and migration are the two basic off-farm employment categories. Their impact on household incomes and the village economy may differ substantially, because migrants live apart from other household members and spend a large share of their earnings outside the village. Local off-farm employment includes agricultural

wage employment, non-agricultural wage employment, and self-employment. Participation in off-farm employment in the three surveyed villages in 2000 is presented in Table 2.3. Up to 82% of farm households in the three surveyed villages participated in off-farm employment in 2000. Migration was relatively more important than local off-farm employment. Of all the households in the three villages, 21% participated in local off-farm employment and 61% in migration. This difference is mainly caused by the much higher participation in migration than in local off-farm employment in Gangyan village. As much as 73% of farm households participated in migration in Gangyan village, the village where per capita farmland resources are scarce while market access is good. The overall participation in off-farm employment is also much higher in this village (92%) than in the other two villages (70% and 73%) due to the relatively high migration rate.

Table 2.3 Participation in off-farm employment in three villages in 2000

Village	No. of farm households	Percentage of households participating in:		
		Off-farm employment	Local off-farm	Migration
Banqiao	54	70	27	43
Shangzhu	108	73	21	52
Gangyan	167	92	19	73
Total	**329**	**82**	**21**	**61**

Source: Farm household survey

Agricultural labour demand

Despite the surplus of rural labour, agricultural labour markets can be found in rural China. They provide mechanisms for labour-constrained farm households to deal with labour shortages, especially during peak agricultural seasons. A distinction can be made between agricultural wage labour and exchange labour. Exchange labour mainly takes place among relatives and friends, and does not involve payment. Rural labour demand for rice production, the most important crop, in the three surveyed villages is shown in Table 2.4. Exchange labour is relatively important in these villages. Only 22% of the farm households hired additional labour, while 40% of the farm households used exchange labour in rice production. Both the hiring of agricultural labour and exchange of labour are highest in Gangyan village, the village where migration is also the highest.

Table 2.4 Labour demand for rice production in three villages in 2000

Village	No. of farm households	Percentage of households involved in:	
		Hire	Exchange
Banqiao	54	15	26
Shangzhu	108	15	38
Gangyan	167	29	45
Total	**329**	**22**	**40**

Source: Farm household survey

Household labour demand and supply

A summary of the labour market situation of households in the surveyed villages is provided in Table 2.5. Hiring out of labour through off-farm employment without hiring in agricultural labour is the most frequent situation (63% of the farm households). Only 2% of the farm households hire additional labour for rice production without being involved in off-farm employment. Of the remaining households, 15% neither hire in nor hire out labour, while 19% of the farm households hire labour in and out in the same year. This latter finding provides support for the hypothesis that the optimal permanent labour force should normally be less than the peak labour demand and be greater than the slack labour demand (Binswanger and Rosenzweig, 1986). Gangyan village has the highest share of farm households that both hire in and out, and also has the lowest share of self-sufficient households. This is consistent with the relatively high incidence of migration and farm labour hiring in this village.

Table 2.5 Labour market participation in three villages in 2000

Village	No. of farm households	Percentage of households involved in:				
		Hiring in	Self-sufficient	Hiring out	Hiring in and out	Total
Banqiao	54	7	22	63	7	100
Shangzhu	108	3	24	61	12	100
Gangyan	167	1	7	64	28	100
Total	**329**	**2**	**15**	**63**	**19**	**100**

Source: Farm household survey

2.5 Model specification and estimation method

2.5.1 Model specification

The theoretical model in section 2.2 suggests several factors that potentially affect household participation in land rental markets and off-farm employment. The dependent variable for land rental market participation and off-farm employment can either be a dummy or a censored variable. Here a categorical variable for land rental market participation is constructed, based on household participation in different land rental market regimes. It is equal to one if the household rents out land, two if the household is autarkic, and three if the household rents in land. Two censored variables are also used to describe the amount of land the household rents in or out. The time involved in off-farm employment cannot be derived from the dataset. Therefore a dummy variable is used, which equals zero if the household does not participate in off-farm employment and equals one otherwise. So, the model of factors affecting land rental market participation and off-farm employment can be specified as:

$$R = \alpha_0 + \alpha_1 Z^h + \alpha_2 Z^q + \alpha_3 \overline{L} + \alpha_4 \overline{A} + \alpha_5 w + \alpha_6 r + \alpha_7 Z + \varepsilon \qquad (2.19)$$

$$O = \beta_0 + \beta_1 Z^h + \beta_2 Z^q + \beta_3 \overline{L} + \beta_4 \overline{A} + \beta_5 w + \beta_6 r + \beta_7 Z + \eta \qquad (2.20)$$

where:

R = categorical variable for land rental market participation (=1 if the household rents out land; =2 if the household is autarkic; =3 if the household rents in land); or land area rented in or out by the household (*mu*)

O = dummy variable for off-farm employment (=1 if there is at least one household member involved in off-farm employment)

Z^h = a vector of household characteristics

Z^q = a vector of fixed factors

$\overline{L}$ = household labour endowment

$\overline{A}$ = household land endowment (*mu*)

w = wage rate

r = land rent

Z = a vector of institutional factors affecting land rental market participation and off-farm employment

$\alpha_0, ..., \alpha_7; \beta_0, ..., \beta_7$ = unknown coefficients

ε, η = error terms with standard properties

As discussed in section 2.4, off-farm employment includes both local off-farm activities and migration. People involved in local off-farm employment live at home. They can combine local off-farm work with working on-farm due to the small sizes of landholdings and the seasonality of agricultural production. In this chapter therefore the analysis of participation in off-farm activities is limited to migration. It is expected that migration reduces renting in land, because it reduces the amount of labour available for agricultural production (Feng *et al.*, 2004; Kung, 2002b; Lohmar *et al.*, 2001; Yao, 2000; Zhang *et al.*, 2004). In the research area land rental activities are mainly restricted to irrigated land. Therefore, the analysis of land rental activities is confined to irrigated land only. Similarly, renting in land is expected to have a negative effect on migration, because renting in land reduces the labour available for off-farm employment (Kung, 2002b; Kung and Lee, 2001; Rozelle *et al.*, 1999a; Shi *et al.*, 2006). Discounting observations with missing information on some variables in the model and dropping the (few) households that both rent in and rent out land, the total number of observations used in the analysis is 278. Descriptive statistics of both dependent and explanatory variables are shown in Table 2.6.

The selected household characteristics (Z^h) are household size, number of dependents[11] in a household, ratio of female to male adults, and the number of durable assets.[12] Household characteristics have a direct effect on consumption preferences, and may have either positive or negative effects on the demand for leisure and consumption goods. It is expected that larger households and those with fewer dependents consume more food. If household decisions are non-separable, such households may increase agricultural production and therefore increase land renting in and decrease off-farm employment.

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[11] Number of dependents in a household is the number of household members under 16 and over 66 years old.

[12] Durable assets include durable goods such as televisions, fridges, radios, transportation vehicles, and so on.

Table 2.6 Descriptive statistics for variables used in the analysis

	Observation	Mean	Standard Deviation	Minimum	Maximum
Dependent variables					
Amount of land rented in (*mu*)	278	2.38	4.57	0	38
Amount of land rented out (*mu*)	278	0.17	0.83	0	8
Migration (1=yes)	278	0.59	0.49	0	1
Independent variables					
Household size (persons)	278	4.46	1.51	1	14
Number of dependents (persons)	278	1.27	1.11	0	4
Number of durable assets	278	6.39	1.84	1	11
Total number of cattle	278	0.76	0.80	0	10
Average adult age (years)	278	37.82	7.30	24.5	63
Average adult education (years)	278	4.35	1.66	0	10
Ratio of female to male adults	278	1.02	0.57	0	4
Irrigated land per adult (*mu*)	278	1.94	0.93	0.25	9
Possession land contract (1=yes)	278	0.28	0.45	0	1
Land transfer rights	278	0.58	0.13	0	1
Social network (1=yes)	278	0.32	0.47	0	1
Banqiao dummy (1=yes)	278	0.17	0.38	0	1
Shangzhu dummy (1=yes)	278	0.33	0.47	0	1

Source: Farm household survey

Fixed factors (Z^q) are represented by the number of cattle in the household at the end of the previous year, the average adult age, the average adult education, and the ratio of female to male adults. Households that use cattle in agricultural production tend to rent in more land and reduce off-farm employment, because, with the draft power that they provide, cattle are very important and have a positive impact on small-scale agricultural production. Renting in land also is expected to depend positively on average adult age and education, as households with older members and higher education have more skills and experience and are more productive in agriculture. For the same reasons average adult age and education are expected to negatively influence off-farm employment. However, education can also play a role in getting access to the limited off-farm employment opportunities. Therefore, the impact of education on off-farm employment is ambiguous. The square of the average adult age is added to the equation to capture possible life-cycle effects. Females and males may have

differences in physical strength in agricultural production. A higher ratio of female to male adults is expected to have a negative effect on renting in land, and a positive effect on off-farm employment if males are more productive in agriculture.

The household time endowment ($\bar{L}$) is determined by its labour force size and so depends on household size and the number of dependents. In addition, it may also depend on the ratio of female to male adults, as taking care of children and housework is usually a female task in Chinese society. Households with a relatively large time endowment are expected to rent in more land and be more involved in off-farm employment. The household land endowment ($\bar{A}$) is represented by the irrigated land contracted per adult. Households with relatively more land are expected to rent in less land and participate less in off-farm employment. The square of this variable is added to the equation to capture possible nonlinearities in its impact.

Institutional factors affecting land rental market participation and off-farm employment (Z) are represented by tenure security, transfer rights, and the presence of a social network. As mentioned earlier, China has implemented a fundamentally new land tenure system since the end of the 1970s. Farmland in China is legally owned by the village collective (the hamlet). Initially, the village collective (the hamlet) distributed land use rights equally to individual households for a period of 15 years. In 1993, Chinese authority adopted a new policy, allowing land use rights to be extended for another 30 years. On January 1, 1999, Chinese authority implemented the amended Land Administration Law (LAL). To guarantee long-term tenure security and encourage land attached investment, the amended LAL regulates that the village collective (or the hamlet) should sign written land contracts with individual households and the duration of the land contract should be 30 years. The written contract should include the rights and responsibilities of both parties. Both parties' rights to the contracted land are protected by the amended LAL. Even though Chinese authority has implemented uniform land laws and policies, different village collectives (hamlets) have their own land institutions, such as different rules in land distribution, land adjustment, and land transfer (see details in Table 2.1), different time in implementing land laws and policies, different durations of land contracts, etc. The survey used for this study asked households whether they possess a land contract, which is taken as an indicator for tenure security. Tenure security is expected to stimulate land market participation (Kung, 2002b; Lohmar, 1999;

Lohmar *et al.*, 2001). Secure tenure is also acknowledged as a major incentive to improve land attached investment (Besley, 1995). Households with secure tenure may therefore spend more time on agriculture and have less labour available for migration. In the survey, households were also asked whether they have the right to transfer land within the village, the right to transfer outside the village, inheritance rights, and mortgage rights. The information is used to derive a land transfer right indicator, defined as the number of transfer rights enjoyed by the household, divided by four. The land transfer right indicator is expected to encourage land rental market participation (Li and Yao, 2002). Land transfer rights may also promote land attached investment (Carter and Yao, 1999), and therefore reduce migration, because households with more transfer rights are more likely to recoup the value of land investment if they should exit farming.

Another institutional factor affecting land rental market participation and off-farm employment is the presence of a social network. Presence of a social network may play an important role in participating in the land rental market and obtaining off-farm employment. A dummy variable is defined that equals one if the household receives remittances from family members who are living apart from the household or if the household had participated in migration before the survey year. Having a social network (previous migration experience may indicate experience in land rental transactions) may reduce transaction costs of finding partners in land rental agreements and of monitoring and enforcing these agreements and therefore is expected to encourage land rental market participation. Existence of a social network may help the household find job information and initial accommodation in the migration destination and therefore will positively affect off-farm employment (Kung and Lee, 2001; Zhang and Li, 2003; Zhao, 2003).

Finally, the land rent (r) and wage rate (w) are assumed to be the same for all households living in the same village. Two dummy variables for Banqiao and Shangzhu village, reflecting these and other factors that systematically differ between the villages, are added to the model.

2.5.2 Estimation method

This chapter is concerned with exploring whether participation in land and labour markets influences each other. Land rental market participation is specified as a categorical variable and two censored variables, whereas migration is a dichotomous variable. In such a situation,

the possibilities of estimating such a relationship may include two procedures, either estimating equations (2.19) and (2.20) separately or simultaneously. By estimating equations (2.19) and (2.20) separately, it is possible to examine the predicted effects of changes in exogenous variables on both land rental market participation and migration and therefore investigate the inter-relationship between predicted changes in these endogenous variables. By estimating equations (2.19) and (2.20) as a simultaneous system using the maximum likelihood method, it is also possible to investigate the correlation between error terms in these two equations.

The focus here is given on investigating whether household decisions on renting in land and migration are inter-related given the prevalence of migration in the research area and the limited number of observations on renting out (16 households). As mentioned earlier, land rental market participation is specified based on household participation in different land rental market regimes: land renting out, autarkic, and land renting in. An endogenous switching regression model is therefore applied. An ordered probit model is firstly estimated for land rental market participation decisions. The amount of land rented in is then estimated only for the land renting in regime. Migration is specified as a dichotomous variable and estimated by the probit method. The bivariate probit method[13] is used to estimate renting in land and migration decisions as a simultaneous system.

2.6 Results for land rental market participation and migration

2.6.1 Results for land rental market participation

Table 2.7 shows the regression results for land rental market participation and migration. The results in the single-equation model column are estimated by the endogenous switching regression method[14] (amount of land rented in) and the probit method (migration). The results in the simultaneous-equation model column are estimated by the bivariate probit method.

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[13] The available statistical software packages are extremely limited in estimating equations (2.19) and (2.20) as a simultaneous system.

[14] The ordered probit regression results for land rental market participation are presented in Appendix 2.1.

Table 2.7 Regression results for land rental market participation and migration

Independent Variables	Single-Equation Model (Marginal Effects)		Simultaneous-Equation Model (Estimation Results)	
	Ln amount of land rented in[a]	Migration	Renting in land	Migration
Household size (persons)	0.02 (0.27)	0.28 (5.45)***	-0.05 (-0.62)	0.74 (5.50)***
Number of dependents (persons)	0.19 (2.35)**	-0.24 (-4.72)***	0.08 (0.70)	-0.68 (-4.88)***
Ratio of female to male adults	0.16 (1.23)	-0.04 (-0.65)	-0.16 (-1.14)	-0.09 (-0.49)
Number of durable assets	0.03 (0.78)	-0.05 (-2.09)**	0.02 (0.41)	-0.14 (-2.08)**
Total number of cattle[b]		-0.06 (-1.17)	0.30 (2.22)**	-0.14 (-1.10)
Average adult age (years)	-0.12 (-1.82)*	0.11 (2.57)***	-0.04 (-0.44)	0.29 (2.62)***
Average adult age squared	0.001 (1.92)*	-0.001 (-2.79)***	0.0001 (0.11)	-0.004 (-2.84)***
Average adult education (years)	0.05 (1.29)	0.01 (0.59)	-0.06 (-1.12)	0.04 (0.62)
Irrigated land per adult (*mu*)	-0.47 (-1.89)*	0.38 (2.15)**	-0.10 (-0.26)	1.09 (2.40)**
Irrigated land per adult squared	0.12 (2.30)**	-0.08 (-2.34)**	-0.04 (-0.59)	-0.23 (-2.53)**
Possession land contract (1=yes)	-0.06 (-0.52)	0.11 (1.12)	0.11 (0.60)	0.33 (1.24)
Land transfer rights	-0.59 (-1.35)	0.15 (0.61)	0.36 (0.62)	0.36 (0.56)
Social network (1=yes)	-0.07 (-0.46)	0.33 (3.84)***	-0.18 (-1.01)	0.95 (3.87)***
Banqiao dummy (1=yes)	-0.53 (-4.08)***	-0.28 (-2.64)***	0.35 (1.53)	-0.69 (-2.51)***
Shangzhu dummy (1=yes)	-0.37 (-2.69)***	-0.24 (-2.38)**	0.16 (0.76)	-0.57 (-2.22)**
Inverse Mill's Ratio	-0.75 (-2.20)**			
Intercept			1.52 (0.74)	-7.92 (-3.51)***
Number of observations	132	278	278	
R^2	0.30			
Pseudo R^2		0.38		
Log pseudolikelihood		-117.36	-291.51	
Correctly specified (%)		83.45		
rho			-0.34 (-3.04)***	
Wald test of rho=0			Chi2(1)=7.87, Prob>chi2=0.005	

Note: z-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are robust to heteroskedasticity. Test for multicollinearity among included variables show that the variance inflation factor (VIF) for Inverse Mill's Ratio (IMR) is 3.08. a: Skewness/Kurtosis tests for normality of error term is performed, normal distribution is accepted at 1% level, but rejected at 5% level. b: The same variables are included as much as possible in both stages to examine which variables are not significant in the second stage but are significant in the first stage. The number of cattle is selected as the identification variable.

The number of dependents in a household positively affects the amount of land rented in by the household. Households with one more dependent person tend to rent 0.19 mu more land on average. This positive sign indicates that the need to earn more income to satisfy consumption needs dominates the negative impact of lower labour availability. The average adult age shows a U-shaped relationship with the amount of land rented in by the household. This finding suggests that both young and old households tend to rent in more land. The turning point is 42 years.

Interestingly, a U-shaped relationship is found between land availability and the amount of land rented in by the household. As expected, households with low land availability tend to rent in more land. However, households with high land availability also tend to rent in more land. A possible explanation is that households with relatively large land endowments tend to specialise in agricultural production and therefore want to enlarge their farm size. The turning point is 1.94 *mu*.

2.6.2 Results for migration

Household size has a positive impact on migration, while the number of dependents in a household has a negative effect. These findings confirm the results of earlier studies, which show that larger households and households with fewer dependents tend to migrate (de Brauw *et al.*, 2002; Rozelle *et al.*, 1999a; Rozelle *et al.*, 1999b; Zhao, 1997, 1999a, 1999b, 2002, 2003). Each additional household member increases the probability to migrate by 0.28 on average, while each additional dependent reduces the probability to migrate by 0.24 on average. The number of durable assets owned by a household has a negative effect on migration, suggesting that richer households tend not to migrate. Households who own one more durable asset tend to reduce their probability to migrate by 0.05 on average. The average adult age shows an inverted U-shaped relationship with migration, supporting the findings of previous studies (Kung and Lee, 2001; Zhang *et al.*, 2002). The turning point is 38 years.

Interestingly, migration also shows an inverted U-shaped relationship with land availability per adult. So, households with both low and high land availability are more likely to stay on-farm. This result is consistent with the finding of Li and Yao (2002) that land resources in rural China not only have a wealth effect, used for financing migration, but also have a substitution effect, that holds back migration when the land rental market is imperfect.

So, households with small land endowments may not be wealthy enough to be able to migrate, while households with relatively large land endowments may have difficulties in renting out their land and therefore work on-farm instead of migrating. The turning point is 2.29 *mu*.

Institutional factors also play a role in migration. As expected, having a social network positively affects migration. Households with social network have 0.33 higher probability to migrate than households without such a network. Finally, the results for the two village dummy variables indicate that households in Banqiao and Shangzhu village are less likely to migrate than households in Gangyan village.

2.6.3 The inter-relationship between land rental market participation and migration

The discussion in the previous two sections shows that land rental market participation and migration are closely inter-related. The number of dependents in a household positively affects the amount of land rented in by the household, and negatively affects household migration decisions; the average adult age and land availability show a U-shaped relationship with the amount of land rented in by the household, and show an inverted U-shaped relationship with migration; indicating a negative relationship between the amount of land rented in and migration.

The result from the bivariate probit model (see last column in Table 2.7) further confirms a negative relationship between household land renting in and migration decisions, as the correlation coefficient between the error terms is -0.34 and significant. Therefore, if the household is more likely to rent in land, then the probability of migration is less and vice versa. This finding confirms the negative impact of migration on renting in land found by both Kung (2002b) and Yao (2000) and the negative impact of renting in land on migration found by Kung and Lee (2001) and Shi *et al.* (2006), who did not take into account the possible endogeneity of land rental market participation decisions.

2.7 Conclusions and policy implications

Economic reforms in rural China have led to the emergence of land and labour markets. Off-farm employment has become a significant phenomenon since the mid-1980s. Recent studies also show a rapid increase in land rental transactions (Deininger and Jin, 2002; Kung, 2002b; Lohmar *et al.*, 2001). The fact that both land rental market participation and off-farm employment have been rising in recent years suggests that these two markets might be closely

inter-related. This chapter examines the factors determining land rental market participation and off-farm employment, and investigates whether participation in rural land and labour markets influence each other indeed, using data from a survey among 329 farm households in three villages in Jiangxi province. Both a single-equation model and a simultaneous-equation model are estimated to examine the inter-relationship of household land and labour market participation decisions.

The empirical results show that the number of dependents in a household positively affects the amount of land rented in by the household, indicating that the need to earn more income to satisfy consumption needs dominates the negative impact of lower labour availability. The average adult age shows a U-shaped relationship with the amount of land rented in by the household, suggesting that both young and old households tend to rent in more land. Land availability shows also a U-shaped relationship with the amount of land rented in by the household, indicating that households with low land availability may tend to rent in more land to earn a living, while households with high land availability may tend to rent in more land to extend farm size and specialise in agricultural production.

The analyses also show that larger household size and fewer dependents have a positive impact on migration. The number of durable assets owned by a household has a negative effect on migration, suggesting that richer households tend not to migrate. The average adult age shows an inverted U-shaped relationship with migration, indicating that both young and old households tend to work on-farm. Land availability shows also an inverted U-shaped relationship with migration. This finding indicate that households with small land endowments may not be wealthy enough to be able to migrate, while households with relatively large land endowments may have difficulties to rent out their land in case of land rental market imperfection. Having a social network is found to have a positive effect on migration.

The empirical evidence indicates that participation in land rental market and off-farm employment do influence each other. A strong negative relationship is found between renting in land and migration. Given the prevalence of surplus labour and the great scarcity of agricultural land, this finding implies that creating more off-farm employment opportunities and improving the functioning of land rental markets are important mechanisms for increasing agricultural productivity and rural household incomes, particularly in poor areas. Policies

aimed at building local institutions (e.g. rural credit, off-farm employment information office, land transaction office, etc.) to facilitate land rental activities and improve access to off-farm employment opportunities may therefore play an important role.

Appendix 2.1 Ordered probit regression results for land rental market participation

Independent Variables	Estimation Results
Household size (persons)	-0.06 (-0.85)
Number of dependents (persons)	0.07 (0.60)
Ratio of female to male adults	-0.19 (-1.37)
Number of durable assets	0.02 (0.42)
Total number of cattle	0.39 (2.79)***
Average adult age (years)	-0.09 (-1.22)
Average adult age squared	0.001 (0.92)
Average adult education (years)	-0.01 (-0.26)
Irrigated land per adult (*mu*)	-0.38 (-1.87)*
Irrigated land per adult squared	0.02 (0.89)
Possession land contract (1=yes)	0.15 (0.81)
Land transfer rights	0.41 (0.80)
Social network (1=yes)	-0.25 (-1.51)
Banqiao dummy (1=yes)	0.39 (1.78)*
Shangzhu dummy (1=yes)	0.21 (1.05)
/cut1	-4.44 (2.41)**
/cut2	-2.63 (1.43)
Number of observations	278
Pseudo R^2	0.08
Log pseudolikelihood	-223.64
Correctly specified (%)	59.71

Note: z-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are robust to heteroskedasticity. As noted in Appendix 2.1, the first boundary "cut1" is significantly different from zero, and "cut1" is smaller than "cut2". Test for multicollinearity among included variables show that mean variance inflation factor (VIF) is equal to 1.43 and that VIF for each individual variable is lower than 10.

CHAPTER 3   Determinants of Joint Land and Labour Market Participation[15]

3.1 Introduction

Imperfections in factor markets are a typical feature of the rural economy in many developing countries. Limited access to land and labour markets or even the absence of these markets implies that rural households are unable to exchange their land and labour as much as they would like to, and have to rely to a large extent, or even fully, on their own resources. Under such circumstances, the households' shadow wage and rent become important determinants of production and consumption decisions, and these decisions are non-separable (Hoff *et al.*, 1993; Singh *et al.*, 1986).

Rural China is characterised by surplus and underemployed rural labour, while land rental markets are rather thin (Brandt *et al.*, 2002; Brandt *et al.*, 2004). Off-farm employment has become an important source of rural income since the start of the economic reforms and has accelerated since the mid-1990s (de Brauw *et al.*, 2002). There is also an increasing incidence of land rental activities in rural China (Deininger and Jin, 2002; Kung, 2002b; Lohmar *et al.*, 2001; Zhang *et al.*, 2004). However, land and labour markets are still far from perfect and exhibit high transaction costs (Benjamin and Brandt, 2002; Bowlus and Sicular, 2003; Kuiper, 2005).

Several studies analyse off-farm employment decisions in rural China either at the individual level (Kung and Lee, 2001; Li and Yao, 2002; Shi *et al.*, 2006; Zhao, 1997, 1999b, 2002, 2003) or at the farm household level (Lohmar, 1999; Rozelle *et al.*, 1999b; Taylor *et al.*, 2003; Zhao, 1999a). A few studies have investigated on-farm labour demand decisions at the household level and tested the separability between household labour demand and supply decisions (Benjamin and Brandt, 2002; Bowlus and Sicular, 2003; Kuiper, 2005). Separability was rejected in these studies. The development of land rental markets has recently attracted

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attention, but empirical analyses of land market participation decisions in rural China are still scarce (Deininger and Jin, 2002; Feng *et al.*, 2004; Kung, 2002b; Lohmar *et al.*, 2001; Yao, 2000; Zhang *et al.*, 2004).

Studies on the determinants of household land and labour market participation decisions have generally focused on either the land or the labour market. So far as can be ascertained, no studies thus far have analysed household joint decision making on land and labour market participation under market imperfections in rural China. The empirical results of Chapter 2 suggest that household land and labour market participation decisions are simultaneously made. Taking into account joint land and labour market participation is therefore crucial when there are land and labour market imperfections. The purpose of this chapter is therefore to analyse the factors influencing household joint land and labour market participation decisions in rural China taking into account prevailing factor market imperfections. The insights gained from such an analysis may lead to conclusions and policy recommendations that differ significantly from those obtained from studies focusing on each of these two markets separately.

The remainder of this chapter is structured as follows. Section 3.2 develops an analytical framework of joint land and labour market participation under market imperfections. Section 3.3 describes joint land and labour market participation in the study area. Section 3.4 discusses the model specification. Section 3.5 presents the results of a multinomial probit analysis explaining household joint land and labour market participation decisions. The chapter concludes by summarising the main findings and drawing some policy implications in section 3.6.

3.2 Analytical framework for understanding joint land and labour market participation

This section develops the analytical framework for understanding household joint land and labour market participation decisions in the presence of land and labour market imperfections. A household facing land rental and labour hiring decisions is assumed to maximise the utility:

$$\underset{\substack{A^{in},A^{out},\\ l^{h},l^{f},l^{o},l}}{Max} \quad U(y,l,Z^{h}) \tag{3.1}$$

where y is income, l is leisure, and Z^{h} are household characteristics pertaining to consumption, such as wealth; A^{in} and A^{out} are land rented in and out by the household, l^{h} is

hired on-farm labour, l^f is family labour used for on-farm production, and l^o is off-farm labour.

Utility is maximised subject to an income constraint. The household's total income is the sum of the income from agricultural production, off-farm employment, and renting out land, minus the costs for hiring in labour and renting in land:

$$y = f(l^a, A, Z^q) + w^o l^o - w^a l^h - (r + T^A)A^{in} + (r - T^A)A^{out} \tag{3.2}$$

where w^o is the off-farm wage, w^a is the on-farm wage, r is the market land rent, and T^A is the variable transaction costs involved in the land rental market (for simplicity it is assumed that variable transaction costs for land demand and supply are equal).

The price of the agricultural product is set to equal one. All other prices are expressed relative to the agricultural product price. $f(l^a, A, Z^q)$ is the agricultural production function, where l^a and A are the labour and land used in agricultural production, and Z^q are fixed factors and farm characteristics, such as cattle, skills and experience. The production function satisfies standard assumptions.

Land used in agricultural production is the sum of the household land endowment ($\overline{A}$) and land rented in, minus land rented out.

$$A = \overline{A} + A^{in} - A^{out} \tag{3.3}$$

Labour used in agricultural production is the sum of family labour for on-farm production, and labour hired in.

$$l^a = l^f + l^h \tag{3.4}$$

The household is subject to a time constraint:

$$\overline{L} = l^f + l^o + l \tag{3.5}$$

where $\overline{L}$ is the total labour endowment.

The following non-negativity constraints apply:

$$A^{in}, A^{out}, l^h, l^f, l^o, l \geq 0 \tag{3.6}$$

In order to investigate the interactions of land and labour markets, three cases are examined. First, the effect of labour market imperfections on household labour allocation decisions is analysed assuming that there is no land rental market. Second, the assumption of no land rental market is relaxed and the effect of land rental market imperfections on household land allocation decisions is examined. Third, land and labour markets are analysed

when there are imperfections in both markets.

3.2.1 Case 1: Household labour allocation decisions without land rental market

When there is no land rental market, the household's utility maximisation problem becomes:

$$\underset{l^h,l^f,l^o,l}{Max} \qquad U(y,l,Z^h) \tag{3.1'}$$

$$y = f(l^a,\overline{A},Z^q) + w^o l^o - w^a l^h \tag{3.2'}$$

$$l^a = l^f + l^h \tag{3.4}$$

$$\overline{L} = l^f + l^o + l \tag{3.5}$$

$$l^h,l^f,l^o,l \geq 0 \tag{3.6'}$$

Different sub-cases can be distinguished, depending on the functioning of the labour market.

Case 1A: Household labour allocation decisions with a perfect labour market

We start with the case of a perfect labour market. In this case, the wage rates for hiring in agricultural labour and off-farm employment are equal ($w^o = w^a = w$). Substituting (3.4) and (3.5) into (3.2'), the optimal household labour allocation can be represented by the following first-order condition:

$$f_{l^a} = w \tag{3.7}$$

i.e. the household equates the marginal product of labour in agricultural production to the market wage.

Equation (3.7) can be rewritten so that the household labour demand is expressed as a function of a set of exogenous variables, including the wage, land and other fixed factors and farm-specific characteristics:

$$l^{i*} = l^{i*}(w,\overline{A},Z^q) \tag{3.8}$$

where l^{i*} represents the demand for family labour (l^{f*}), hired labour (l^{h*}) and total on-farm labour (l^{a*}). Equation (3.8) shows that household characteristics pertaining to consumption (Z^h) do not affect household production decisions. Hence, production decisions are independent of consumption decisions.

Case 1B: Household labour allocation decisions with an imperfect labour market

Labour markets can be imperfect for several reasons (Benjamin, 1992). The main reasons are:

(1) the household may face constraints in looking for off-farm employment opportunities; (2) the household may have constraints in hiring in agricultural labour; and (3) family and hired labour may not be perfect substitutes in agricultural production. The analysis explores each of these three circumstances successively and then explores their consequences for household labour allocation decisions.

(1) Constraints in off-farm employment opportunities

The household can participate in off-farm employment and earn a wage (w^o) which is higher than the agricultural wage (w^a). In this situation, the household faces an off-farm employment constraint that prevents all of its labour from moving out of agriculture. The labour market, as a result, is assumed to be cleared by quantity rationing. Following Yao (2000), it is assumed that quantity rationing takes the form of imposing a ceiling (l^o_{max}) on the household. Therefore, the household faces an additional constraint:

$$l^o \leq l^o_{max} \tag{3.9}$$

Inserting (3.2'), (3.4), (3.5) and (3.9) into (3.1') household labour allocation decisions under the off-farm employment constraint give the following first-order conditions (assuming an interior solution):

$$l^f : f_{l^a} = w^o - \mu^o / U_y \tag{3.10}$$

$$l^h : f_{l^a} = w^a \tag{3.11}$$

In equations (3.10) and (3.11), the left-hand side is the marginal product of agricultural labour, and μ^o is the Lagrange multiplier for the constraint on l^o. Denote $w^* = w^o - \mu^o / U_y$ where w^* is only equal to w^o when the off-farm employment constraint is not binding, and is smaller than w^o when the off-farm employment constraint is binding. Substituting w^* into equation (3.10) gives:

$$f_{l^a} = w^* \tag{3.10'}$$

As mentioned previously, rural China is characterised by a surplus of rural labour. Therefore, it can be assumed that w^* is smaller than w^a for a binding household and that the household will not hire out labour.

(2) Constraints for hiring in labour

Agricultural production is characterised by seasonality, with peak and slack seasons. During the slack season, labour is underutilised. In the peak season, however, labour is scarce compared to employment opportunities. As before, it is assumed that the market for hiring in labour is cleared by quantity rationing that takes the form of imposing a ceiling (l_{max}^h) on the household:

$$l^h \leq l_{max}^h \tag{3.12}$$

Inserting (3.2'), (3.4), (3.5) and (3.12) into (3.1'), the labour allocation decisions of households faced with a hiring in constraint give us the following first-order conditions (assuming an interior solution):

$$l^f : f_{l^a} = w^o \tag{3.13}$$

$$l^h : f_{l^a} = w^a + \mu^a / U_y \tag{3.14}$$

In equation (3.13) and (3.14), the left hand side is the marginal product of agricultural labour, and μ^a is the Lagrange multiplier for the constraints on l^h. Denote $w^{*'} = w^a + \mu^a / U_y$ where $w^{*'}$ is equal to w^a when the labour hiring in constraint is not binding, and is greater than w^a when the labour hiring in constraint is binding. Substituting $w^{*'}$ into equation (3.14) gives:

$$f_{l^a} = w^{*'} \tag{3.14'}$$

It is assumed that $w^{*'}$ is greater than w^o for a binding household and that the household will not hire in labour.

(3) The different efficiency of family and hired labour

Due to the disutility of labour effort and the way labour is paid, hired labour has less incentive to work efficiently. These incentive problems lead to a high monitoring cost of hired labour. Family and hired labour are therefore not perfect substitutes. It is assumed that one unit of hired labour is perfectly substitutable to β units of family labour, with $\beta < 1$. Accordingly, equation (3.4) is replaced by (3.4'):

$$l^a = l^f + \beta l^h \tag{3.4'}$$

Inserting (3.2'), (3.4') and (3.5) into (3.1'), the household's labour allocation decisions when there is a different efficiency of family and hired labour give the following first-order

conditions (assuming an interior solution):

$$l^f : f_{l^a} = w^o \tag{3.15}$$

$$l^h : f_{l^a} = w^a / \beta \tag{3.16}$$

In equations (3.15) and (3.16), the left hand side is the marginal product of agricultural labour. Under a perfect labour market, w^o is equal to w^a. Denote $w^{*"} = w^a / \beta$ where $w^{*"}$ is equal to w^o (w^a) when hired labour is perfectly substitutable to family labour, and is greater than w^o (w^a) when hired labour is less efficient than family labour. Substituting $w^{*"}$ into equation (3.16) gives:

$$f_{l^a} = w^{*"} \tag{3.16'}$$

The first-order conditions in the case of different efficiency of family and hired labour (equations (3.15) and (3.16)) are consistent with those that exist in the case of constraints in off-farm employment opportunities (equations (3.10) and (3.11)) and those that exist in the case of constraints in hire in labour (equations (3.13) and (3.14)). In all cases, the household shadow wage does not equal to the market wage.

The first-order conditions under labour market imperfections can be rewritten as a function of the shadow wage (w^s) and a set of exogenous variables, including land and other fixed assets and farm-specific characteristics:

$$l^{i*} = l^{i*}(\overline{A}, Z^q, w^s) \tag{3.17}$$

where l^{i*} represents the demand for family labour (l^{f*}), hired labour (l^{h*}), and total on-farm labour (l^{a*}). As the shadow wage is endogenous, households' production and consumption decisions are non-separable.

Labour market imperfection in rural China is mainly characterised by a lack of off-farm employment opportunities. The shadow wage (w^s) can then be expressed as a function of the market wage (w) and the transaction costs involved in the off-farm labour market (T^L). For simplicity it is assumed that transaction costs for labour demand and supply are equal. Therefore, the household's status in the labour market can be generalised by:

$$f_{l^a} = w + T^L \qquad \text{for households that hire in labour}$$

$$w - T^L \le f_{l^a} \le w + T^L \qquad \text{for households that are self-sufficient in labour use}$$

$$f_{l^a} = w - T^L \qquad\qquad \text{for households that hire out labour}$$

As can be seen from above, the household will not hire in and hire out labour simultaneously. However, in reality some households may both hire in and hire out labour during peak agricultural seasons.

3.2.2 Case 2: Household land allocation decisions when there is a land rental market

When there is a land rental market, (3.2) and (3.3) can be inserted into (3.1) and household land allocation decisions are characterised by the following first-order conditions (assuming an interior solution):

$$f_A = r + T^A \qquad\qquad\qquad\qquad\qquad\qquad (3.18)$$

$$f_A = r - T^A \qquad\qquad\qquad\qquad\qquad\qquad (3.19)$$

If the land rental market functions perfectly, T^A is equal to zero as there are no transaction costs in the land rental market. In this case, the first-order condition is $f_A = r$, i.e. the marginal product of land is equal to the land rent.

However, when $T^A > 0$, the household faces a land rent band. The household's status in the land market is then characterised by:

$$f_A = r + T^A \qquad\qquad \text{for households that rent in land}$$

$$r - T^A \le f_A \le r + T^A \qquad\qquad \text{for self-sufficient households}$$

$$f_A = r - T^A \qquad\qquad \text{for households that rent out land}$$

As can be seen from equations (3.18) and (3.19), the household will not rent in and rent out land simultaneously. However, in reality some households do rent in and rent out simultaneously, in order to consolidate scattered plots, or to substitute low-quality for high-quality plots (or vice versa).

3.2.3 Case 3: Interactions of land and labour markets with imperfections in these markets

The above analysis identified four different alternatives under which a household can operate with respect to the labour market, namely hiring in, self-sufficiency, hiring out, and both hiring in and hiring out. Four different alternatives are also identified for households with respect to the land market, namely renting in, self-sufficiency, renting out, and both renting in and renting out. As a result, a household may participate in land and labour markets in 16 different combinations. These 16 different combinations are represented by FOC1-FOC16

(FOC stands for first-order condition) and presented in Table 3.1. They reflect the variation in transaction costs and resource endowments that underlie household's participation in land and labour markets.

Table 3.1 First-order conditions for the household's joint land and labour market participation

Land market / Labour market	Renting in	Self-sufficient	Renting out	Renting in and out
Hiring in	FOC1: $$f_A = r + T^A$$ $$f_{l^a} = w + T^L$$	FOC2: $$r - T^A \leq f_A \leq r + T^A$$ $$f_{l^a} = w + T^L$$	FOC3: $$f_A = r - T^A$$ $$f_{l^a} = w + T^L$$	FOC4: Renting in: good quality, etc. Renting out: poor quality, etc. $$f_{l^a} = w + T^L$$
Self-sufficient	FOC5: $$f_A = r + T^A$$ $$w - T^L \leq f_{l^a} \leq w + T^L$$	FOC6: $$r - T^A \leq f_A \leq r + T^A$$ $$w - T^L \leq f_{l^a} \leq w + T^L$$	FOC7: $$f_A = r - T^A$$ $$w - T^L \leq f_{l^a} \leq w + T^L$$	FOC8: Renting in: good quality, etc. Renting out: poor quality, etc. $$w - T^L \leq f_{l^a} \leq w + T^L$$
Hiring out	FOC9: $$f_A = r + T^A$$ $$f_{l^a} = w - T^L$$	FOC10: $$r - T^A \leq f_A \leq r + T^A$$ $$f_{l^a} = w - T^L$$	FOC11: $$f_A = r - T^A$$ $$f_{l^a} = w - T^L$$	FOC12: Renting in: good quality, etc. Renting out: poor quality, etc. $$f_{l^a} = w - T^L$$
Hiring in and out	FOC13: $$f_A = r + T^A$$ Hiring out: slack season Hiring in: peak season	FOC14: $$r - T^A \leq f_A \leq r + T^A$$ Hiring out: slack season Hiring in: peak season	FOC15: $$f_A = r - T^A$$ Hiring out: slack season Hiring in: peak season	FOC16: Renting in: good quality, etc. Renting out: poor quality, etc. Hiring out: slack season Hiring in: peak season

3.3 Joint land and labour market participation in Jiangxi province

Household participation in the land or the labour market was discussed in section 2.4 of this study. Household joint land and labour market participation in Jiangxi province is presented in Table 3.2. Farm households may engage in land and labour markets in 16 different combinations[16]. The two most frequent combinations in the research area are hiring out labour, combined with either renting in land (30%) or self-sufficiency in land (29%). Very few households hire in agricultural labour without being involved in off-farm employment (row 1). The share of households simultaneously involved in renting in and renting out land (column 4) is also very small. Therefore, the bottom-left corner of Table 3.2, which depicts the most frequent combinations of land and labour market participation, is the most important for the research.

Table 3.2 Percentage of households participating in land and labour market in 2000

Land rental market / Labour market	Renting in	Self-sufficient	Renting out	Rent in and out	**Total**
Hiring in	1	2	0	0	**2**
Self-sufficient	8	6	1	0	**15**
Hiring out	30	29	3	1	**63**
Hiring in and out	6	9	4	0	**19**
Total	**46**	**45**	**8**	**1**	**100**

Source: Farm household survey

3.4 Model specification

Based on the first-order conditions presented above, the reduced-form equations for land and labour market participation decisions can be derived:

$$I = I(Z^h, Z^q, \overline{L}, \overline{A}, r, T^A, w, T^L) \tag{3.20}$$

where I represents the land and labour allocation decisions on A^{in}, A^{out}, l^h, l^f, l^o, and l.

Substituting (3.20) into (3.1) gives the indirect utility function:

$$V = V(Z^h, Z^q, \overline{L}, \overline{A}, r, T^A, w, T^L) \tag{3.21}$$

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[16] The analysis here deals only with irrigated land, the most important category. Furthermore, only paid labour is considered.

As the model is non-separable, the functional form of the reduced-form equations and the indirect utility function cannot be derived analytically. To estimate the impact of the exogenous variables at the right-hand side of (3.20) on land and labour allocation decisions, it is assumed for simplicity that their relationship can be approximated by a linear function. In other words, decisions on the 16 land and labour market participation alternatives by the ith household can be represented by:

$$V_{ij} = \beta_j' x_{ij} + \varepsilon_{ij} \tag{3.22}$$

where V_{ij} is a categorical variable, which equals j if household i chooses alternative j ($j = 1,2,\cdots,16$), and x_{ij} is the set of exogenous variables listed in (3.20) for the ith household.

As in Chapter 2, the household characteristics pertaining to consumption (Z^h) are represented by the number of durable assets owned by a household, household size, number of dependents in a household, and the ratio of female to male adults. Household characteristics have a direct effect on consumption preferences; they can have either positive or negative effects on the demand for leisure and consumption goods. In the case of household size and number of dependents, it may be expected that larger households and those with fewer dependents consume more food at a given income level. If household decisions are non-separable, this will put an upward pressure on agricultural production and therefore stimulate hiring in labour and renting in land, while have a negative impact on off-farm employment and renting out land in respect of a given time endowment.

Fixed factors and farm characteristics (Z^q) are represented by the number of cattle in a household at the end of the preceding year, the average adult age, the average adult education (average years of schooling of adults), and the ratio of female to male adults. Cattle play a very important role as draft animals for small-scale households in rural China. The use of cattle has a positive impact on agricultural productivity, and hence increases both the shadow rent and the shadow wage. Therefore, land renting in and labour hiring in are expected to depend positively on the number of cattle, while land renting out and off-farm employment are expected to depend negatively on it. Average adult age and education are used as a proxy for the skills and experience of a family. A household with older members and higher education are more productive in agriculture, and as a result, has a higher shadow rent and wage. So, again it is expected that land renting in and labour hiring in depend positively on

the average adult age and education, while land renting out and off-farm employment depend negatively on them. However, education increases the probability in getting access to the limited off-farm employment opportunities. Therefore, the impact of education on off-farm employment is ambiguous. The square of the average adult age is added to the equation in order to capture possible life cycle effects. The ratio of female to male adults is used to test for differences between females and males in physical strength or other differences in productivity. If males are more productive in agriculture, then a higher value of this ratio will lead to less renting in and more renting out of land and to less hiring in of labour and greater involvement in off-farm employment.

The household time endowment ($\overline{L}$) equals household size minus the number of dependents. In addition, the household time endowment may depend on the ratio of female to male adults, as taking care of children is usually a female task in Chinese society. Households with a relatively large time endowment may face a lower shadow wage[17] and are expected to hire fewer agricultural labourers and to be more involved in off-farm employment. When the labour market is imperfect, they will face a higher shadow rent[18]. Renting in of land is expected to be higher and renting out lower.

The household land endowment ($\overline{A}$) is represented by the irrigated land contracted per

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[17] The first-order condition for labour market imperfection presented in section 3.2 can be rewritten as: $f_{l^a} = w^s$, where w^s is the shadow wage. Taking the derivative of the equation with respect to $\overline{L}$, yields: $\partial w^s / \partial \overline{L} = f_{l^a l^a} \partial l^a / \partial \overline{L}$. Because $\partial l^a / \partial \overline{L} = 1$, and it is assumed that the production function is concave, $\partial w^s / \partial \overline{L} = f_{l^a l^a} < 0$. Taking the derivative of the equation with respect to $\overline{A}$, yields: $\partial w^s / \partial \overline{A} = f_{l^a A} \partial A / \partial \overline{A}$. Because $\partial A / \partial \overline{A} = 1$, and it is assumed that the inputs in agricultural production function are complementary, $\partial w^s / \partial \overline{A} = f_{l^a A} > 0$.

[18] The first-order condition for land market imperfection presented in section 3.2 can be rewritten as: $f_A = r^s$, where r^s is the shadow rent. Taking the derivative of the equation with respect to $\overline{L}$, yields: $\partial r^s / \partial \overline{L} = f_{A l^a} \partial l^a / \partial \overline{L}$. Based on the assumptions in footnote 19, $\partial r^s / \partial \overline{L} = f_{A l^a} > 0$. Taking the derivative of the equation with respect to $\overline{A}$, yields: $\partial r^s / \partial \overline{A} = f_{AA} \partial A / \partial \overline{A}$. Based on the assumptions above, $\partial r^s / \partial \overline{A} = f_{AA} < 0$.

adult. Households with relatively more land may have a lower shadow rent[19] and are expected to rent out more land and rent in less. When land markets are imperfect, they will also face a higher shadow wage[20]. Hiring in of labour is expected to be hirer and off-farm employment lower. The square of this variable is added to the equation to capture possible nonlinearities in its impact.

A number of proxies are used for transaction costs in the land (T^A) and labour (T^L) market: tenure security, transfer rights, the presence of a social network, land endowment, and the number of durable assets in a household. As specified in Chapter 2, possession of a land contract is used to represent tenure security. Land transfer rights are represented by the number of transfer rights enjoyed by the household, divided by four. Possession of a land contract and land transfer rights are expected to reduce transaction costs and the rent band and hence increase land rental market transactions (Kung, 2002b; Li and Yao, 2002; Lohmar, 1999; Lohmar *et al.*, 2001). Possession of a land contract and land transfer rights are also expected to encourage land attached investment and therefore reduce off-farm employment (Besley, 1995; Carter and Yao, 1999).

The presence of a social network is defined in Chapter 2. The existence of such a network is expected to reduce transaction costs in land and labour market transactions (Zhang and Li, 2003; Zhao, 2003). Households with a relative abundance of land (the most productive asset) and durable assets are also expected to face fewer obstacles to land and labour market participation, as they have more resources available for paying fixed costs and for obtaining the information needed to get access to land rental market participation and off-farm employment.

The market land rent (r) and labour wage (w) are exogenous to the model and are assumed to be the same for all households living in the same village. They are therefore captured by village dummy variables.

As discussed in section 3.3, hiring of additional labour only takes place in peak seasons and is done in small quantities. Therefore hiring in of labour is left out of the analysis. Households involved in off-farm employment are sub-divided into those engaged in local off-farm employment and with migration. The reason for making this distinction is that local off-

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[19] See footnote 18.

[20] See footnote 17.

farm employment and migration may subject to different constraints and face different wages. In addition, people involved in local off-farm employment usually live and consume at home. They can combine local off-farm employment with working on-farm, whereas this is not possible for migration. So, when household decision making is non-separable, the effects of migration and local off-farm employment on agricultural production will differ. In relation to the land rental market, households are divided into those that rent out, households only using their own land, and those that rent in[21]. In total, nine combinations of land and labour market participation can be distinguished. The percentage distribution of the 329 households over these nine combinations is presented in Table 3.3.

Only a small share of households rent out land while at the same time being either self-sufficient in labour (1%) or participating in local off-farm employment (2%). These two alternatives are dropped from the analysis because the number of observations is insufficient for empirical analysis. The analysis is therefore confined to seven land and labour market participation combinations. The same dataset of 278 farm households used in the previous chapter is used in this one.

Table 3.3 Percentage distribution of joint participation in land rental market and off-farm employment in 2000

Labour market \ Land market	Renting out	Self-sufficient	Renting in	**Total**
On-farm	1	8	9	**18**
Local off-farm	2	9	11	**21**
Migration	7	29	26	**61**
Total	**9**	**45**	**46**	**100**

Note: Totals may not always add up due to rounding errors.
Source: Farm household survey

Descriptive statistics of the explanatory variables, sub-divided by household groups, are shown in Table 3.4. Households that rent in land and are not involved in off-farm employment have the most cattle (1.24), while household involved in migration and renting out land have the smallest number (0.31). Households that are self-sufficient in land and labour have the smallest average household size (3.38) as well as the largest area of contracted irrigated land

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[21] The four households that both rent in and rent out land are dropped from the analysis.

(2.61 *mu* per adult). Households involved in migration and land renting in, on the other hand, have the largest average household size (5.04) and the smallest contracted land area (1.60 *mu* per adult). Households that are self-sufficient in land and labour also have the fewest assets (5.08) and the lowest level of education (3.72 years). The ratio of female to male adults is substantially higher for households involved in migration and renting out land (1.26) than for the other six groups. A last noteworthy feature is that a far higher proportion of households in the remote village (Shangzhu) are self-sufficient in both the land and the labour market (0.63) compared to the other groups.

Table 3.4 Descriptive statistics for variables used in this analysis

	On-farm & renting in land	On-farm & self-sufficient in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land	Migration & renting in land	Migration & self-sufficient in land	Migration & renting out land	**All households**
Number of observations	29	24	34	27	69	79	16	**278**
				Mean (standard deviation)				
Household size (persons)	4.07 (1.00)	3.38 (1.31)	3.91 (1.11)	4.11 (1.19)	5.04 (1.42)	4.71 (1.74)	4.81 (1.56)	**4.46 (1.51)**
Number of dependents (persons)	1.59 (1.21)	1.21 (1.25)	1.32 (1.04)	1.70 (0.99)	1.14 (1.10)	1.03 (1.10)	1.63 (0.81)	**1.27 (1.11)**
Number of durable assets	6.07 (2.27)	5.08 (2.02)	6.76 (1.58)	7.00 (1.96)	6.62 (1.54)	6.34 (1.83)	6.38 (1.41)	**6.39 (1.84)**
Total number of cattle	1.24 (1.77)	0.67 (0.48)	0.85 (0.61)	0.56 (0.51)	0.75 (0.53)	0.72 (0.60)	0.31 (0.60)	**0.76 (0.80)**
Average adult age (years)	38.00 (8.19)	46.31 (11.25)	38.30 (8.24)	35.85 (6.31)	35.37 (4.31)	37.60 (6.00)	38.71 (4.78)	**37.82 (7.30)**
Average adult education (years)	3.79 (1.50)	3.72 (2.16)	4.17 (1.63)	4.34 (1.35)	4.61 (1.44)	4.73 (1.70)	3.75 (1.87)	**4.35 (1.66)**
Ratio of female to male adults	1.09 (0.55)	0.96 (0.44)	1.06 (0.55)	0.95 (0.31)	0.92 (0.55)	1.05 (0.62)	1.26 (0.90)	**1.02 (0.57)**
Irrigated land per adult (*mu*)	2.07 (0.86)	2.61 (1.78)	2.05 (0.68)	2.29 (1.20)	1.60 (0.64)	1.73 (0.59)	2.36 (0.84)	**1.94 (0.93)**
Possession land contract (1=yes)	0.21 (0.41)	0.29 (0.46)	0.29 (0.46)	0.26 (0.45)	0.33 (0.47)	0.29 (0.46)	0.13 (0.34)	**0.28 (0.45)**
Land transfer rights	0.57 (0.13)	0.53 (0.17)	0.60 (0.12)	0.58 (0.12)	0.59 (0.12)	0.59 (0.14)	0.58 (0.12)	**0.58 (0.13)**
Social network (1=yes)	0.17 (0.38)	0.29 (0.46)	0.15 (0.36)	0.04 (0.19)	0.39 (0.49)	0.44 (0.50)	0.50 (0.52)	**0.32 (0.47)**
Banqiao dummy (1=yes)	0.28 (0.45)	0.25 (0.44)	0.26 (0.45)	0.15 (0.36)	0.14 (0.35)	0.11 (0.32)	0.06 (0.25)	**0.17 (0.38)**
Shangzhu dummy (1=yes)	0.41 (0.50)	0.63 (0.49)	0.38 (0.49)	0.26 (0.45)	0.30 (0.46)	0.27 (0.44)	0.13 (0.34)	**0.33 (0.47)**

Source: Farm household survey

3.5 Estimation results

It is possible to use either the multinomial logit model or the multinomial probit model to estimate the model (equation 3.22). The first option is widely used because of its computational ease. However, it assumes independence of irrelevant alternatives (Judge *et al.*, 1995). The multinomial probit model does not have this limitation, and is therefore adopted in this analysis.

The analysis uses the household group that is self-sufficient in both land and labour as the base and reference point. The estimated coefficients therefore represent the effect of the explanatory variables on the probability of households choosing a particular combination of participation in the land and/or labour markets against the base situation of being self-sufficient in both markets. These results are presented in Table 3.5. The differences between the mean proportions of each regime and the mean predicted probabilities of each regime are small, indicating a good fit of the model to the data.

Household size has a positive impact on all three migration combinations, while the number of dependants in a household has a negative effect on the probability of migration combined with either land renting in or land self-sufficiency. These findings confirm the results of the previous chapter and of earlier studies that larger households and households with fewer dependents tend to migrate (de Brauw *et al.*, 2002; Rozelle *et al.*, 1999a; Rozelle *et al.*, 1999b; Zhao, 1997, 1999a, 1999b, 2002, 2003). As previously mentioned, if household decisions are non-separable, larger households and those with fewer dependents consume more food and are therefore expected to have a negative effect on off-farm employment. In terms of the model employed here it means that the time endowment effect of household size and number of dependents exceeds the food consumption effect. For local off-farm employment, however, the results indicate that the time endowment effect is counterbalanced by the food consumption effect. The fact that, contrary to migrants, people involved in local off-farm employment generally live and consume food at home seems to play an important role here. The number of durable assets has a positive effect on the probability of households being involved in local off-farm employment, but not on the probability of them being involved in migration. This suggests that richer households may have better access to local off-farm jobs than poorer ones.

Table 3.5 Multinomial probit analysis results of joint land and labour market participation

Independent variables	Coefficient (z-score)					
	On-farm & renting in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land	Migration & renting in land	Migration & self-sufficient in land	Migration & renting out land
Household size (persons)	0.04 (0.10)	0.04 (0.12)	-0.02 (-0.06)	0.80 (2.33)**	0.81 (2.34)**	0.85 (2.16)**
Number of dependents (persons)	0.19 (0.57)	-0.14 (-0.45)	0.30 (0.93)	-0.56 (-1.82)*	-0.66 (-2.23)**	-0.53 (-1.34)
Number of durable assets	0.06 (0.44)	0.28 (2.36)**	0.26 (1.92)*	0.01 (0.08)	-0.01 (-0.07)	0.08 (0.52)
Total number of cattle	0.50 (1.61)*	0.24 (0.80)	-0.43 (-1.19)	0.07 (0.23)	0.08 (0.27)	-0.93 (-2.23)**
Average adult age (years)	0.07 (0.32)	0.14 (0.66)	0.05 (0.21)	0.63 (1.97)**	0.35 (1.61)*	1.10 (3.23)***
Average adult age squared	-0.001 (-0.59)	-0.002 (-0.81)	-0.001 (-0.50)	-0.01 (-2.28)**	-0.01(-1.85)*	-0.01 (-3.45)***
Average adult education (years)	-0.20 (-1.55)	-0.13 (-0.93)	-0.14 (-1.03)	-0.12 (-0.85)	0.004 (0.03)	-0.39 (-2.58)**
Ratio of female to male adults	0.01 (0.03)	-0.003 (-0.01)	-0.60 (-1.46)	-0.47 (-1.46)	-0.10 (-0.31)	0.03 (0.08)
Irrigated land per adult (*mu*)	-0.13 (-0.16)	1.70 (1.84)*	-0.52 (-0.94)	0.80 (0.96)	2.27 (2.35)**	3.32 (2.43)**
Irrigated land per adult squared	-0.09 (-0.71)	-0.44 (-2.45)**	0.01 (0.14)	-0.30 (-2.03)**	-0.60 (-2.97)***	-0.62 (-2.74)***
Possession land contract (1=yes)	0.44 (0.88)	0.61 (1.32)	0.64 (1.24)	1.06 (2.33)**	0.79 (1.81)*	0.39 (0.63)
Land transfer rights	0.74 (0.61)	2.28 (1.81)*	1.53 (1.13)	1.73 (1.41)	1.66 (1.39)	0.44 (0.26)
Socail network (1=yes)	-0.002 (-0.00)	-0.40 (-0.84)	-1.00 (-1.68)*	0.60 (1.39)	0.69 (1.67)*	1.00 (2.08)**
Banqiao dummy	-0.36 (-0.67)	-0.54 (-1.01)	-0.96 (-1.69)*	-1.03 (-1.91)*	-1.40 (-2.62)***	-2.09 (-3.07)***
Shangzhu dummy	-0.83 (-1.42)	-0.60 (-1.05)	-1.16 (-1.94)*	-1.37 (-2.38)**	-1.51 (-2.60)***	-1.63 (-2.45)***
Intercept	0.29 (0.06)	-5.50 (-1.17)	0.74 (0.15)	-11.85 (-1.82)*	-10.08 (-2.02)**	-26.08 (-3.16)***
Share of households participating in different regimes	0.1043	0.1223	0.0971	0.2482	0.2842	0.0576
Mean predicted probability of participating in different regimes	0.1064	0.1221	0.0975	0.2449	0.2822	0.0588
Log pseudolikelihood			-364.98			
Wald chi2(90)=281.68 Prob>chi2=0.00						

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are robust to heteroskedasticity. Test for multicollinearity among included variables show that mean variance inflation factor (VIF) is equal to 1.43 and that VIF for each individual variable is lower than 10.
Base outcome is self-sufficiency in land and labour markets.

The number of cattle owned by a household positively affects the likelihood of being involved in renting in land and staying on-farm, while negatively affects the likelihood of a household having a migrated member and renting out land. The average adult age shows an inverted U-shaped relationship with the likelihood of migration. The turning point is 34 years for households that migrate and rent in land, 37 for households that migrate and are self-sufficient in land, and 39 years for households that migrate and rent out land. So, young households are relatively more likely to rent in additional land when a member migrates, while older households are more likely to rent out land when a member migrates. A possible explanation for this finding is that households involved in migration and renting in land are mainly young migrants who return home after a few years of working elsewhere and reinvest in agriculture, which is a common phenomenon in China (Hare, 1999; Zhao, 2002). The high economic and psychological costs of settlement in migration destinations are assumed to be the cause of this phenomenon. The inverted U-shape only partly supports the findings of previous studies that young farmers tend to migrate (de Brauw *et al.*, 2002; Rozelle *et al.*, 1999a; Rozelle *et al.*, 1999b; Zhao, 1997, 1999a, 1999b, 2002, 2003). Surprisingly, average adult education has a negative effect on the probability of migration and renting out land.

The size of contracted irrigated land has an effect on migration, under all three land market combinations, as well as on the probability of being involved in local off-farm employment and renting in land. Interestingly, the likelihood of pursuing these options displays an inverted U-shaped relationship with land availability per adult, except for the combination of migration and renting in land. So, households with both low and high land availability are more likely to stay on-farm. This result is consistent with the findings of Chapter 2 and of Li and Yao (2002), who showed that land resources in rural China not only have a wealth effect, used for financing migration, but also have a substitution effect that holds back migration when the land rental market is imperfect. Thus, households with small land endowments may not be wealthy enough to be able to migrate, while households with relatively large land endowments may have difficulties in renting out their land and hence prefer to work on-farm instead of migrating.

Possession of a land contract increases the likelihood that households migrate and either rent in land or remain self-sufficient. Having a migration network has a positive effect on the probability of migration combined with either land self-sufficiency or renting out land, while

a negative effect on the probability of local off-farm employment with land self-sufficiency. As discussed above, the number of durable assets owned by a household also has a positive effect on off-farm labour participation decisions. These results confirm that households facing low transaction costs in the labour market are more likely to participate in off-farm employment. Enjoying more land transfer rights positively affects the probability of renting in land combined with local off-farm employment. Other transaction cost proxies specified in the model do not influence land and labour market participation. Measurement problems and the inadequacy of these proxies in representing differences in transaction costs may play a role here.

Finally, the results for the two village dummy variables indicate that significant differences exist in market wages, land rents and/or other variables affecting land and labour market participation decisions between these villages.

3.6 Conclusions and policy implications

Exchange of land and engagement in labour markets are two important decisions faced by rural households. In the absence of well functioning factor markets, decisions on land and labour use are jointly made, implying that production and consumption behaviour should be analysed within a non-separability framework. This chapter assesses different combinations of land and labour market participation, using data from a survey among 329 farm households in three villages in Jiangxi province. A multinomial probit model is estimated to examine the determinants of the seven most common combinations of land and labour market participation in the three villages.

The empirical results indicate that households with few land resources and those with relatively large land resources are both more likely to remain on-farm. This finding suggests that households with small land endowments may not be wealthy enough to gain access to off-farm employment, while households with relatively large land endowments may have difficulties in renting out their land and hence prefer to work on-farm instead of migrating. Policies aimed at improving access to credit for households with relatively small land endowments and facilitating the renting out of land by land abundant households may therefore play an important role in stimulating the development of land and labour markets and thereby improving the efficiency of agricultural production.

The likelihood of being involved in migration showed an inverted U-shaped relationship with the average age of adults in a household. The turning point is 34 years for households that migrate and rent in land, 37 years for households that migrate and are self-sufficient in land, and 39 years for households that migrate and rent out land. A possible explanation for this finding is that households involved in migration and renting in land are mainly young migrants who return home after a few years of working elsewhere. Policies that reduce the high economic and psychological costs of settlement in migration destinations are likely to reduce such return migration flows, but may also adversely affect investments in agriculture made by such return migrants.

A larger household size and fewer dependents have a positive impact on migration, but not on local off-farm employment. The time endowment effect is counterbalanced by the food consumption effect for local off-farm employment. The fact that, contrary to migrants, people involved in local off-farm employment generally live and consume food at home seems to play an important role here. The number of durable assets in a household has a positive effect on the probability that households are involved in local off-farm employment. This result suggests that richer households may have better access to local off-farm jobs than poorer households. Policies that improve the access of poorer households to off-farm jobs may therefore provide an important contribution to reduce income gaps and alleviate rural poverty.

The findings also show that possession of a land contract and having a social network has a positive effect on migration. Enjoying more land transfer rights has a positive effect on renting in land. These results confirm that households facing low transaction costs in labour and land markets are more likely to participate in these markets. Policies that improve tenure security, increase the bundle of land transfer rights, and provide more off-farm employment information may therefore reduce transaction costs in both the land and the labour markets, and contribute to the further development of rural factor markets.

Further surveys among different household types are needed to gain more insights into their motives about whether to participate in land and labour markets and to formulate more specific policy recommendations.

CHAPTER 4   Allocative Efficiency and Non-separability under Different Rural Land and Labour Regimes[22]

4.1 Introduction

Imperfections in land and labour markets imply that rural households are unable to exchange their land and labour as much as they may like to and have to rely to a large extent, or even fully, on their own land and labour endowments for agricultural production. Such market imperfections have been used to explain the presence of an inverse relationship between farm size and labour intensity or farm productivity (Sen, 1966). In most societies, there is a large heterogeneity in the integration of rural households into land and labour markets. High variable transaction costs on these markets lead to large differences between the effective rents and wages faced by households participating in land and labour markets and the market rent and wage, creating wide price bands around the market rent and wage (Sadoulet and de Janvry, 1995; Sadoulet *et al.*, 1998). Households facing effective rents and/or wages within these price bands will choose to be self-sufficient in land and/or labour. Under such circumstances, rural households are differentially integrated into land markets (renting in, self-sufficient, and renting out) and labour markets (hiring in, self-sufficient, and hiring out), resulting in different land-labour market participation regimes.

According to economic theory, the marginal value product of land and labour are equal to the effective rents and wages received (paid) when farm households are sellers (buyers) in both land and labour markets. If there are no other market imperfections, they are allocatively efficient, and their production and consumption decisions are separable. Households can also participate in either the land or the labour market. In this case, the marginal value product of land or labour is equal to the effective rent or wage received (paid) on that market. If there are no other market failures, these households are also allocatively efficient, and their production and consumption decisions are separable. If households are self-sufficient in both land and

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[22] An earlier version of this chapter has been presented at the International Conference on "Poverty Reduction Strategy in the New Millennium: Emerging Issues, Experiences, and Lessons" on May 23-24, 2006 in Beijing, China and the CES (Chinese Economists Society) International Symposium on "Governing Rapid Growth in China: Efficiency, Equity and Institutions" on July 2-4, 2006 in Shanghai, China.

labour markets, the marginal products of land and labour are determined by their own land and labour endowments. Such households are allocatively inefficient and their production and consumption decisions are non-separable (Hoff *et al.*, 1993; Sadoulet and de Janvry, 1995; Sadoulet *et al.*, 1998; Singh *et al.*, 1986). Separability of production and consumption decisions is therefore related to allocative efficiency in land and labour if there are no other market failures.

Previous studies that have tested for separability have generally applied two types of tests. The first approach is to estimate the fully reduced-form factor demand or productivity equations (Sadoulet and de Janvry, 1995). In these tests, a single regression model is used to test whether the estimated coefficients of the household characteristics variables (e.g. household size and its composition) jointly are significantly different from zero (Benjamin, 1992; Bowlus and Sicular, 2003; Gavian and Fafchamps, 1996; Kuiper, 2005). The second approach is to estimate a production function and then calculate the marginal value product of labour (Sadoulet and de Janvry, 1995). In these tests, a single production function is used to test if the marginal value product of labour (the shadow wage) is equal to the effective market price (Jacoby, 1993; Skoufias, 1994).

Both types of tests are global tests, i.e. they are applied to all households in a sample. However, a global test is only appropriate when the decision making of all households is constrained by the same underlying market imperfections. But rural markets are rarely completely absent. More commonly heterogeneity in resource availability and transaction costs limits market participation for some households, but not for others (de Janvry and Sadoulet, 2006). If some households are constrained and others are not, a global test that pools all households together cannot correctly estimate non-separability (Carter and Yao, 2002; Sadoulet *et al.*, 1998). Regime-specific tests have been applied in the context of imperfect land or labour markets to estimate non-separability for different labour regimes in Mexican agriculture (Sadoulet *et al.*, 1998) and for different land regimes in Chinese agriculture (Carter and Yao, 2002). In such local tests, separability is estimated by regressing labour intensity on resource endowments for each regime. The results showed that household decision making is separable for seller and buyer labour market participation regimes in the Mexico case and for the land renting out regime, but surprisingly not for the land renting in regime in the China case.

A few studies have investigated on-farm labour demand decisions at the household level and tested the global separability between household labour demand and supply decisions in rural China (Benjamin and Brandt, 2002; Bowlus and Sicular, 2003; Kuiper, 2005). These studies rejected global separability. Benjamin and Brandt (2002) found that an increase in off-farm employment opportunities improves allocative efficiency. Grouping households on criteria other than land or labour regimes and testing the impact of household characteristics on production decisions, Bowlus and Sicular (2003) and Kuiper (2005) found that production and consumption decisions of some household groups are separable, while for other household groups they are non-separable. Carter and Yao (2002) estimated the impact of resource endowments on labour intensity at the household level, and tested local separability for different land renting regimes. Their study does not distinguish, however, between different labour regimes.

Building on earlier work by Sadoulet *et al.* (1998) and Carter and Yao (2002), this chapter analyses the allocative efficiency and (non-)separability of household decision making for households classified according to land as well as labour regimes. As argued in previous chapters, both labour and land market imperfections are pervasive in China and should be taken into account in estimating allocative efficiency. The results of the analysis offer important insights for developing efficiency-enhancing policies that differentiate between groups of rural households on the basis of the market imperfections that they face and their available resources.

The remainder of this chapter is structured as follows. Section 4.2 presents a farm household model in the presence of imperfect land and labour markets, and derives testable hypotheses of land and labour regime-specific allocative efficiency and separability. Section 4.3 discusses the model specification. Section 4.4 presents the results of an endogenous switching regression analysis explaining farm households' labour intensity under different land and labour market participation regimes. This chapter concludes by summarising the main findings and drawing some policy implications in section 4.5.

4.2 A farm household model in the presence of imperfect land and labour markets

4.2.1 A farm household model of joint land and labour market participation

Building on the work of Carter and Yao (2002), a farm household model is developed that

accounts for the presence of imperfect land and labour markets. In contrast to Carter and Yao (2002), who focus on the production side and examine the influence of productive assets on production choices and factor productivities[23], the consumption side is also included by considering leisure as an endogenous variable.

Suppose a household is endowed with labour $\overline{L}$, cultivated land $\overline{A}$, household characteristics Z^h, such as household size, household composition and number of durable assets, and fixed factors Z^q, such as cattle, skills and experience. Assume that there is no agricultural labour market[24], that the household can allocate its labour between agricultural production (l^a), off-farm employment (l^o), and leisure (l), and that the household can rent in land (A^{in}) and rent out land (A^{out}). Hence, the household can have income from on-farm agricultural production, off-farm employment, and land rental activities. The household chooses l^a, l^o, l, A^{in} and A^{out} to maximise utility:

$$\underset{\substack{l^a, l^o, l \\ A^{in}, A^{out}}}{Max} \qquad U(y, l, Z^h) \qquad\qquad\qquad (4.1)$$

Subject to:

$$y = f(l^a, A, Z^q) + (w - T^L)l^o - (r + T^{Ain})A^{in} + (r - T^{Aout})A^{out} \qquad (4.2)$$

$$l^a + l^o + l = \overline{L} \qquad\qquad\qquad (4.3)$$

$$A = \overline{A} + A^{in} - A^{out} \qquad\qquad\qquad (4.4)$$

$$A^{out} \leq \overline{A} \qquad\qquad\qquad (4.5)$$

$$l^a, l^o, l, A^{in}, A^{out} \geq 0 \qquad\qquad\qquad (4.6)$$

where w is the market off-farm wage, r is the market land rent, $f(.)$ is an agricultural production function, and T^{Ain}, T^{Aout} and T^L are the transaction costs involved in renting in land, renting out land and off-farm employment, respectively. The price of the agricultural

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[23] Carter and Yao (2002) describe non-separability more generally as any situation in which the production choices and factor productivities of the agricultural household are influenced by its wealth and endowments. Their production model, however, assumes production and consumption decisions to be separable and thereby only focuses on the influence of productive endowments on production decisions.

[24] As discussed in previous chapters, hiring in agricultural labour in the research area (and many other parts of China) only takes place in peak seasons and is done in small quantities. Hiring in labour is therefore not considered in this chapter.

product is set to equal one; all other prices are expressed relative to this.

The farm household land and labour allocation decisions are characterised by the following first-order conditions (assuming interior solutions, equation (4.8) and (4.9) cannot hold simultaneously):

$$f_{l^a} = w - T^L \tag{4.7}$$

$$f_A = r + T^{Ain} \tag{4.8}$$

$$f_A = r - T^{Aout} \tag{4.9}$$

Assuming that the production function satisfies constant returns to scale, the first-order conditions can be rewritten in terms of agricultural labour intensity per unit of land, ℓ, and average output per unit of land, $f(\ell)$:

$$f_\ell(\ell) = w - T^L \tag{4.10}$$

$$f(\ell) - \ell f_\ell(\ell) = r + T^{Ain} \tag{4.11}$$

$$f(\ell) - \ell f_\ell(\ell) = r - T^{Aout} \tag{4.12}$$

With variable transaction costs in access to off-farm employment, the households' labour market participation regimes are given by:

$$w - T^L \leq f_\ell(\ell) \leq w \qquad \text{for households that are self-sufficient in labour use (4.13)}$$

$$f_\ell(\ell) = w - T^L \qquad \text{for households that hire out labour} \tag{4.14}$$

With variable transaction costs in land rental activities, the households' land rental market participation regimes are given by:

$$f(\ell) - \ell f_\ell(\ell) = r + T^{Ain} \qquad \text{for households that rent in land} \qquad (4.15)$$

$$r - T^{Aout} \leq f(\ell) - \ell f_\ell(\ell) \leq r + T^{Ain} \qquad \text{for self-sufficient households} \qquad (4.16)$$

$$f(\ell) - \ell f_\ell(\ell) = r - T^{Aout} \qquad \text{for households that rent out land} \qquad (4.17)$$

The above identifies two alternatives in which the farm household can operate with respect to the labour market, and three alternatives with respect to the land market. As a result, farm households face six possible combinations of land and labour market participation. These six different combinations are represented by their first-order conditions (FOC) and presented in Table 4.1. These combinations reflect the heterogeneity in farm household transaction costs and resource endowments that drive land and labour market participation.

Table 4.1 First-order conditions for household participating in land and labour markets

Land \ Labour	Renting in	Self-sufficient	Renting out
Self-sufficient	FOC1: $f(\ell) - \ell f_\ell(\ell) = r + T^{Ain}$ $w - T^L \leq f_\ell(\ell) \leq w$	FOC2: $r - T^{Aout} \leq f(\ell) - \ell f_\ell(\ell) \leq r + T^{Ain}$ $w - T^L \leq f_\ell(\ell) \leq w$	FOC3: $f(\ell) - \ell f_\ell(\ell) = r - T^{Aout}$ $w - T^L \leq f_\ell(\ell) \leq w$
Hiring out	FOC4: $f(\ell) - \ell f_\ell(\ell) = r + T^{Ain}$ $f_\ell(\ell) = w - T^L$	FOC5: $r - T^{Aout} \leq f(\ell) - \ell f_\ell(\ell) \leq r + T^{Ain}$ $f_\ell(\ell) = w - T^L$	FOC6: $f(\ell) - \ell f_\ell(\ell) = r - T^{Aout}$ $f_\ell(\ell) = w - T^L$

4.2.2 Hypotheses of regime-specific allocative efficiency and separability and transaction costs effects

In order to derive testable hypotheses on the allocative efficiency and separability of decision making and on the effects of changes in transaction costs, three different cases are distinguished: (1) households that are self-sufficient in land and labour (FOC2), (2) households that participate in both land and labour markets (FOC4 and FOC 6), and (3) households that participate in either the land or the labour market (FOC1, FOC3 and FOC 5).

Case 1: Households that are self-sufficient in land and labour (FOC2)

The land and labour allocation decisions of households not participating in land and labour markets are based on their own endowments of land and labour. They use their own labour to cultivate their land and this implies that an increase in land endowment leads to a decline in labour intensity, while an increase in labour endowment leads to a rise in labour intensity. By defining household per capita land endowment as $E = \overline{A}/\overline{L}$, the following hypothesis can be derived[25]:

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[25] As previously specified, $\ell = l^a / A$. Taking the derivative of the equation with respect to $\overline{L}$, yields: $\partial\ell / \partial\overline{L} = (\partial l^a / \partial\overline{L})(1/A) = 1/A > 0$. Taking the derivative of the equation with respect to $\overline{A}$, yields: $\partial\ell / \partial\overline{A} = -(l^a / A^2)(\partial A / \partial\overline{A}) = -l^a / A^2 < 0$. So, $\partial\ell / \partial E < 0$. When households are self-sufficient in land and labour, the first-order conditions can be written as: $f(\ell) - \ell f_\ell(\ell) = r^s$ and $f_\ell(\ell) = w^s$, where r^s

$$\frac{\partial \ell_0^*}{\partial E} < 0 \qquad\qquad (4.18)$$

where ℓ_0^* is the optimal on-farm labour intensity for households that are self-sufficient in land and labour. Equation (4.18) specifies that the optimal on-farm labour intensity decreases in relation to per capita land endowment for households that are self-sufficient in land and labour (allocatively inefficient).

This result is consistent with the finding obtained by Carter and Yao (2002) for land-autarkic households. In this model, however, leisure is endogenous. Changes in household characteristics that affect consumption will therefore also affect the production decisions of autarkic households, making their production and consumption decisions non-separable. It is therefore expected that on-farm labour intensity (ℓ_0^*) will also be dependent on household characteristics Z^h (locally non-separable).

When households are self-sufficient in land and labour, their land and labour allocation decisions depend on shadow, rather than effective rents and wages. Their optimal on-farm labour intensity is therefore not affected by transaction costs:

$$\frac{\partial \ell_{FOC2}^*}{\partial T^{Ain}} = 0 \, , \; \frac{\partial \ell_{FOC2}^*}{\partial T^{Aout}} = 0 \qquad\qquad (4.19)$$

$$\frac{\partial \ell_{FOC2}^*}{\partial T^{L}} = 0 \qquad\qquad (4.20)$$

Case 2: Households that participate in both land and labour markets (FOC4 and FOC 6)

When households participate in both land and labour markets, they are expected to adjust their land and labour according to the effective wages and rents they face. If there are no other market imperfections, optimal labour intensity decisions will not be affected by land and

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and w^s are the shadow rent and wage. Taking the derivative of the first equation with respect to $\overline{L}$, yields: $\partial r^s / \partial \overline{L} = f_\ell(\ell)(\partial \ell / \partial \overline{L}) - (\partial \ell / \partial \overline{L}) f_\ell(\ell) - \ell f_{\ell\ell}(\ell)(\partial \ell / \partial \overline{L}) = -\ell f_{\ell\ell}(\ell)(1/A) > 0$ (assuming that production function is concave). Taking the derivative of the first equation with respect to $\overline{A}$, yields: $\partial r^s / \partial \overline{A} = f_\ell(\ell)(\partial \ell / \partial \overline{A}) - (\partial \ell / \partial \overline{A}) f_\ell(\ell) - \ell f_{\ell\ell}(\ell)(\partial \ell / \partial \overline{A}) = \ell f_{\ell\ell}(\ell)(l^a / A^2) < 0$. So, $\partial r^s / \partial E < 0$. Taking the derivative of the second equation with respect to $\overline{L}$ and $\overline{A}$, and combine them, yields $\partial w^s / \partial E > 0$. These results are consistent with Chapter 3.

labour endowments (allocatively efficient):

$$\frac{\partial \ell_2^*}{\partial E} = 0 \tag{4.21}$$

where ℓ_2^* is the optimal on-farm labour intensity for households participating in both land and labour markets. Likewise, on-farm labour intensity is expected to be independent of household characteristics Z^h (locally separable).

An increase of transaction costs involved in off-farm employment decreases the effective wage that these households receive. As a consequence, they are expected to lower their participation in off-farm employment, thereby increasing on-farm labour intensity[26]:

$$\frac{\partial \ell_{FOC4}^*}{\partial T^L} > 0, \ \frac{\partial \ell_{FOC6}^*}{\partial T^L} > 0 \tag{4.22}$$

For households within this group that rent in land, an increase of transaction costs in renting in land will increase the effective rents they pay. As a result, they are expected to rent less land, and hence increasing on-farm labour intensity:

$$\frac{\partial \ell_{FOC4}^*}{\partial T^{Ain}} > 0 \tag{4.23}$$

Likewise, an increase of transaction costs in renting out land will decrease the effective rents received by households that rent out (part of) their land. They are expected to respond by lowering the quantity of land rented out and decreasing on-farm labour intensity:

$$\frac{\partial \ell_{FOC6}^*}{\partial T^{Aout}} < 0 \tag{4.24}$$

Case 3: Households that participate in either the land or the labour market (FOC1, FOC3

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[26] When households participate in both land and labour markets, the first-order conditions are written in Table 4.1 (see FOC4 and FOC6), where the first-order conditions for labour are the same. Taking the derivative of $f_\ell(\ell) = w - T^L$ with respect to T^L, yields: $f_{\ell\ell}(\ell)(\partial \ell / \partial T^L) = -1$. So, $\partial \ell / \partial T^L = -1/ f_{\ell\ell}(\ell) > 0$ (assuming that production function is concave). Taking the derivative of $f(\ell) - \ell f_\ell(\ell) = r + T^{Ain}$ with respect to T^{Ain}, yields: $f_\ell(\ell)(\partial \ell / \partial T^{Ain}) - (\partial \ell / \partial T^{Ain}) f_\ell(\ell) - \ell f_{\ell\ell}(\ell)(\partial \ell / \partial T^{Ain}) = 1$. So, $\partial \ell / \partial T^{Ain} = -1/ \ell f_{\ell\ell}(\ell) > 0$. Taking the derivative of $f(\ell) - \ell f_\ell(\ell) = r - T^{Aout}$ with respect to T^{Aout}, yields: $f_\ell(\ell)(\partial \ell / \partial T^{Aout}) - (\partial \ell / \partial T^{Aout}) f_\ell(\ell) - \ell f_{\ell\ell}(\ell)(\partial \ell / \partial T^{Aout}) = -1$. So, $\partial \ell / \partial T^{Aout} = 1/ \ell f_{\ell\ell}(\ell) < 0$.

and FOC 5)

If there are no other market imperfections, households that participate in the labour market but not in the land market are expected to adjust the size of their off-farm labour in relation to the effective wage they receive. Likewise, households that participate in the land market but not in the labour market are expected to adjust the size of their land on the basis of the effective rent that they pay or receive. Therefore, decisions about optimal labour intensity will not be affected by land and labour endowments, but by the effective wage or rent (allocatively efficient):

$$\frac{\partial \ell_1^*}{\partial E} = 0 \qquad\qquad (4.25)$$

where ℓ_1^* is the optimal on-farm labour intensity for households participating in either the land or the labour market. As in Case 2, on-farm labour intensity is also expected to be independent of household characteristics Z^h (locally separable).

To examine the impact of changes in transaction costs, this case is subdivided into households involved in land markets and those involved in labour markets.

Case 3A: Households only participating in land markets (FOC1 and FOC3)

Since these households do not participate in the labour market, their factor intensity decisions are unaffected by changes in the effective wage:

$$\frac{\partial \ell_{FOC1}^*}{\partial T^L} = 0 \,, \frac{\partial \ell_{FOC3}^*}{\partial T^L} = 0 \qquad\qquad (4.26)$$

For households that rent in land, an increase in transaction costs of renting in land will decrease the amount of rented land and thereby increase optimal labour intensity:

$$\frac{\partial \ell_{FOC1}^*}{\partial T^{Ain}} > 0 \qquad\qquad (4.27)$$

For households that rent out land, increased transaction costs involved in renting out land are expected to have the opposite effect:

$$\frac{\partial \ell_{FOC3}^*}{\partial T^{Aout}} < 0 \qquad\qquad (4.28)$$

Case 3B: Households only participating in off-farm employment (FOC5)

In this case, optimal on-farm labour intensity is negatively affected by the effective wage

received by these households. An increase in the transaction costs on the off-farm labour market is therefore expected to have a positive effect on optimal labour intensity:

$$\frac{\partial \ell^*_{FOC5}}{\partial T^L} > 0 \qquad (4.29)$$

Since households in this group only participate in off-farm employment, optimal on-farm labour intensity is unaffected by transaction costs on the land market:

$$\frac{\partial \ell^*_{FOC5}}{\partial T^{Ain}} = 0 \,, \; \frac{\partial \ell^*_{FOC5}}{\partial T^{Aout}} = 0 \qquad (4.30)$$

The hypotheses derived above refer to the allocative efficiency and separability of decision making and to the so-called direct factor price equalisation effect of transaction costs on the land and labour markets. Carter and Yao (2002) further distinguish a threshold effect of changes in transaction costs, which also contributes to factor price equalisation. In terms of this model, the threshold effect means that a reduction of transaction costs in the land or labour market induces more households to participate in those markets by shrinking the price band around the market wage or rent. The following sections provide an empirical test of allocative efficiency, separability, direct factor price equalisation and threshold effects hypothesised above.

4.3 Model specification

The objective of this chapter is to explore whether participation in land and labour markets has an impact on the allocative efficiency and (non-)separability of household decision making. The analysis also aims to take into account that land and labour market participation decisions may depend on transaction costs and household resources. Based on the first-order conditions presented in the analytical framework, the labour intensity for household i with land and labour participation regime j is specified as:

$$\ln \ell_{ij} = x'_i \beta_j + \varepsilon_{ij} \qquad\qquad j = 1, \dots, 7 \qquad (4.31)$$

where x_i is a vector of household characteristics (Z^h), fixed factors (Z^q), land and labour endowments ($E = \overline{A}/\overline{L}$), transaction costs in land and labour markets (T^{Ain}, T^{Aout}, T^L), market wage and rent (w, r), and $\varepsilon_{ij} \sim N(0, \sigma_j^2)$. The specification in equation (4.31) allows the factors determining labour intensity in agricultural production to differ between the

seven[27] land and labour market participation regimes.

Households are assumed to select land and labour market participation regimes that maximise their expected utility. The ith household's expected utility from a land and labour market participation regime is modelled by the indirect utility function:

$$V_{ij} = z_i' \gamma_j + \upsilon_{ij} \qquad\qquad j = 1, \dots, 7 \qquad\qquad (4.32)$$

where z_i is a vector representing the variables that may determine labour intensity as well as the variables that may affect household preferences with regard to decisions over land and labour market participation. Assuming the disturbance term has a Weibull distribution, the standard multinomial logit choice model can be used:

$$\Pr ob(I_i = j) = \frac{\exp(z_i' \gamma_j)}{\sum\limits_{j=1}^{7} \exp(z_i' \gamma_j)} \qquad\qquad (4.33)$$

Labour intensity equations are estimated using the generalised two-step procedure (Lee, 1982, 1983). The labour intensity that is conditional on alternative j is specified as:

$$\ln \ell_{ij} = x_i' \beta_j - \sigma_j \rho_j \frac{\phi\{\Phi^{-1}[F(z_i' \gamma_j)]\}}{F(z_i' \gamma_j)} + \xi_{ij} \qquad\qquad (4.34)$$

where F denotes the multinomial logit distribution function, Φ and ϕ denote the standard normal distribution and density functions respectively, ρ_j is the correlation coefficient between ε_{ij} and υ_{ij} in the labour intensity and land and labour market participation equations, and $E(\xi_{ij} | I_i = j) = 0$. The second term on the right-hand side of equation (4.34) is the inverse Mill's ratio for the multinomial logit model which corrects for endogeneity (selection bias) of multiple land and labour market participation decisions.

The dependent variable in the second step is labour intensity for rice production, measured in hours per *mu*. The household per capita land endowment E is measured as the amount of contracted irrigated land divided by the number of adults in the household.

As in previous chapters, household characteristics (Z^h) are represented by the number of durable assets in a household, household size, number of dependents and the ratio of female to male adults. Household characteristics have a direct effect on consumption preferences and

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[27] See section 3.4 of Chapter 3 for details.

can have either positive or negative effects on demand for leisure and consumption goods. Fixed factors (Z^q) are represented by the average adult age and education of the household. Average adult age is used as a proxy for experience. More experienced households are expected to be more productive. Education can have mixed effects. It can increase agricultural productivity, but it can also induce household members to engage in off-farm employment.

Transaction costs in the land and labour markets (T^{Ain}, T^{Aout}, T^L) are represented by tenure security, transfer rights, the presence of a social network, and the number of durable assets in a household. As in previous chapters land transfer rights are represented by number of transfer rights enjoyed by the households, divided by four. Possession of a land contract is used to represent tenure security. More land transfer rights and high tenure security are expected to reduce transaction costs in the land rental (Li and Yao, 2002) and off-farm labour (Kung, 2002a; Kung and Lee, 2001; Li and Yao, 2002; Lohmar, 1999; OECD, 2005b; Rozelle *et al.*, 1999a; Yang, 1997; Zhao, 2002) markets. Households with many durable assets and a social network are expected to have lower transaction costs in land rental market transactions and in obtaining off-farm employment (Zhang and Li, 2003; Zhao, 2003).

As in previous chapters, the market land rent (r) and labour wage (w) are captured by village dummy variables.

The expected effects of the aforementioned explanatory variables in the labour intensity equation (discussed in section 4.2) are summarised in Table 4.2.

The explanatory variables included in the multinomial logit model explaining participation in the seven land and labour regimes include the same variables plus the number of cattle available to the household (see chapter 3 for details)[28]. The transaction costs variables in the joint land and labour market participation equation provide tests for the threshold effect, distinguished by Carter and Yao (2002).

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[28] The same variables are included as much as possible in both stages to examine which variables are not statistically in the second stage but are statistically significant in the first stage. Since all of the household characteristics variables, transaction costs variables and land endowments variable must be included for the hypothesis test. The number of cattle is selected as the identification variable.

Table 4.2 Expected effects of variables used in labour intensity analysis

	On-farm & renting in land	On-farm & self-sufficient in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land	Migration & renting in land	Migration & self-sufficient in land	Migration & renting out land
Allocative efficiency and separability							
Irrigated land per adult	0	-	0	0	0	0	0
Household characteristics	0	≠0	0	0	0	0	0
Direct factor price equalisation effect (Transaction costs in land and labour markets)							
Number of durable assets	-	0	-	-	-	-	+/-
Migration network	-	0	-	-	-	-	+/-
Land transfer rights	-	0	-	-	-	-	+/-
Possession land contract	-	0	-	-	-	-	+/-

The model specified above is an endogenous switching regression model. The first step in this consists of explaining households' land and labour market participation decisions through a multinomial logit model that gives the inverse Mill's ratio. In the second step, the labour intensity equation is estimated for seven land and labour market participation regimes with the inverse Mill's ratio included as one of the explanatory variables. The results for the land endowment variable and the household characteristics will serve as test of local allocative efficiency and separability for each of these groups. For comparative purposes, the second step is also estimated for the whole sample, to give a test of global allocative efficiency and separability.

The weakness of the generalised two-step procedure is that it depends greatly on the instruments used to identify the first-stage choice model. Normally, it is very difficult to have good instruments for this purpose. Weak identification causes an imprecise estimation of the effect of the inverse Mill's ratio in the second-stage labour intensity model. It can also cause imprecise estimation of the other coefficients as well if those variables suffer from multicollinearity with the Inverse Mill's ratio. Statistical test on multicollinearity is thus performed. Descriptive statistics of the variables used in the analysis, sub-divided by household land and labour market participation regimes, are shown in Table 4.3.

Table 4.3 Descriptive statistics for variables used in this analysis

	On-farm & renting in land	On-farm & self-sufficient in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land	Migration & renting in land	Migration & self-sufficient in land	Migration & renting out land	**All households**
Number of observations	29	24	34	27	69	79	16	**278**
				Mean (standard deviation)				
Labour intensity (hours/*mu*)	81.81 (29.93)	136.97 (67.26)	82.83 (28.18)	90.00 (34.97)	85.00 (30.31)	100.21 (38.31)	81.96 (16.20)	**93.52 (39.50)**
Household size (persons)	4.07 (1.00)	3.38 (1.31)	3.91 (1.11)	4.11 (1.19)	5.04 (1.42)	4.71 (1.74)	4.81 (1.56)	**4.46 (1.51)**
Number of dependents (persons)	1.59 (1.21)	1.21 (1.25)	1.32 (1.04)	1.70 (0.99)	1.14 (1.10)	1.03 (1.10)	1.63 (0.81)	**1.27 (1.11)**
Ratio of female to male adults	1.09 (0.55)	0.96 (0.44)	1.06 (0.55)	0.95 (0.31)	0.92 (0.55)	1.05 (0.62)	1.26 (0.90)	**1.02 (0.57)**
Irrigated land per adult (*mu*)	2.07 (0.86)	2.61 (1.78)	2.05 (0.68)	2.29 (1.20)	1.60 (0.64)	1.73 (0.59)	2.36 (0.84)	**1.94 (0.93)**
Average adult age (years)	38.00 (8.19)	46.31 (11.25)	38.30 (8.24)	35.85 (6.31)	35.37 (4.31)	37.60 (6.00)	38.71 (4.78)	**37.82 (7.30)**
Average adult education (years)	3.79 (1.50)	3.72 (2.16)	4.17 (1.63)	4.34 (1.35)	4.61 (1.44)	4.73 (1.70)	3.75 (1.87)	**4.35 (1.66)**
Total number of cattle	1.24 (1.77)	0.67 (0.48)	0.85 (0.61)	0.56 (0.51)	0.75 (0.53)	0.72 (0.60)	0.31 (0.60)	**0.76 (0.80)**
Number of durable assets	6.07 (2.27)	5.08 (2.02)	6.76 (1.58)	7.00 (1.96)	6.62 (1.54)	6.34 (1.83)	6.38 (1.41)	**6.39 (1.84)**
Social network (1=yes)	0.17 (0.38)	0.29 (0.46)	0.15 (0.36)	0.04 (0.19)	0.39 (0.49)	0.44 (0.50)	0.50 (0.52)	**0.32 (0.47)**
Land transfer rights	0.57 (0.13)	0.53 (0.17)	0.60 (0.12)	0.58 (0.12)	0.59 (0.12)	0.59 (0.14)	0.58 (0.12)	**0.58 (0.13)**
Possession land contract (1=yes)	0.21 (0.41)	0.29 (0.46)	0.29 (0.46)	0.26 (0.45)	0.33 (0.47)	0.29 (0.46)	0.13 (0.34)	**0.28 (0.45)**
Banqiao dummy (1=yes)	0.28 (0.45)	0.25 (0.44)	0.26 (0.45)	0.15 (0.36)	0.14 (0.35)	0.11 (0.32)	0.06 (0.25)	**0.17 (0.38)**
Shangzhu dummy (1=yes)	0.41 (0.50)	0.63 (0.49)	0.38 (0.49)	0.26 (0.45)	0.30 (0.46)	0.27 (0.44)	0.13 (0.34)	**0.33 (0.47)**

Source: Farm household survey

4.4 Estimation results

The main objective of this chapter is to examine whether participation in land and labour markets has an impact on allocative efficiency and separability. The focus is therefore on the second step that explained in section 4.3. The estimation results of that step are presented in Table 4.4[29].

As the results in the first column show, land endowment has a negative impact on labour intensity for the sample as a whole. Separability as defined by Carter and Yao (2002) is therefore rejected globally, and the households within the sample are found to be allocatively inefficient. This finding coincides with the results of previous studies for rural China (Benjamin and Brandt, 2002; Bowlus and Sicular, 2003; Carter and Yao, 2002; Kuiper, 2005). When we take differences in land and labour regimes into account, however, a much more diverse picture emerges (see the other columns in Table 4.4). As expected from equation (4.18), land endowment has a strongly negative impact on labour intensity for households not participating in land and labour markets. And for households that participate in both land and labour markets, land endowment does not affect labour intensity as expected in equation (4.21). For households that participate in the land market but are self-sufficient in the labour market, land endowment does not affect labour intensity as hypothesised in equation (4.25). But the labour intensity of households that are self-sufficient in the land market and participate in off-farm employment is affected by their land endowment, contradicting equation (4.25) in this instance. In other words, households participating in the land rental market but not in the labour market, are able to adjust the size of their land as much as needed to equate the marginal value product to the effective prices, whereas households that participate in the labour market and not in the land market are not able to do so. The former group is allocatively efficient, whereas the latter is not.

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[29] Due to the limited number of observations on renting out and migration (16 households), the estimation for this category has a small F statistic, accepting the hypothesis that all coefficients excluding the constant are zero. The results are therefore dropped from Table 4.4.

Table 4.4 Endogenous switching regression results for labour intensity

	Whole sample	Household land and labour regimes					
		On-farm & renting in land	On-farm & self-sufficient in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land	Migration & renting in land	Migration & self-sufficient in land
Ln irrigated land per adult	-0.13 (-2.42)**	0.20 (0.92)	-1.28 (-3.17)***	-0.08 (-0.36)	-0.62 (-3.76)***	0.12 (1.35)	-0.30 (-2.49)**
Ln household size	-0.07 (-0.86)	-0.42 (-0.95)	1.06 (2.17)*	0.90 (1.34)	-0.09 (-0.42)	-0.07 (-0.22)	-0.15 (-0.83)
Number of dependents (persons)	-0.02 (-0.58)	-0.13 (-1.17)	-0.16 (-0.81)	-0.19 (-1.60)	0.26 (1.90)*	-0.05 (-0.81)	0.03 (0.50)
Ln ratio of female to male adults	0.20 (2.88)***	0.28 (0.78)	-1.14 (-2.27)**	0.03 (0.14)	-0.58 (-1.05)	-0.01 (-0.05)	0.31 (2.11)**
Ln number of durable assets	0.05 (0.58)	-0.001 (-0.00)	0.78 (2.93)**	-0.33 (-0.95)	0.19 (0.59)	-0.03 (-0.24)	-0.10 (-0.82)
Social network (1=yes)	0.03 (0.66)	-0.15 (-0.62)	0.01 (0.03)	0.19 (0.96)	-0.91 (-2.57)**	0.04 (0.82)	-0.09 (-1.17)
Land transfer rights	-0.03 (-0.17)	0.58 (0.75)	-0.27 (-0.49)	0.41 (0.79)	0.21 (0.31)	0.21 (0.65)	-0.04 (-0.20)
Possession land contract (1=yes)	-0.08 (-1.79)*	-0.08 (-0.30)	0.12 (0.31)	-0.08 (-0.56)	0.18 (1.10)	-0.12 (-1.53)	-0.12 (-1.18)
Ln average adult age	0.44 (3.30)***	-0.29 (-0.44)	0.19 (0.41)	0.09 (0.19)	0.38 (0.67)	0.66 (2.13)**	0.36 (1.44)
Average adult education (years)	-0.02 (-1.96)*	0.03 (0.47)	0.03 (0.65)	0.004 (0.08)	-0.08 (-0.93)	-0.02 (-0.76)	-0.07 (-2.69)***
Banqiao dummy (1=yes)	-0.14 (-2.85)***	-0.25 (-1.36)	0.45 (1.09)	-0.29 (-1.25)	-0.22 (-1.04)	-0.01 (-0.04)	-0.39 (-3.53)***
Shangzhu dummy (1=yes)	0.36 (7.18)***	0.47 (1.81)*	0.98 (1.70)	0.23 (1.32)	0.18 (1.15)	0.45 (5.84)***	0.33 (2.96)***
Intercept	2.89 (4.98)***	5.18 (1.81)*	3.34 (1.28)	4.36 (2.00)*	3.19 (1.45)	2.14 (1.84)*	4.06 (3.40)***
Inverse Mill's Ratio		0.10 (0.74)	-0.39 (-1.10)	-0.65 (-1.60)	0.15 (0.96)	-0.06 (-0.32)	-0.13 (-0.92)
Joint test for household characteristics (F statistic)	2.49**	2.35	2.63*	0.71	1.54	1.37	1.72
R-squared	0.36	0.55	0.81	0.60	0.67	0.50	0.49

Note: t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are robust to heteroskedasticity. Test for multicollinearity among included variables show that variance inflation factor (VIF) for Inverse Mill's Ratio (IMR) is larger than 10 for housheolds that are self-sufficient in land and labour. An estimation excluding IMR is carried out, SUEST Test is performed and no evidence is found that there are differences between estimators (Prob>chi2=0.56). Skewness/Kurtosis tests for normality is performed, normal distribution is accepted for all categories except for households that migrate and rent in land (prob>chi2=0.04).

These findings suggest that prevailing imperfections in the off-farm employment market and/or the market for hiring agricultural labour prevent households that participate in off-farm employment from adjusting their on-farm labour as much as they would like. The estimated coefficients are -1.28 for fully self-sufficient households, and -0.62 and -0.30 for households involved in local off-farm employment and migration (but not in land rental activities), respectively. These coefficients support the presumption that households involved in off-farm employment only partly adjust their on-farm labour to their land endowment. They also suggest that households involved in migration can do so to a larger extent than households involved in local off-farm employment.

Household wealth and demographic characteristics have mixed effects on labour intensity. Household wealth, measured by the number of durable assets in a household, has a positive impact on labour intensity in production for households that are self-sufficient in land and labour, but not for the other groups. The size of a household has a similar effect. It has a positive impact on labour intensity in rice production only for the group of fully autarkic households. These findings suggest that larger and wealthier households consume more, and that autarkic households therefore need to employ more of their own labour to meet these consumption demands. For this group, household consumption and production decisions are therefore non-separable. Consistent with these findings, the ratio of female to male adults has a negative effect on labour intensity in rice production for self-sufficient households. But no significant effect is found for the number of dependents in a household. A test of the null hypothesis that all four coefficients for the household wealth and demographic variables are jointly equal to zero is rejected for the group of self-sufficient households, whereas it cannot be rejected for the other five groups.

The results provide no evidence of a direct factor price equalisation effect. It is expected that higher transaction costs in the land and labour markets will lower their participation in land rental transactions and off-farm employment, and hence increase (land renting in, off-farm employment) or decrease (land renting out) their labour intensity in rice production. Only the coefficient estimate of social network for households involved in local off-farm employment and self-sufficient in land provide evidence of such an effect. This is consistent with the results in Chapter 2, where possession of a land contract and land transfer rights do not affect the amount of land rented in and migration, and therefore do not affect labour

intensity in rice production.

There is some limited evidence, however, that lower transaction costs in the land or labour market induce more households to participate in those markets (the 'threshold effect'). As shown in the results for the multinomial logit model for joint land and labour market participation (presented in Appendix 4.1), more wealth increases the probability that households participate in local off-farm employment and renting in land, but not in other groups. The results further indicate that the probability of migration, combined with renting in land or self-sufficient in land, is higher when households possess a land contract. The probability of renting in land is found to be higher when households possess more land transfer rights, but only for households that combine renting in with local off-farm employment. The probability of migration, combined with renting out land is also found to be higher when households have a land contract.

The efficiency of the estimators may be affected by the use of instrumental variables and the problems of multicollinearity. The number of cattle in a household is used as the instrument to identify the first-stage choice model. As shown in Appendix 4.1, the number of cattle owned by a household positively affects the likelihood of being involved in renting in land and staying on-farm, and negatively affects the likelihood of being involved in migration and renting out land, but does not affect the likelihood of being in the other land and labour regimes, indicating the existence of weak identification. Multicollinearity is only a problem for the inverse Mill's ratio and for some of household characteristics variables (e.g. household size and number of dependents) and land endowment variable (variance inflation factor is greater than 10) for households that are self-sufficient in land and labour. Dropping the inverse Mill's ratio from the regression does not have an impact on the regression results. The multicollinearity among land endowment and household characteristics variables are inevitable, since these variables must be included in the analysis for the allocative efficiency and separability test.

4.5 Conclusions and policy implications

Farm household behaviour in developing countries and farm household responses to macro policies aimed at changing production incentives, cannot be understood without reference to the specificity of market failures that these farmers face (de Janvry and Sadoulet, 2006;

Thorbecke, 1993). In China, there is convincing empirical evidence that agricultural commodity markets have become highly integrated in recent years (Huang *et al.*, 2004; Park *et al.*, 2002). But markets for agricultural production factors, particularly land and labour, face many institutional obstacles and remain underdeveloped in rural areas (Bowlus and Sicular, 2003; Carter and Yao, 2002). These factor market imperfections have important implications for farm household behaviour and for the allocative efficiency of farm households.

Integration of farm households into markets depends on their endowments and the transaction costs they face (de Janvry and Sadoulet, 2006; Sadoulet and de Janvry, 1995). It is important to take this diversity in endowments and transaction costs, and the resulting diversity in market participation regimes, into account when analysing farm household behaviour. This chapter analyses the allocative efficiency and (non-)separability of household decision making for different land and labour regimes, using data from a household survey held in 2000 in three villages in Northeast Jiangxi province. It extends previous research on allocative efficiency and separability for different land participation regimes in China by Carter and Yao (2002) in that it allows for joint consumption and production decision making, and distinguishes households according to land as well as labour regimes.

As expected, households participating in both land and labour markets are found to be allocatively efficient, and households that do not participate in both markets are not. The analysis also shows that households that participate in the land rental market but not in the labour market are allocatively efficient, whereas households that participate in the labour market but not in the land rental market are not. This finding suggests that prevailing imperfections in the off-farm employment market and/or the market for hiring agricultural labour prevent households that participate in off-farm employment from adjusting their on-farm labour as much as they would like. Allocative inefficiency is found to be highest for households that do not participate in either market, and is higher for households working in local off-farm employment than for households involved in migration. 45% of the households in the sample do not participate in the land rental market (see Table 4.3). This means that substantial efficiency gains in agriculture can still be obtained by improving the functioning of the land rental market and/or the labour market in the research area, and in other parts of rural China with similar obstacles to factor markets.

There is also convincing evidence that household consumption and production decisions

are non-separable for households not participating in either the land rental or the labour market. Policies aimed at influencing farm household production incentives, such as the recent direct income support for grain farmers in China, should take into account that the responses of such autarkic farm households are likely to be very small. In the research area, however, this group constitutes only 8% of the interviewed households. For households participating in either the land rental or the labour market, or both, the hypothesis that consumption and production decisions are separable could not be rejected.

With respect to the role of transaction costs, some evidence could be found that lower transaction costs in the land or labour market induce more households to participate in those markets (the 'threshold effect'). But the effects of changes in transaction costs on the labour intensity of production for households that participate in the land and/or labour market were not found to be significant. In other words, there is no evidence of a direct factor price equalisation effect for the households within the sample. It should be kept in mind, however, that measurement of transaction costs is rather problematic (de Janvry and Sadoulet, 2006). The survey lacks information on some important aspects of transaction costs in land and labour markets, such as travel time, search costs, negotiation costs, or underemployment. The results for the threshold effect and the direct factor price equalisation effect should therefore be interpreted with caution. A more detailed analysis based on an extensive survey of transaction costs and other imperfections in rural land and labour markets may shed more light on these issues.

Appendix 4.1 Multinomial logit analysis results of joint land and labour market participation

Independent variables	Coefficient (z-score)					
	On-farm & renting in land	Local off-farm & renting in land	Local off-farm & self-sufficient in land market	Migration & renting in land	Migration & self-sufficient in land market	Migration & renting out land
Household size (persons)	0.10 (0.13)	0.20 (0.26)	-0.03 (-0.03)	1.40 (1.80)*	1.45 (1.85)*	1.67(1.90)*
Number of dependents (persons)	0.34 (0.52)	-0.22 (-0.36)	0.51 (0.79)	-0.87 (-1.45)	-1.04 (-1.76)*	-1.11(-1.37)
Number of durable assets	0.03 (0.13)	0.35 (1.70)*	0.33 (1.33)	-0.06 (-0.28)	-0.07 (-0.32)	0.09(0.32)
Total number of cattle	0.85 (1.63)*	0.44 (0.81)	-0.63 (-1.05)	0.06 (0.11)	0.06 (0.12)	-1.64(-1.94)*
Average adult age (years)	-0.05 (-0.11)	0.02 (0.05)	-0.09 (-0.22)	0.93 (1.65)*	0.40 (0.97)	1.65(2.33)**
Average adult age squared	-0.0004 (-0.10)	-0.001 (-0.20)	-0.0001 (-0.03)	-0.01 (-2.01)**	-0.01 (-1.23)	-0.02(-2.58)***
Average adult education (years)	-0.26 (-1.07)	-0.13 (-0.50)	-0.15 (-0.60)	-0.09 (-0.35)	0.07 (0.28)	-0.47(-1.61)
Ratio of female to male adults	-0.10 (-0.15)	-0.18 (-0.28)	-0.95 (-1.20)	-0.81 (-1.32)	-0.27 (-0.46)	0.13(0.18)
Irrigated land per adult (*mu*)	-0.45 (-0.29)	2.39 (1.37)	-1.16 (-1.14)	1.09 (0.68)	3.05 (1.74)*	5.22(1.89)*
Irrigated land per adult squared	-0.10 (-0.42)	-0.66 (-1.99)**	0.06 (0.58)	-0.46 (-1.67)*	-0.86 (-2.48)**	-0.95(-2.25)**
Land transfer rights	0.96 (0.49)	3.25 (1.63)*	1.88 (0.85)	2.54 (1.31)	2.47 (1.31)	0.18(0.06)
Possession land contract (1=yes)	0.66 (0.72)	1.24 (1.45)	1.25 (1.33)	1.89 (2.24)**	1.64 (1.99)**	0.87(0.63)
Social network (1=yes)	-0.18 (-0.20)	-0.51 (-0.60)	-1.83 (-1.31)	1.08 (1.36)	1.20 (1.55)	1.73(1.91)*
Banqiao dummy (1=yes)	-0.89 (-0.80)	-1.22 (-1.11)	-1.95 (-1.66)*	-2.16 (-1.90)*	-2.51 (-2.24)**	-3.48(-2.57)***
Shangzhu dummy (1=yes)	-1.60 (-1.29)	-1.55 (-1.23)	-2.29 (-1.83)*	-2.89 (-2.22)**	-2.90 (-2.24)**	-2.91(-1.88)*
Intercept	4.22 (0.41)	-3.64 (-0.36)	5.82 (0.56)	-16.83 (-1.31)	-11.97 (-1.13)	-40.63(-2.11)**
Number of observations	29	34	27	69	79	16
Log pseudolikelihood			-361.57			
Pseudo R^2			0.28			
Wald chi2(90)			229.43 (p=0.00)			

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are robust to heteroskedasticity. Test for multicollinearity among included variables show that mean variance inflation factor (VIF) is equal to 1.43 and that VIF for each individual variable is lower than 10.

Base outcome is self-sufficiency in land and labour markets.
Having performed SUEST (Seemingly unrelated estimation) test, no evidence was found that the IIA assumption has been violated.

CHAPTER 5   Land Rental Market, Off-farm Employment and Agricultural Production

5.1 Introduction

Economic reforms initiated in 1978 have led to the emergence of land and labour markets in rural China. Recent studies show an increasing incidence of land rental activities (Deininger and Jin, 2002; Feng *et al.*, 2004; Kung, 2002b; Lohmar *et al.*, 2001; Zhang *et al.*, 2004) and off-farm employment has become a significant phenomenon since the mid-1980s. By 2000, more than 200 million rural labourers worked off-farm (de Brauw *et al.*, 2002; Zhang *et al.*, 2002). As China's economy continues to grow, the development of land and labour markets is expected to continue or even accelerate.

The development of land rental markets can enhance allocative efficiency and agricultural productivity by equalising the marginal product of land across households with different land-labour endowments and by facilitating transfers of land from less productive households to more productive ones (Carter and Olinto, 1998; Carter and Yao, 1999, 2002; Deininger, 2003; Deininger and Feder, 1998; Deininger and Jin, 2002; Deininger *et al.*, 2003b; Deininger and Zegarra, 2003; Faruqee and Carey, 1997; Yao, 2003). However, in present-day China land rental arrangements are generally informal, short term, and between households living in the same village. Rented in plots are therefore subject to tenure insecurity, which may discourage land investment and reduce agricultural productivity.

The effect of off-farm employment on agricultural production is ambiguous. Off-farm employment reduces the labour available for agricultural production, especially if hiring agricultural labour incurs transaction costs and if hired labour is not as efficient as family labour. But off-farm employment also enables households to increase their incomes, to overcome credit and insurance constraints and to increase their investment in agricultural production (Rozelle *et al.*, 1999b; Taylor *et al.*, 2003). In addition, the reduction in food consumption by household members working off-farm (e.g. those who migrate) may have an impact on agricultural production decisions if household production and consumption decisions are non-separable (Burger, 1994; Wouterse, 2006).

Few studies provide empirical evidence of the effect of land rental market development on allocative efficiency and agricultural productivity in rural china (Carter and Yao, 2002;

Lohmar *et al.*, 2001). Carter and Yao (2002) find that allocative efficiency is achieved by households that rent out land, but surprisingly not by households that rent in land. Lohmar *et al.* (2001) find that allocative efficiency and aggregate agricultural production is improved because the households that rent in land have a significantly higher marginal product of land than households that do not rent additional land.

Previous studies on the effect of land tenure contracts on agricultural production have focused on South Asia (Binswanger *et al.*, 1993; Otsuka and Hayami, 1988; Shaban, 1987) and Africa (Ahmed *et al.*, 2002; Benin *et al.*, 2005; Gavian and Ehui, 1999; Gavian and Fafchamps, 1996; Pender and Fafchamps, 2006; Place and Otsuka, 1997). The focus of these studies has been on to compare the relative efficiency of owner-operated, rented, or sharecropped plots. Many studies find an efficiency loss of sharecropped land relative to owner-operated land.

Land tenure research in rural China focuses on the land tenure insecurity resulting from frequent land reallocations, and the impact of this insecurity on household investment and agricultural productivity (Benjamin and Brandt, 2002; Jacoby *et al.*, 2002; Kung and Liu, 1997; Li *et al.*, 1998; Yao, 1998). Most studies find that land tenure insecurity has a significant but small effect on investment (e.g. green manure, organic manure), but no significant effect on productivity. The main explanation is that land investment plays a minor role in agricultural production compared with other agricultural inputs such as land, labour, and chemical fertilisers (Yao, 2003).

Many empirical studies have investigated the effect of off-farm employment on agricultural production in rural China (Rozelle *et al.*, 1999b; Taylor *et al.*, 2003; Wu and Meng, 1997a, 1997b). The studies by Rozelle *et al.* (1999b) and Taylor *et al.* (2003) apply the "new economics of labour migration" (NELM) framework developed by Stark and Bloom (1985), in which the migration decision is part of a set of interwoven economic choices made by households facing imperfect markets. Using a simultaneous-equation model, they find a negative lost-labour effect and a positive income effect. The studies by Wu and Meng (1997a; 1997b) find no lost-labour effect and a positive income effect.

So far as can be ascertained, no studies until now have analysed the joint impact of land rental market development and off-farm employment on agricultural production in China. As pointed out in previous chapters, rural China is characterised by surplus and underemployed

rural labour, and land rental markets are rather thin (Brandt *et al.*, 2002; Brandt *et al.*, 2004). Rural households facing such land and labour market imperfections will make simultaneous decisions on land and labour market participation. The purpose of this chapter is therefore to analyse the effect of land rental market participation, and the resulting land tenure contracts, and off-farm employment on agricultural production (land investment, input use, and agricultural productivity) in rural China. Since 2004, promoting agricultural productivity, raising farmers' incomes and narrowing the rural-urban income gap have been priorities for the Chinese authorities. The results from this chapter can provide important evidence for the development of policies to enhance agricultural productivity and increase farm household incomes.

The remainder of this chapter is structured as follows. Section 5.2 presents a theoretical framework for the analysis. Section 5.3 introduces the estimation procedures. In section 5.4, estimation results are presented. The chapter concludes with summarising the main findings and drawing some policy implications in section 5.5.

5.2 Theoretical framework

The objective of this chapter is to explore the impacts of household level land rental market participation and off-farm employment on plot level agricultural production. Assume that the household first makes land and labour market participation decisions at the farm household level. As discussed in previous chapters, the reduced-form equations for land rental and off-farm labour market participation can be represented as[30] (see equations (2.16) and (2.17) in Chapter 2):

$$A^{in} = A^{in}(Z^h, Z^q, \overline{L}, \overline{A}, w, r, Z) \tag{5.1}$$

$$l^o = l^o(Z^h, Z^q, \overline{L}, \overline{A}, w, r, Z) \tag{5.2}$$

where A^{in} is the amount of land rented in by the household, l^o is the amount of labour involved in off-farm employment, Z^h are household preferences (household size, household composition and wealth), Z^q are farm characteristics (cattle, age and education), $\overline{L}$ is the household labour endowment, $\overline{A}$ is the land endowment, w is the market labour wage, r is the market land rent, Z are institutional factors (tenure security, transfer rights and migration

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[30] The analysis here is confined to households that rent in land.

network) that affect land rental and off-farm labour market participation.

Plot level decisions about land investment, labour use and the use of non-labour inputs are made in a later stage. The model employed here is an extension of the previous studies by Feder *et al.* (1988), Place and Hazell (1993) and Hayes *et al.* (1997), which describes the relationship between tenure security, land investment, input use, and yield, and can be written as follows:

$$LI_i = LI_i(TS_i, Z_i^p, Z^q, Z^h, \overline{L}, \overline{A}, r, w, p_X, A^{in}, l^o) \tag{5.3}$$

$$l_i^a = l_i^a(TS_i, Z_i^p, Z^q, Z^h, \overline{L}, \overline{A}, r, w, p_X, A^{in}, l^o) \tag{5.4}$$

$$X_i = X_i(TS_i, Z_i^p, Z^q, Z^h, \overline{L}, \overline{A}, r, w, p_X, A^{in}, l^o) \tag{5.5}$$

$$Q_i = Q_i(TS_i, Z_i^p, Z^q, Z^h, \overline{L}, \overline{A}, r, w, p_X, A^{in}, l^o) \tag{5.6}$$

where LI, l^a, X, and Q are land investment, labour use, the use of non-labour inputs, and yield on each plot (subscript i), TS is the plot-specific tenure security indicator, Z^p are plot characteristics, and p_X is the price for non-labour inputs. By estimating equations (5.3), (5.4), (5.5), and (5.6), the effects of land rental market participation, and the resulting land tenure contracts, and off-farm employment have on land investment, labour use, non-labour inputs, and land productivity can be determined.

5.3 Model specification and estimation methods

Data used for this chapter were collected in the three villages described in Chapter 2. Farm household level data were collected for the year 2000. At that time plot level data were not collected. Out of the 329 households interviewed in 2000, 52 households were randomly selected, and plot level agricultural production data covering all of 2002 were collected in January 2003. In total 215 rice plots[31] were surveyed, 56 in Banqiao, 74 in Shangzhu and 85 in Gangyan. Collected information includes tenure status of the plots, inputs and the output of each plot, plot characteristics, and soil quality.

5.3.1 Model specification

The objective of this chapter is to measure the impact of household land rental market participation, the tenure status of the plot, and off-farm employment on land investment, input

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[31] Only plots cultivated with rice are included in the sample as rice is the most important crop in the research area.

use, and land productivity. The theoretical framework in section 5.2 suggests the variables that potentially affect agricultural production in rural China. An overview of the dependent and explanatory variables included in the analysis, subdivided by land market regimes and tenure status of the plot, is presented in Table 5.1.

Table 5.1 Descriptive statistics of the variables used in the plot level analyses

Item	Unit	Renting in household		Self-sufficient household	All plots
		Contracted	Rented	Contracted	
Number of sample plots		60	43	112	215
			Mean (standard deviation)		
Dependent variables					
Rice yield	*Yuan/mu*	327.41 (79.76)	355.40 (81.41)	259.69 (79.13)	297.73 (89.30)
Input use					
-Labour	Man day/ *mu*	37.58 (19.96)	37.72 (36.04)	43.42 (19.58)	40.65 (23.92)
-Chemical fertilisers	*Yuan*	53.98 (30.94)	54.93 (13.54)	40.28 (21.72)	47.03 (24.39)
Land investment					
-Green manure	0 or 1	0.32 (0.47)	0.19 (0.39)	0.39 (0.49)	0.33 (0.47)
-Organic manure	0 or 1	0.50 (0.50)	0.37 (0.49)	0.47 (0.50)	0.46 (0.50)
Independent variables					
Rented in plot	0 or 1	-	-	-	0.20 (0.40)
Household renting in land[a]		0.72 (0.29)	0.77 (0.27)	0.14 (0.20)	0.43 (0.39)
Household renting in land[a] × rented in plot interaction		**0.00 (0.00)**	**0.77 (0.27)**	0.00 (0.00)	0.16 (0.33)
Participate in migration	0 or 1	0.53 (0.50)	0.40 (0.49)	0.54 (0.50)	0.51 (0.50)
Participate in local off-farm	0 or 1	0.20 (0.40)	0.12 (0.32)	0.29 (0.45)	0.23 (0.42)
Fertility		1.93 (0.84)	2.09 (0.84)	1.93 (0.80)	1.96 (0.82)
Topsoil depth	Cm	16.73 (4.54)	17.80 (3.86)	16.36 (3.74)	16.75 (4.02)
Plot size	*Mu*	1.83 (1.17)	2.46 (2.59)	1.49 (1.23)	1.78 (1.62)
Distance from home	Minute	**11.76 (8.22)**	**17.92 (13.63)**	11.23 (10.29)	12.71 (10.81)
Household size	Persons	5.60 (1.44)	5.40 (1.43)	4.79 (1.91)	5.13 (1.73)
Number of dependents	Persons	1.98 (1.32)	2.26 (1.42)	1.39 (1.02)	1.73 (1.24)
Number of durable assets		7.08 (1.41)	7.30 (1.32)	6.46 (1.67)	6.80 (1.57)
Total number of cattle		1.17 (1.76)	2.16 (3.22)	0.67 (0.47)	1.11 (1.82)
Average adult age	Years	35.86 (4.21)	35.27 (3.41)	37.03 (6.09)	36.35 (5.19)
Average adult education	Years	4.99 (1.71)	4.98 (1.78)	5.00 (2.03)	4.99 (1.88)
Female to male adult ratio		1.12 (0.67)	1.14 (0.57)	1.09 (0.69)	1.11 (0.66)
Number of plots		4.33 (1.74)	4.30 (1.32)	4.98 (1.96)	4.67 (1.81)
Irrigated land per adult	*Mu*	**2.39 (1.65)**	**3.25 (2.10)**	2.06 (1.38)	2.39 (1.68)
Banqiao Dummy	0 or 1	0.22 (0.42)	0.12 (0.32)	0.34 (0.48)	0.26 (0.44)
Shangzhu Dummy	0 or 1	0.15 (0.36)	0.07 (0.26)	0.55 (0.50)	0.34 (0.48)

Note: [a]: Household renting in decisions are predicted probabilities by estimating a probit model in Appendix 5.2.
     Difference in means within renting in household group is statistically significant for variables highlighted in bold.
Source: Farm household survey

As mentioned, the dependent variables in this chapter are land investment, input use, and

land productivity. Land investment includes long-term or fixed investment (e.g. wells and fences), fruit trees, and medium-term soil investment (e.g. manuring and fallowing) (Hayes *et al.*, 1997). In this analysis, land investment is represented by green manure planting and organic manure application[32] as no data on other types of land investment on rice plots in the dataset is available. The land investment variable is a dummy variable equal to one if the household invests on the plot. As can be seen from Table 5.1, green manure is planted on 33% of the plots, and organic manure is applied on 46% of the plots in the sample.

Input use includes labour and chemical fertilisers[33]. These inputs are aggregated in terms of volume or value per unit area. Labour is measured in man days. There are five different commonly used types of chemical fertilisers, which are aggregated and measured in value terms. Households grow either a single, or a double, rice crop in the surveyed area. Rice yields vary for different varieties and are aggregated and measured in values per unit area. As can be seen from Table 5.1, the average rice yield is 297.73 *yuan* per *mu*[34], and households work on average around 40 days on each *mu* of land.

As indicated in equations (5.3), (5.4), (5.5), and (5.6), explanatory variables in the analysis include indicators of plot tenure security, plot characteristics, farm characteristics, household characteristics, household land and labour endowments, land rent, market wage rate, non-labour input prices, and household participation in the land rental market and off-farm employment. Tenure security (*TS*) is represented by the tenure status of the plot. Two plot tenure statuses can be distinguished: contracted and rented in. Contracted plots are those plots distributed directly by the village collective. Rented in plots are the plots rented from other households. Of all the plots in the analysis, 172 plots are contracted, and 43 plots rented

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[32] The research on the effect of tenure security on land investment focuses on the use of green manure planting and organic manure application as the main forms of land investment in rural China (Jacoby *et al.*, 2002; Li *et al.*, 1998; Yao, 1998). Some studies in Africa have addressed the long-term or fixed investment and the planting of trees and have produced mixed results (Besley, 1995; Brasselle *et al.*, 2002; Deininger *et al.*, 2003a; Gebremedhin and Swinton, 2003; Hayes *et al.*, 1997; Holden and Yohannes, 2002; Place and Otsuka, 1997; Smith, 2004).

[33] Data are also available on seed, herbicides and pesticides and animal traction. These inputs are not included in the analysis for simplicity, because they are relatively minor inputs.

[34] The calculation of the rice yield is based on prices for the year 2002. Since the autumn of 2003, rice prices have increased rapidly.

in. A dummy variable, which equals one if the plot is rented in, is used to indicate whether a plot is rented in or contracted. The land rental arrangements are normally verbal and of short duration. Rented in plots are therefore less secure than contracted plots and are expected to receive less land investment and, thus to produce less output. However, it is expected that the use of variable inputs is higher on rented in plots because households renting in land tend to maximise short-term agricultural profits on these plots. Thus the effect of tenure security on yield is ambiguous.

Plot characteristics (Z^p) are represented by soil quality indicators, plot size, and distance from the home. Soil quality indicators include fertility and topsoil depth. Households in the survey were asked their perceptions about soil quality, which were given a value of one if households perceived soil fertility as low, two if households perceived soil fertility as average, and three if households perceived soil fertility as high. Topsoil depth is estimated by soil scientists, and measured in centimetres. It is expected that land productivity is higher on plots with high soil quality and topsoil depth. The effect of soil quality on land investment and use of chemical fertiliser is expected to depend on the marginal returns of land investment and chemical fertiliser use on plots with different soil fertility. Land investment and chemical fertiliser use may be higher on fertile plots, if the marginal returns of land investment and chemical fertiliser use are higher than on plots with low soil fertility, but to be lower if the marginal returns are lower. It is uncommon for the households in the surveyed villages to plant green manure and apply organic manure on only part of a plot. Organic manure is very limited, and tends to be applied to small plots or those planted with cash crops. Large plots are easier to manage and have higher input use efficiency (economies of scale), and therefore are expected to receive less inputs. The impact of large plots on rice yield is unclear. Distance between home and each plot is measured in minutes travel time. Longer travel time raises the cost of carrying organic manure and other inputs from home. Planting green manure on distant plots is sometimes risky because of high supervision costs involved in keeping out wild animals. Distance from home is thus expected to reduce land investment, the use of inputs, and rice yield. The square of this variable is added to the equation to capture possible nonlinearities in its impact.

Farm characteristics (Z^q) are represented by the number of cattle in a household at the end of the previous year, the average adult age, the average adult education, the ratio of

female to male adults, and the number of plots that a household has. In the research area, organic manure cannot be exchanged in the market. Therefore the number of cattle in a household is expected to increase land investment, and therefore land productivity. Cattle are very important draft animals for small-scale households in rural China. Their use is expected to have a positive impact on land productivity. Average adult age and education is used as a proxy for the skills and experience of a family. Households with older members and higher education have more skills and experience and are more productive in agriculture. Average adult age and education are expected to have a positive effect on green manure planting and organic manure application because older farmers like to stick to farming traditions and well-educated farmers are more aware of the potential benefits of land investment. The ratio of female to male adults is used to test for differences between females and males in physical strength or other differences in agricultural production. Transporting organic manure and cutting the roots of green manure for land preparation requires much physical strength. It is therefore expected that a higher value of this ratio leads to less land investment, more chemical fertiliser use and less labour input. The number of plots in a household is an indicator of land fragmentation, which can have either negative or positive effects on agricultural production (Tan, 2005). On the one hand, a larger number of plots needs more labour to manage (Nguyen *et al.*, 1996). On the other land, it enables the households to diversify agricultural production and reduce risk (Bentley, 1987), and to optimise their labour allocation over different crop varieties and seasons, especially when there is no market for agricultural labour (Fenoaltea, 1976).

Household characteristics (Z^h) are represented by the number of durable assets in a household, household size, number of dependents in a household, and the ratio of female to male adults. These factors have a direct effect on household consumption preferences, and can have either positive or negative effects on the demand for leisure and consumption goods. As argued in Chapter 2 and 3, it may be expected that larger households and households with fewer dependents consume more food at a given income level. If household decisions are non-separable, this will put an upward pressure on agricultural production and therefore stimulate land investment, input use, and land productivity.

The household time endowment ($\bar{L}$) equals household size minus the number of dependents. In addition, household time endowment may depend on the ratio of female to

male adults, as taking care of children and doing housework is usually a female task in Chinese society. If household decisions are non-separable, land investment, labour use, and rice yield are expected to be positively related to the household labour endowment. The household land endowment ($\bar{A}$) is represented by the amount of irrigated land contracted per adult. If household decisions are non-separable, land investment, labour use and rice yield are expected to be negatively related to the household land endowment.

The market land rent (r), wage rate (w), and non-labour input prices (p_X) are exogenous in the model, and are assumed to be the same for all households living in the same village. They are therefore captured by village dummy variables.

As mentioned previously, household participation in the land rental market (A^{in}) is expected to increase agricultural productivity because a developed land rental market enables the transfer of land from less productive, to more productive, households. Following Pender and Fafchamps (2006), the interaction between households' participation in the land rental market and the rented in plot dummy is included in the model to test for differences in land investment, input use, and rice yield on contracted and rented in plots for households that rent in land. This is because it is not possible to determine these differences from the average effect of either the tenure status of the plot or from household participation in the land rental market.

Off-farm employment (l^o) affects agricultural production in many ways. The first is through the lost-labour effect. Off-farm employment can be expected to reduce land investment, the use of labour, and therefore land productivity if hiring in agricultural labour incurs transaction costs and hired labour is not as efficient as family labour. The second is through the income effect. Off-farm employment is expected to increase household incomes, and thereby increase the use of material inputs and land productivity (Rozelle *et al.*, 1999b; Taylor *et al.*, 2003). The third is through the reduced-consumption effect. Off-farm employment reduces the food consumption by household members working off-farm (e.g. migrated members), and hence reduce agricultural production if household production and consumption decisions are non-separable (Burger, 1994; Wouterse, 2006). Off-farm employment includes local off-farm employment and migration. Local off-farm employment may only have an income effect because household members that involved in local off-farm employment normally live and consume at home, and combine local off-farm employment

with on-farm agricultural production, while migration has all three effects.

5.3.2 Estimation method

Ideally, one would like to investigate all the structural relationships[35] between land rental market participation, off-farm employment and agricultural production using a systems approach to deal with endogeneity, and account for correlation of error terms across different equations. As mentioned, data on household participation in off-farm employment was collected for the year 2000, while data on plot level agricultural production was collected for the year 2002. Thus it is not possible to investigate the structural relationship between migration, remittances and agricultural production. In addition, in this analysis the land investment variable is binary and estimation of the resulting system with three-stage least squares estimation is not feasible. The estimation (equations (5.3), (5.4), (5.5), and (5.6)) is therefore based on the nature of each dependent variable. The land investment variable is binary, and thus estimated by a probit model. Input use and rice yield variables are continuous, and thus estimated by ordinary least squares regression.

All explanatory variables in the analysis are exogenous, except for households' participation in land renting in and off-farm employment, which may be endogenous as they depend on household characteristics, farm characteristics, household land and labour endowments, institutional factors, and market rent, wage, and other prices as indicated in equations (5.1) and (5.2) in section 5.2. As mentioned, data on plot level agricultural production was collected two years later. Household participation in off-farm employment is therefore treated as an exogenous variable in the analysis, and represented by households' participation in local off-farm employment and migration in the year 2000.

Decisions on land renting in were made in the year 2002 and may therefore be endogenous. Inclusion of endogenous variables in the estimation may result in biased estimates. Instrumental variables are used to address this endogeneity problem. A probit model is first used to estimate land renting in at the farm household level, and to predict the probability of households' participation in land renting in. This is then used as an instrument

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[35] The structural relationship between tenure security, land investment, input use, and land productivity has been discussed in Feder *et al.*(1988), Hayes *et al.*(1997) and Place and Hazell (1993). The structural relationship between migration, remittances, and agricultural production has been discussed in Rozelle et al. (1999b) and Taylor et al. (2003).

for the actual participation in the land rental market in estimating equations (5.3), (5.4), (5.5), and (5.6). Estimated standard errors are robust to heteroskedasticity and possible non-independence of different plots managed by the same household for all regressions.

5.4 Regression results

5.4.1 Determinants of renting in land

The dependent variable for renting in land is a binary variable, which equals one if the household rented in land in year 2002 and otherwise zero. The explanatory variables and their expected effects were specified and discussed in detail in Chapter 2 and 3. Summary statistics of the explanatory variables, grouped by households' land market participation decisions, are presented in Appendix 5.1.

Of all the households in the three villages, 19 households rented in irrigated land in 2002. The results of the probit model are presented in Appendix 5.2. As expected, well-educated households tend to rent in land. A U-shaped relationship is found between land availability and land renting in decisions. This finding confirms the result in Chapter 2 that households with both low and high land availability are more likely to rent additional land. A possible explanation is that households with relatively large land availability tend to specialise in agricultural production and therefore want to enlarge their farm size. The turning point is 2.92 *mu*.

Land transfer rights indicator positively affects land renting in decisions. This confirms the hypothesis that households who enjoy more land transfer rights tend to rent additional land. Households' migration experience does not affect land renting in. The results for the two village dummy variables indicate that there are significant differences between the villages in market wage, land rent and other variables affecting renting in land. Households in Banqiao and Shangzhu villages are less likely to rent additional land than those in Gangyan village.

5.4.2 Determinants of land investment

Table 5.2 shows the estimation results for green manure planting and organic manure application. As expected, rented in plots are found to receive less land investment. This result supports the findings of Jacoby *et al.* (2002), Li *et al.* (1998), and Yao (1998) that tenure security has a positive effect on land investment. Interestingly, renting in land has a negative effect on green manure plantation. This finding indicates that households that rent in land

reduce green manure to increase the intensity of land use. Households that rent in land are found to make the same investment on rented in plots as on their contracted plots. This is shown by the insignificance of the sum of the coefficients for rented in plots and the interaction term between household renting in land and rented in plot (see Appendix 5.3).

Table 5.2 Determinants of land investment – instrumental variable regression

Independent variables	Green manure	Organic manure
Type of tenure		
Rented in plot	-1.05 (-1.69)*	-2.01 (-2.16)**
Land rental market participation and off-farm employment		
Household renting in land[a]	-1.27 (-2.13)**	0.61 (0.84)
Household renting in land[a] × rented in plot interaction	0.85 (1.00)	2.42 (2.02)**
Participate in migration (1=yes)	-0.40 (-0.71)	0.56 (1.35)
Participate in local off-farm (1=yes)	-1.12 (-2.26)**	0.92 (2.20)**
Other variables		
Fertility	-0.95 (-5.88)***	-0.82 (-4.61)***
Ln topsoil depth (cm)	-0.52 (-1.06)	-1.39 (-2.74)***
Ln plot size (*mu*)	-0.40 (-2.02)**	-0.14 (-0.71)
Ln distance from home (minutes)	1.49 (3.13)***	0.34 (0.84)
Ln distance from home squared	-0.29 (-2.39)**	-0.07 (-0.71)
Ln household size (persons)	-0.11 (-0.14)	-1.22 (-1.47)
Ln number of dependents (persons)	-0.42 (-0.86)	0.09 (0.23)
Ln number of durable assets	0.79 (1.59)	0.11 (0.25)
Ln total number of cattle	0.38 (1.08)	-0.03 (-0.08)
Ln average adult age (years)	-0.62 (-0.52)	-0.24 (-0.20)
Ln average adult education (years)	-0.33 (-0.88)	0.53 (1.56)
Ln ratio of female to male adults	-0.23 (-0.44)	0.19 (0.30)
Ln number of plots	-0.004 (-0.01)	0.40 (1.01)
Ln irrigated land per adult (*mu*)	-0.44 (-0.98)	-0.88 (-2.09)**
Banqiao dummy	0.46 (0.88)	-1.05 (-2.13)**
Shangzhu dummy	-0.92 (-1.49)	-0.55 (-1.01)
Intercept	4.47 (0.83)	6.32 (1.15)
Number of observations	215	215
Log likelihood	-97.82	-101.87
Pseudo R^2	0.28	0.31

Note: [a]: Household renting in decisions are predicted probabilities by estimating a probit model in Appendix 5.2.
    *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. z-statistics are in parentheses. Standard errors are robust to heteroskedasticity and to possible non-independence of different plots from the same household. Test for multicollinearity among included variables show that mean variance inflation factor (VIF) is equal to 3.54. VIF for type of tenure and the interaction term are 9.08 and 10.43 respectively. However, this is inevitable since they must be included for the test. Estimations treating household land renting in decision as exogenous are carried out, Hausman Tests are performed to test if there are no systematic differences in estimators, and the hypotheses are accepted both for green manure planting (Prob>chi2=0.98) and for the use of organic manure (Prob>chi2=1.00).

Participation in local off-farm employment has a negative effect on green manure plantation, but a positive effect on the use of organic manure. This finding indicates that

households involved in local off-farm employment can combine local off-farm employment with on-farm agricultural production and therefore reduce planting green manure to increase the intensity of land use and increase organic manure use.

Of the soil quality indicators, soil fertility and topsoil depth are found to have a negative impact on land investment, indicating that the marginal return of land investment is higher on plots with low soil fertility. Large plots are less likely to receive green manure plantation, possibly because of the substantial effort required to clear the field of the roots of the green manure prior to planting rice. Interviews during the fieldwork suggested this explanation.

Distance from home also has an effect on green manure plantation. It shows an inverted U-shaped relationship, with the turning points at a travel time of around 13.6 minutes from home. So, plots that are close to and distant from the home receive less green manure plantation. Nearby plots require less travel costs and thus are used for crop production. Distant plots require high supervision costs, and therefore receive less green manure plantation. These findings were confirmed by farmers during interviews. They mentioned that it is very difficult to prevent cattle and wild pigs from eating green manure on distant plots.

As expected, land availability has a negative effect on the use of organic manure. Keeping other factors constant, farmers use less green manure in Banqiao village.

5.4.3 Determinants of chemical fertiliser use

Table 5.3 shows the regression results for chemical fertiliser use. The use of chemical fertilisers does not differ significantly between rented in plots and contracted plots. This finding confirms the results of Jacoby *et al.* (2002), Li *et al.* (1998), and Yao (1998) that tenure security does not affect short-term input use. Renting in land does not have an effect on chemical fertiliser use. Households that rent in land, however, use more chemical fertiliser inputs on the plots they rent in than on those they contract from the village collective. This is shown by the positive sum of the coefficients for rented in plot and the interaction term between household renting in land and rented in plot (see Appendix 5.3). This may be a response to the relative insecurity of tenure of the rented in plots, where households wish to maximise their return within a short period, and therefore use more chemical fertilisers to improve their yield.

Participation in off-farm employment does not have an effect on chemical fertiliser use. In terms of this model, this means that participation in off-farm employment does not have an

income effect. A possible explanation of this finding is that within the research area households involved in off-farm employment normally use the remittances for other purposes, such as building a house, marriage, etc., which is a common phenomenon in rural China.

Table 5.3 Determinants of the use of chemical fertilisers – instrumental variable regression

Independent variables	Chemical fertilisers
Type of tenure	
Rented in plot	0.10 (0.52)
Land rental market participation and off-farm employment	
Household renting in land[a]	0.03 (0.15)
Household renting in land[a] × rented plot interaction	0.03 (0.14)
Participate in migration (1=yes)	0.10 (0.93)
Participate in local off-farm (1=yes)	-0.11 (-0.89)
Other variables	
Fertility	-0.01 (-0.33)
Ln topsoil depth (cm)	-0.20 (-1.82)*
Ln plot size (*mu*)	-0.02 (-0.59)
Ln distance from home (minutes)	0.02 (0.13)
Ln distance from home squared	0.01 (0.18)
Ln household size (persons)	-0.83 (-3.90)***
Ln number of dependents (persons)	0.53 (3.50)***
Ln number of durable assets	0.11 (0.94)
Ln total number of cattle	0.15 (1.32)
Ln average adult age (years)	-0.83 (-2.41)**
Ln average adult education (years)	-0.04 (-0.39)
Ln ratio of female to male adults	0.09 (0.49)
Ln number of plots	-0.01 (-0.12)
Ln irrigated land per adult (*mu*)	-0.36 (-3.22)***
Banqiao dummy	0.26 (1.79)*
Shangzhu dummy	-0.64 (-3.56)***
Intercept	8.12 (5.20)***
Number of observations	215
R^2	0.40

Note: [a]: Household renting in decisions are predicted probabilities by estimating a probit model in Appendix 5.2. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. t-statistics are in parentheses. Standard errors are robust to heteroskedasticity and to possible non-independence of different plots from the same household. Test for multicollinearity among included variables show that variance inflation factor (VIF) for type of tenure and the interaction term are 9.10 and 10.50 respectively. This is inevitable since they must be included for the test. Estimations treating household land renting in decision as exogenous are carried out, Hausman Test is performed to test if there are no systematic differences in estimators, and the hypothesis is accepted (Prob>chi2=1.00).

Topsoil depth negatively affects the use of chemical fertilisers. With respect to household characteristics, large households with fewer dependents tend to use less chemical fertilisers, which is against expectations. As expected, the average adult age reduces the use of chemical fertilisers. Land availability has a negative impact on the use of chemical fertilisers, indicating possible cash constraints. Keeping other things constant, households in Banqiao village use

more chemical fertilisers than that in Gangyan village, while households in Shangzhu village use less chemical fertilisers than that in Gangyan village.

5.4.4 Determinants of labour use

Table 5.4 shows the regression results for labour use. As can be seen from the middle column, labour use does not differ between rented in plots and contracted plots. Renting in land does not affect labour use. For households that rent in land, there is also no difference in labour use between rented in and contracted plots (see Appendix 5.3). Participation in migration does not have an effect on labour use. In terms of the model, it means that migration does not lead to a lost-labour effect, which may be due to the small farm sizes and large labour surplus in rural China.

As expected, plot size is found to have a negative impact on labour use. This suggests that large plots have higher input use efficiency because of economies of scale. Measurement errors in measuring plot size may also result in such a negative effect on labour use. A 1% increase in plot size can lead to a 0.13% decrease in labour use per *mu*. An inverted-U shaped relationship is found between the distance of the plot from home and the use of labour, which confirms the earlier finding by Tan (2005). The turning point is about 8.7 minutes from home. Data on labour use in the survey include travel time to the plots. Therefore, this finding should be interpreted with caution. Surprisingly, the number of durable assets in a household has a positive effect on labour use. Keeping other things constant, households in Shangzhu village use more labour in rice production than that in Gangyan village.

As mentioned previously, if household production and consumption decisions are separable, labour use will not depend on household characteristics. The joint significance of household characteristics variables is tested, and the result indicates that household production and consumption decisions are globally separable (see Chapter 4 for details). The same model can therefore be estimated without household characteristics. Estimation results are presented in the last column of Table 5.4, which is consistent with the previous findings.

Table 5.4 Determinants of labour use – instrumental variable regression

Independent variables	Labour	
Type of tenure		
Rented in plot	0.37 (1.28)	0.36 (1.13)
Land rental market participation and off-farm employment		
Household renting in land[a]	0.002 (0.01)	-0.07 (-0.30)
Household renting in land[a] × rented plot interaction	-0.43 (-1.16)	-0.41 (-1.03)
Participate in migration (1=yes)	-0.04 (-0.37)	0.01 (0.11)
Participate in local off-farm (1=yes)	-0.06 (-0.55)	0.001 (0.01)
Other variables		
Fertility	0.03 (0.75)	0.03 (0.97)
Ln topsoil depth (cm)	-0.02 (-0.18)	-0.06 (-0.40)
Ln plot size (*mu*)	-0.13 (-2.93)***	-0.12 (-2.66)***
Ln distance from home (minutes)	0.43 (2.98)***	0.39 (2.72)***
Ln distance from home squared	-0.10 (-2.67)***	-0.09 (-2.47)**
Ln household size (persons)	0.14 (0.64)	
Ln number of dependents (persons)	-0.19 (-1.24)	
Ln number of durable assets	0.22 (2.30)**	
Ln total number of cattle	-0.05 (-0.36)	-0.003 (-0.02)
Ln average adult age (years)	0.43 (1.16)	0.29 (0.85)
Ln average adult education (years)	-0.07 (-0.65)	-0.04 (-0.32)
Ln ratio of female to male adults	0.04 (0.16)	
Ln number of plots	0.07 (0.61)	0.09 (0.84)
Ln irrigated land per adult (*mu*)	-0.01 (-0.05)	-0.10 (-1.03)
Banqiao dummy	-0.08 (-0.58)	-0.13 (-0.94)
Shangzhu dummy	0.44 (1.96)*	0.29 (1.48)
Intercept	1.16 (0.67)	2.29 (1.62)*
Number of observations	215	215
R^2	0.38	0.36

Note: [a]: Household renting in decisions are predicted probabilities by estimating a probit model in Appendix 5.2.
    *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. t-statistics are in parentheses. Standard errors are robust to heteroskedasticity and to possible non-independence of different plots from the same household. Test for multicollinearity among included variables show that variance inflation factor (VIF) for type of tenure and the interaction term are 9.10 and 10.50 respectively. This is inevitable since they must be included for the test. Estimations treating household land renting in decision as exogenous are carried out, SUEST Test is performed and no evidence is found that there are differences between estimators (Prob>chi2=1.00).

5.4.5 Determinants of rice yield

Table 5.5 shows regression results for rice yield. As can be seen from the middle column, rice yield does not differ between rented in plots and contracted plots. This finding confirms the results of Jacoby *et al.* (2002), Li *et al.* (1998) and Yao (1998) that tenure security does not affect yield because, compared with other agricultural inputs, land investment plays a minor role in agricultural production. Surprisingly, participation in land renting in does not have an effect on rice yield. For households that rent in land, no difference is found in rice yield between rented in plots and contracted plots (see Appendix 5.3). This finding indicates that

there is no efficiency loss on rented in plots relative to contracted plots (Pender and Fafchamps, 2006; Shaban, 1987). Equally, participation in off-farm employment does not have an effect on rice yield.

Table 5.5 Determinants of rice yield − instrumental variable regression

Independent variables	Yield	
Type of tenure		
Rented in plot	0.18 (1.07)	0.20 (1.17)
Land rental market participation and off-farm employment		
Household renting in land[a]	0.18 (1.42)	0.21 (1.91)*
Household renting in land[a] × rented plot interaction	-0.25 (-1.24)	-0.27 (-1.35)
Participate in migration (1=yes)	-0.03 (-0.31)	-0.03 (-0.37)
Participate in local off-farm (1=yes)	-0.09 (-1.05)	-0.08 (-0.89)
Other variables		
Fertility	0.06 (2.77)***	0.07 (2.68)***
Ln topsoil depth (cm)	0.15 (1.92)*	0.15 (1.77)*
Ln plot size (*mu*)	-0.04 (-1.51)	-0.04 (-1.51)
Ln distance from home (minutes)	-0.09 (-0.74)	-0.09 (-0.81)
Ln distance from home squared	0.02 (0.60)	0.02 (0.66)
Ln household size (persons)	-0.07 (-0.40)	
Ln number of dependents (persons)	0.07 (0.71)	
Ln number of durable assets	0.06 (0.77)	
Ln total number of cattle	-0.06 (-1.31)	-0.06 (-1.26)
Ln average adult age (years)	0.19 (0.96)	0.26 (1.33)
Ln average adult education (years)	0.02 (0.32)	0.04 (0.70)
Ln ratio of female to male adults	-0.08 (-0.81)	
Ln number of plots	-0.21 (-2.81)***	-0.20 (-2.96)***
Ln irrigated land per adult (*mu*)	0.07 (0.83)	0.11 (1.68)*
Banqiao dummy	-0.09 (-0.96)	-0.09 (-0.97)
Shangzhu dummy	-0.34 (-2.59)**	-0.31 (-2.89)***
Intercept	4.87 (5.18)***	4.58 (5.77)***
Number of observations	215	215
R^2	0.50	0.49

Note: [a]: Household renting in decisions are predicted probabilities by estimating a probit model in Appendix 5.2. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. t-statistics are in parentheses. Standard errors are robust to heteroskedasticity and to possible non-independence of different plots from the same household. Test for multicollinearity among included variables show that variance inflation factor (VIF) for type of tenure and the interaction term are 9.10 and 10.50 respectively. This is inevitable since they must be included for the test. Estimations treating household land renting in decision as exogenous are carried out, SUEST Test is performed and no evidence is found that there are differences between estimators (Prob>chi2=0.99).

As expected, soil fertility and topsoil depth do increase rice yield. The number of plots in a household negatively affect rice yield, which indicates that land fragmentation reduces rice yield. Plots in Shangzhu village have a lower rice yield compared to those in Gangyan village, which is consistent with the earlier results by Tan (2005). Keeping other things constant, rice yield in Shangzhu village is 34% lower than that of Gangyan.

Test is also made for the joint significance of household characteristics variables, and it shows that household production and consumption decisions are globally separable. The same model is therefore estimated without household characteristics. Estimation results are presented in the last column of Table 5.5. Comparing the two columns, it is found that the regression results are generally consistent except for the effect of renting in land and labour availability on rice yield. Participation in land renting in has a positive effect on rice yield. This finding confirms our expectation and the result of earlier research by Lohmar *et al.* (2001) that land rental markets could facilitate the transfer of land from less productive households to more productive households. Surprisingly, land availability positively affects rice yield, indicating either an increasing returns to scale or imperfections in factor markets.

5.5 Conclusions and policy implications

Development of land rental markets has important implications for allocative efficiency and agricultural productivity. Off-farm employment can also have important effects on agricultural production. Applying household and plot level data, this chapter investigates the effect of land rental market participation, and the resulting land tenure contracts, and off-farm employment on agricultural production in three villages in Northeast Jiangxi province.

The empirical results indicate that rented in plots are found to receive less land investment than contracted plots. Chemical fertiliser use, labour use, and rice yield, however, do not differ between the two types of plot. This finding suggests that tenure security has a positive effect on long-term land investment, but no effect on short-term input use and yield.

Land renting in has a negative effect on green manure plantation. This finding indicates that households that rent in land reduce green manure plantation to increase land use intensity. Participation in the land renting in has a positive effect on rice yield, which indicates that the development of the land rental market allows land to be transferred to those households that are more capable of earning a high return from agricultural production. The results therefore suggest that policies to stimulate the development of land rental markets could contribute significantly to agricultural production in rural China.

Households that rent in land use more chemical fertiliser inputs on the rented in plots than on contracted plots. One possible explanation for this is that households that rent in land tend to maximise their return from rented-in plots within a short period, and therefore use more

chemical fertilisers to increase rice yield. However, in other respects (land investment, labour use, and rice yield) there is no discernable difference between rented in plots and contracted plots. This finding confirms that there is no efficiency loss in yield on rented in plots relative to contracted plots.

Participation in local off-farm employment has a negative effect on green manure plantation, but a positive effect on the use of organic manure. This finding indicates that households involved in local off-farm employment can combine local off-farm employment with on-farm agricultural production and therefore reduce green manure to increase land use intensity and increase organic manure use. Participation in off-farm employment does not have an effect on chemical fertiliser use, labour use, or rice yield. In terms of the model, off-farm employment does not induce the lost-labour, income, or reduced consumption effect. A possible explanation of this finding is that agricultural production in the research area is characterised by the small farm sizes and large labour surplus and the remittances send by migrants are mainly used for non-agricultural purposes, such as building houses, marriage, etc.

Appendix 5.1 Descriptive statistics of the variables used in land rental market participation

Item	Unit	Type of household		
		Self-sufficient in land	**Renting in land**	**All households**
Number of sample households		33	19	52
		Means (Std. Dev.)		
Household size	persons	4.70 (1.86)	5.47 (1.50)	4.98 (1.77)
Number of dependents	persons	1.33 (0.99)	1.79 (1.32)	1.50 (1.13)
Number of durable assets		6.52 (1.82)	7.11 (1.41)	6.73 (1.69)
Total number of cattle		0.67 (0.48)	1.32 (2.19)	0.90 (1.39)
Average adult age	Years	37.12 (6.26)	36.30 (4.30)	36.82 (5.59)
Average adult education	years	4.97 (1.95)	4.99 (1.80)	4.98 (1.88)
Ratio of female to male adults		1.13 (0.74)	1.23 (0.79)	1.17 (0.75)
Irrigated land per adult	*mu*	1.88 (1.26)	2.24 (1.76)	2.01 (1.46)
Possession land contract	0 or 1	0.15 (0.36)	0.21 (0.42)	0.17 (0.38)
Land transfer rights		**0.56 (0.13)**	**0.64 (0.13)**	0.59 (0.13)
Participate in migration	0 or 1	0.52 (0.51)	0.53 (0.51)	0.52 (0.50)
Participation in local off-farm	0 or 1	0.33 (0.48)	0.21 (0.42)	0.29 (0.46)
Banqiao Dummy	0 or 1	0.33 (0.48)	0.21 (0.42)	0.29 (0.46)
Shangzhu Dummy	0 or 1	**0.55 (0.51)**	**0.16 (0.38)**	0.40 (0.50)

Note: Difference in means between self-sufficient and renting in households is statistically significant for variables highlighted in bold.
Source: Farm household survey

Appendix 5.2 Determinants of land renting in– probit model

Independent variables	Estimated coefficients (z-score)
Ln household size (persons)	2.06 (1.23)
Ln number of dependents (persons)	-0.49 (-0.45)
Ln number of durable assets	-0.31 (-0.37)
Ln total number of cattle	0.54 (0.69)
Ln average adult age (years)	117.45 (0.97)
Ln average adult age squared	-16.28 (-0.96)
Ln average adult education (years)	1.38 (1.78)*
Ln ratio of female to male adults	-0.01 (-0.00)
Ln irrigated land per adult (*mu*)	-2.43 (-3.24)***
Ln irrigated land per adult squared	1.14 (2.71)***
Possession land contract (1=yes)	0.65 (1.03)
Land transfer rights	6.79 (3.16)***
Participate in migration (1=yes)	-0.75 (-0.85)
Participation in local off-farm (1=yes)	0.20 (0.30)
Banqiao Dummy	-2.42 (-3.17)***
Shangzhu Dummy	-3.71 (-4.81)***
Intercept	-217.99 (-1.01)
Number of observations	52
Log likelihood	-16.50
Pseudo R^2	0.52
Correctly specified (%)	78.85

Note: * and *** indicate statistical significance at the 10% and 1% levels respectively. Standard errors are robust to heteroskedasticity. Test for multicollinearity among included variables show that mean variance inflation factor (VIF) is equal to 2.07 and that VIF for each individual variables is lower than 10.

Appendix 5.3 Hypothesis tests

Hypothesis	Renting in household rented in plot – renting in household contracted plot= 0
Green manure	-0.20 (0.63)
Organic manure	0.42 (0.35)
Chemical fertilisers	0.13 (0.10)*
Labour	-0.05 (0.68)
Yield	-0.06 (0.18)

Note: p values are in parentheses.
* indicates statistical significance at the 10% level.

CHAPTER 6   Discussion and Conclusions

6.1 Introduction

As a result of over 25 years of economic reforms, China has made rapid progress in increasing agricultural productivity and farmers' incomes as well as alleviating poverty. However, agricultural productivity and rural industrial growth have slowed down in recent years, and income inequality has increased rapidly between rural and urban households. In 2003, the rural-urban income gap reached the highest ratio (1:3.23) in over 25 years (National Bureau of Statistics of China, 2005a).

Since 2004, promoting agricultural productivity, raising farmers' incomes and narrowing the rural-urban income gap have become the top priorities for the Chinese authorities. In rural China, there is convincing empirical evidence that the agricultural production factor markets, particularly land and labour, face many institutional obstacles (e.g. HRS and *hukou*) and remain underdeveloped (Bowlus and Sicular, 2003; Carter and Yao, 2002). The development of land and labour markets may contribute both to increasing agricultural productivity and rural household incomes and to reducing income inequality between rural and urban areas.

Off-farm employment has become a significant phenomenon in rural China since the mid-1980s, and has attracted much attention from researchers and policy makers, due to its importance in absorbing surplus labour from agriculture, increasing and diversifying household incomes, and alleviating rural poverty. The development of land rental markets in rural China has recently attracted attention because of its increasing incidence and its role in lifting allocative efficiency and agricultural productivity. Research into factor market development and agricultural production in rural China has often focused on either the land or the labour market. However, the growth in importance of both of these in recent years suggests that households may make simultaneous decisions on land and labour market participation. Analysing these phenomena therefore requires a simultaneous approach.

The objective of this study is to improve the understanding of factors determining the participation of farm households in rural land and off-farm labour markets, and identify the consequences of land rental and off-farm labour market participation for allocative efficiency and agricultural productivity in Southeast China. To fulfil this objective, this study uses a farm household model approach and applies data collected for the years 2000 and 2002 from three

villages in Northeast Jiangxi province. This final chapter summarises the main findings and puts them into a policy perspective. In addition, the major innovations of this study, its shortcomings and directions for future research are discussed. The remainder of this chapter is organised as follows. Section 6.2 discusses key debates in the literature on this subject and presents the main findings. Section 6.3 draws some policy implications. In section 6.4, directions for future research are presented.

6.2 Key debates and main findings

6.2.1 Do land rental market participation and off-farm employment influence each other?

The inter-relationship of participation in the land rental market and in the off-farm labour market has received little attention in the literature. The effect of land rental market participation on off-farm employment has been examined by Kung and Lee (2001) and Shi *et al.* (2006), but they take land rental market participation decisions as exogenous. These studies conclude that the development of land rental markets positively affects engagement in off-farm employment. Equally, the effect of off-farm employment on land rental market participation has been addressed by Deininger and Jin (2002), Feng *et al.* (2004), Kung (2002b), Lohmar *et al.* (2001), Yao (2000), and Zhang *et al.* (2004), but only Kung (2002b) and Yao (2000) consider the endogenous character of off-farm employment decisions. They all find that off-farm employment, especially migration, has a positive effect on the development of the land rental market. When major land and labour market imperfections exist, however, land rental market participation and off-farm employment decisions are jointly determined. Therefore, the extent to which participation in land rental markets and off-farm employment influence each other remains an unresolved issue.

Both a single-equation model and a simultaneous-equation model are estimated in Chapter 2 to investigate the inter-relationship between participation in the land rental market and off-farm employment. The empirical evidence indicates that participation in the land rental market and off-farm employment do influence each other. The number of dependents in a household positively affects the amount of land rented in by the household, and negatively affects household migration decisions; the average adult age and land availability show a U-shaped relationship with the amount of land rented in by the household, and show an inverted U-shaped relationship with migration; indicating a strong negative relationship between land

renting in and migration. This result highlights the importance of considering household joint decision making over land rental market participation and off-farm employment in the context of land and labour market imperfections.

6.2.2 Determinants of joint land and labour market participation

Studies on the determinants of land and labour market participation in China have generally focused on either the land or the labour market. So far as can be ascertained, no studies have thus far analysed joint decision making on land and labour market participation under market imperfections. However, as discussed in section 6.2.1, it is crucial to take joint land and labour market participation into account in the presence of land and labour market imperfections.

A multinomial probit model is estimated in Chapter 3 to examine the determinants of the seven most common joint land and labour market participation options. The empirical results indicate that a larger household size and fewer dependents have a positive impact on migration, but not on local off-farm employment. The time endowment effect is counterbalanced by the food consumption effect for local off-farm employment. The fact that, contrary to migrants, people involved in local off-farm employment generally live and consume food at home seems to play an important role here. The number of durable assets in a household has a positive effect on the probability of household involvement in local off-farm employment. This suggests that richer households have better access to local off-farm jobs than poorer households.

The average adult age shows an inverted U-shaped relationship with the likelihood of being involved in migration. Differences in estimated turning points suggests that households involved in migration and renting in land are mainly young migrants who return home after a few years of working elsewhere and reinvest in agriculture. Households with both low and high land availability are less likely to participate in off-farm employment. This finding suggests that households with small land endowments may not be wealthy enough to work off-farm, while households with relatively large land endowments may have difficulties in renting out their land and hence prefer to work on-farm.

The results also show that possession of a land contract and having a social network has a positive effect on migration. Enjoying more land transfer rights has a positive effect on land renting in. These results confirm that households facing low transaction costs in land and

labour markets are more likely to participate in these markets.

6.2.3 Allocative efficiency and (non-)separability under different rural land and labour regimes

In the case of perfect markets, households are expected to be allocatively efficient and their production and consumption decisions are separable (Hoff *et al.*, 1993; Sadoulet and de Janvry, 1995; Sadoulet *et al.*, 1998; Singh *et al.*, 1986). However, when there are market imperfections rural households are differentially integrated into land and labour markets, and the allocative efficiency and (non-)separability of household decision making under different land and labour market participation regimes may therefore also be different (Carter and Yao, 2002; de Janvry and Sadoulet, 2006; Sadoulet *et al.*, 1998).

Previous studies that tested for separability have generally applied two types of tests (Sadoulet and de Janvry, 1995). The first approach is to estimate the reduced-form factor demand or productivity equations and to test whether the estimated coefficients of the household characteristics variables (e.g. household size and its composition) jointly are significantly different from zero (Benjamin, 1992; Benjamin and Brandt, 2002; Bowlus and Sicular, 2003; Gavian and Fafchamps, 1996; Kuiper, 2005). The second approach is to estimate a production function and to test if the marginal value product of labour (shadow wage) is equal to the effective market price (Jacoby, 1993; Skoufias, 1994). Both types of tests are global tests. However, a global test is not appropriate when heterogeneity in resource availability and transaction costs limits market participation for some households, but not for others (de Janvry and Sadoulet, 2006). Regime-specific tests are therefore needed to estimate allocative efficiency and (non-)separability (Carter and Yao, 2002; Sadoulet *et al.*, 1998).

Regime-specific tests have been applied in the context of imperfect land or labour markets to estimate non-separability for different labour regimes in Mexican agriculture (Sadoulet *et al.*, 1998) and for different land regimes in Chinese agriculture (Carter and Yao, 2002). These studies found that household decision making is separable for both seller and buyer labour market participation regimes (in Mexico) and for the land renting out regime, but surprisingly not for the land renting in regime (in China). Building on earlier work by Sadoulet *et al.* (1998) and Carter and Yao (2002), an endogenous switching regression model is estimated in Chapter 4 to analyse the allocative efficiency and (non-)separability of household decision making for households classified according to their participation in land

and labour market regimes.

The findings of this study indicate that households that do not participate in both land and labour markets are allocatively inefficient. It is further shown that households that participate in the land rental market are allocatively efficient whether or not they are involved in off-farm employment, whereas households that participate in the labour market but not in the land rental market are not allocatively efficient. These findings indicate that prevailing imperfections in the off-farm employment market and/or the market for hiring agricultural labour prevent households that only participate in off-farm employment from adjusting their on-farm labour as much as they would like. Allocative inefficiency is found to be highest among households that participate in neither market and is higher for households working in local off-farm employment than for households involved in migration. There is also convincing evidence that household consumption and production decisions are non-separable for households that do not participate in either the land rental or the labour market. For households in the other land and labour regimes, the separability hypothesis could not be rejected.

6.2.4 Land rental market, off-farm employment and agricultural production

Studies on the effect of land rental market development on allocative efficiency and agricultural productivity have found that allocative efficiency and agricultural productivity can be improved because land is transferred from less productive to more productive households, and because the marginal product of land across households with different land-labour endowments is equalised (Carter and Yao, 2002; Lohmar *et al.*, 2001).

Previous studies on the effect of land tenure contracts on agricultural production have focused on South Asia (Binswanger *et al.*, 1993; Otsuka and Hayami, 1988; Shaban, 1987) and Africa (Ahmed *et al.*, 2002; Benin *et al.*, 2005; Gavian and Ehui, 1999; Gavian and Fafchamps, 1996; Pender and Fafchamps, 2006; Place and Otsuka, 1997). Most studies find an efficiency loss of sharecropped land relative to owner-operated land, but no efficiency loss of rented land relative to owner-operated land.

Earlier studies regarding the effect of off-farm employment on agricultural production in China find no lost-labour effect and a positive income effect (Wu and Meng, 1997a, 1997b). Using the "new economics of labour migration" (NELM) framework developed by Stark and Bloom (1985), Rozelle *et al.* (1999b) and Taylor *et al.* (2003) find a negative lost-labour

effect and a positive income effect, with the overall effect of off-farm employment on agricultural production being negative.

When faced with land and labour market imperfections households make simultaneous decisions on land and labour market participation. Chapter 5 therefore makes an empirical analysis of household agricultural production decisions, taking into account household-level decision making on participation in the land rental market and off-farm employment. The analysis is made at the plot level, so that differences in household production decisions between contracted plots and rented in plots can be examined.

The empirical results indicate that rented in plots receive less land investment than contracted plots. Chemical fertiliser use, labour use, and rice yield, however, do not differ between rented in plots and contracted plots. This finding suggests that tenure security has a positive effect on long-term land investment, but no effect on short-term input use and yield. Participation in the land rental market has a positive effect on rice yield, which indicates that the development of a land rental market would allow land to be transferred to households that are more capable of earning a higher return out of agricultural production.

Households that rent in land use more chemical fertilisers on the rented in plots than on contracted plots. This may be a response to the relative insecurity of tenure of the rented in plots, where households wish to maximise their short-term return, and therefore use more chemical fertilisers to increase rice yield. However these households are also found to make the same investment on rented in plots as on their contracted plots, use the same amount of labour and obtain the same rice yield. This finding confirms that there is no efficiency loss in yield on rented in plots relative to contracted plots.

Participation in local off-farm employment appears with a negative effect on green manure plantation, but a positive effect on the use of organic manure. This finding indicates that households involved in local off-farm employment can combine their local off-farm jobs with working on-farm and therefore reduce green manure to increase land use intensity and increase organic manure use. Participation in off-farm employment has no effect on chemical fertiliser use, labour use, and rice yield. In terms of the model, off-farm employment does not have the lost-labour, income, or reduced consumption effect. A possible explanation of this finding is that agricultural production in the research area is characterised by the small farm sizes and large labour surplus and the remittances send by migrants are mainly used for non-

agricultural purposes, such as building houses, marriage, etc.

6.3 Policy implications

The Chinese authorities have identified promoting agricultural productivity, raising farmers' incomes and narrowing the rural-urban income gap as top priorities for the near future. As Nyberg and Rozelle (1999) argue, further growth in agricultural productivity and rural household incomes and a reduction in rural-urban income gap are likely to depend on increases in the productivity of land and labour, and therefore on the development of rural land and off-farm labour markets.

China has witnessed a massive movement of labour away from the farm and an increasing incidence of land rental activities over the past 25 years. Institutional mechanisms, however, still impose substantial restrictions on the development of land rental markets and off-farm employment. The empirical analyses indicate that the development of land rental markets improves allocative efficiency and land productivity, while off-farm employment improves allocative efficiency but not land productivity. By summarising the policy recommendations in previous chapters, a number of policy options can be formulated for further improving the development of rural land rental and off-farm labour markets.

The first is to reform the *hukou* system and land tenure system. The *hukou* system and land tenure system have, for a long time, served as China's strategy to support and stimulate industrial growth. However, they have also limited the development of land and labour markets and thereby constrained increases in agricultural land and labour productivity. The *hukou* system restricts the mobility of labour (and land) resources because rural households moving to urban areas are normally required to pay various fees in the city of destination, have difficulties in getting access to education for their children, various forms of insurance (e.g. income, health) and housing. The present land tenure system, characterised by tenure insecurity and restrictions on land transfer rights, prevents rural households from marketing their land (and labour) resources as land remains the most important asset for farm households in terms of providing basic consumption needs (Burgess, 2001), generating part of their income, and serving as a social safety net (Dong, 1996). Removing *hukou* restrictions, providing a social safety net and equal employment rights for rural households, improving tenure security, reducing restrictions on land right transfers, and providing legal protection to

households are therefore very important prerequisites for developing land rental markets and stimulating off-farm employment, thereby increasing agricultural productivity and rural households' incomes.

The second set of options is to build local institutions that facilitate land transfers and off-farm employment. Land rental market participation and off-farm employment often involve high uncertainty and risk. Land rental transactions tend to be informal, short term, and involve little or no payment. Starting one's own business requires a large amount of initial (sunk) costs. Off-farm jobs imply transportation costs, accommodation in migration destination, and a minimum level of education or technical skills. Rural migrants sometimes cannot find a job, and when they do, these jobs are often dirty and in an unsafe environment. Very low wages and delayed payment (or even no payment) by their employers are very common. Institutions that provide credit and help building information networks may therefore be instrumental in reducing the uncertainty and risk involved in land rental market participation and off-farm employment. These local institutions could provide information for households willing to participate in land rental transactions, and ensure long-term transactions with consolidated land, appropriate rents and written land rental contracts. They could also provide information for households interested in working off-farm, offer specialised training, and intervene in the negotiation with urban employers to ensure a fair salary, insurance, appropriate working conditions and written work contracts. They could provide interested households with relevant information and other help, such as credit to cover the initial costs of starting their own business or investing in farming or other industries.

The third option is to implement pro-poor policy interventions. Most of the poor in China live in an environment characterised by poor infrastructure, underdeveloped social services, a fragile natural environment, and self-sufficiency in agricultural production (OECD, 2005b). Policies aimed at improving farm household production incentives, such as the recent agricultural tax elimination and direct income support for grain farmers in China, are likely to have only a minor impact on these self-sufficient farm households. The conditions under which they live not only limit the potential for improving their incomes, but constrain their ability to invest sufficiently in raising their children's education, thereby making these households fall into a poverty trap (OECD, 2005b). Pro-poor public investment in terms of improving rural infrastructure and social services in areas where these households are living

and providing free education and training may assist such poor households to obtain access to off-farm employment opportunities and stimulate local land transfers. In this way these interventions provide an important contribution to reducing income gaps and breaking poverty traps.

6.4 Future research

The study develops a theoretical framework in which, in the context of land and labour market imperfections, households make simultaneous decisions on land rental market participation and off-farm employment. The empirical analysis, however, has some limitations that could be addressed in future research.

The study was analysed by using data from 329 farm households in three villages in Jiangxi province. They were selected in such a way that the findings are assumed to be applicable for a much larger area of Northeast Jiangxi province, and probably for the entire hilly area of Southeast China with rice-based production systems. But the empirical results evidently do not allow up-scaling of the conclusions to China as a whole. Further research in other regions in China is needed to assess the extent to which the findings have a more general validity.

This research was carried out using cross-sectional data. Due to limitations of the data, this study examines the inter-relationship of household land rental and off-farm labour market participation (see Chapter 2) and the reduced-form relationships between land rental market participation, off-farm employment and agricultural production (see Chapter 5). Future research might use the panel data and develop a systems approach to fully investigate the causality of household land rental and off-farm labour market participation, and all the structural relationships between land rental market participation, off-farm employment (remittances), and household production decisions on land investment, input use and land productivity.

An important feature of landholdings in China is the high degree of land fragmentation. Given the current level of development of land rental and off-farm labour markets and the data limitations, this research was not able to investigate the impact of the development of the land rental market and off-farm employment on land consolidation and therefore on agricultural production. With institutional reforms and economic development land and labour

markets are expected to continue to develop, possibly at an accelerated rate. Future research is possible, and necessary, to examine the effect of land and labour market developments on land consolidation and thereby on agricultural production.

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Summary

As a result of over 25 years of economic reforms, China has made rapid progress in increasing agricultural productivity and farmers' incomes and alleviating rural poverty. However, agricultural productivity and rural industrial growth have slowed down in recent years, and income inequality has increased rapidly between rural and urban households. In rural China, there is convincing empirical evidence that the agricultural production factor markets, particularly land and labour, face many institutional obstacles and remain underdeveloped. The development of land and labour markets may contribute both to increasing agricultural productivity and rural household incomes and to reducing income inequality between rural and urban areas.

Off-farm employment has become a significant phenomenon in rural China since the mid-1980s, and has attracted much attention from researchers and policy makers, due to its importance in absorbing surplus labour from agriculture, increasing and diversifying household incomes, and alleviating rural poverty. The development of land rental markets in rural China has recently attracted attention because of its increasing incidence and its role in increasing allocative efficiency and agricultural productivity. Research into factor market development and agricultural production in rural China has often focused on either the land or the labour market. However, the growth in importance of both of these in recent years suggests that households may make simultaneous decisions on land and labour market participation. Analysing these phenomena therefore requires a simultaneous approach.

The objective of this study is to improve the understanding of factors determining the participation of farm households in rural land and off-farm labour markets, and the consequences of participation in these markets for allocative efficiency and agricultural productivity in Southeast China.

To fulfil this objective, this study uses a farm household model approach and applies data collected for the years 2000 and 2002 from three villages in Northeast Jiangxi province to provide answers to the following specific research questions:

1. Do rural land rental market participation and off-farm employment influence each other?

2. What are the most important factors determining differences in decision making

regarding joint land and labour market participation by rural households operating under imperfect market conditions?

3. What is the effect of joint land and labour market participation on the allocative efficiency and (non-)separability of household decision making?

4. What are the effects of land rental market participation, and the resulting alternative land tenure contracts, and off-farm labour market participation on agricultural production?

In Chapter 2, both a single-equation model and a simultaneous-equation model are estimated to investigate the inter-relationship between participation in the land rental market and off-farm employment (Question 1). The empirical evidence indicates that participation in the land rental market and off-farm employment do influence each other. The number of dependents in a household positively affects the amount of land rented in by the household, and negatively affects household migration decisions; the average adult age and land availability show a U-shaped relationship with the amount of land rented in by the household, and show an inverted U-shaped relationship with migration; indicating a strong negative relationship between land renting in and migration. This result highlights the importance of considering household joint decision making over land rental market participation and off-farm employment in the context of land and labour market imperfections.

In Chapter 3, a multinomial probit model is estimated to examine the determinants of the seven most common joint land and labour market participation decisions (Question 2). The empirical results indicate that a larger household size and fewer dependents have a positive impact on migration, but not on local off-farm employment. The time endowment effect is counterbalanced by the food consumption effect for local off-farm employment. The fact that, contrary to migrants, people involved in local off-farm employment generally live and consume food at home seems to play an important role here. The number of durable assets in a household has a positive effect on the probability of household involvement in local off-farm employment. This suggests that richer households have better access to local off-farm jobs than poorer households.

The average adult age shows an inverted U-shaped relationship with the likelihood of being involved in migration. Differences in estimated turning points suggests that households involved in migration and renting in land are mainly young migrants who return home after a few years of working elsewhere and reinvest in agriculture. Households with both low and

high land availability are less likely to participate in off-farm employment. This finding suggests that households with small land endowments may not be wealthy enough to work off-farm, while households with relatively large land endowments may have difficulties in renting out their land and hence prefer to work on-farm. The results also show that possession of a land contract and having a social network has a positive effect on migration. Enjoying more land transfer rights has a positive effect on land renting in. These results confirm that households facing low transaction costs in land and labour markets are more likely to participate in these markets.

In Chapter 4, an endogenous switching regression model is estimated to analyse the allocative efficiency and (non-)separability of household decision making for households classified according to land and labour market participation regimes (Question 3). The empirical analysis indicates that households that do not participate in both land and labour markets are allocatively inefficient. It is further shown that households that participate in the land rental market are allocatively efficient whether or not they are involved in off-farm employment, whereas households that participate in the labour market but not in the land rental market are not allocatively efficient. This finding suggests that prevailing imperfections in the off-farm employment market and/or the market for hiring agricultural labour, prevent households that only participate in off-farm employment from adjusting their on-farm labour as much as they would like. Allocative inefficiency is found to be highest among households that participate in neither market and is higher for households working in local off-farm employment than for households involved in migration. There is also convincing evidence that household consumption and production decisions are non-separable for households that do not participate in either the land rental or the labour market. For households in the other land and labour regimes, the separability hypothesis could not be rejected.

In Chapter 5, an instrumental variable technique is used to estimate the plot level agricultural production taking into account the household level decisions on land rental market participation and off-farm employment (Question 4). The empirical results indicate that rented in plots receive less land investment than contracted plots. Chemical fertiliser use, labour use, and rice yield, however, do not differ between rented in plots and contracted plots. This finding suggests that tenure security has a positive effect on long-term land investment, but no effect on short-term input use and yield. Participation in the land rental market has a

positive effect on rice yield, which indicates that the development of a land rental market would allow land to be transferred to households that are more capable of earning a higher return out of agricultural production.

Households that rent in land use more chemical fertilisers on the rented in plots than on contracted plots. This may be a response to the relative insecurity of tenure of the rented in plots, where households wish to maximise their return within a short period, and therefore use more chemical fertilisers to increase rice yield. However these households are found to make the same investment on rented in plots as on their contracted plots, use the same amount of labour and obtain the same rice yield. This finding confirms that there is no efficiency loss in yield on rented in plots relative to contracted plots.

Participation in local off-farm employment appears with a negative effect on green manure plantation, but a positive effect on the use of organic manure. This finding indicates that households involved in local off-farm employment can combine their local off-farm jobs with working on-farm and therefore reduce green manure to increase land use intensity and increase organic manure use. Participation in off-farm employment has no effect on chemical fertiliser use, labour use, and rice yield. In terms of the model, off-farm employment does not have the lost-labour, income, or reduced consumption effect. A possible explanation of this finding is that agricultural production in the research area is characterised by the small farm sizes and large labour surplus and the remittances send by migrants are mainly used for non-agricultural purposes, such as building houses, marriage, etc.

This study contributes to the existing literature in a number of ways. First, this study investigates the inter-relationship of participation in the land rental market and off-farm employment. It extends previous work about the relationship between rural land and labour market development by allowing for the endogenous decision making over land and labour market participation. In the context of land and labour market imperfections, land rental market participation and off-farm employment decisions may be jointly made by rural households. Testing this inter-relationship is highly appropriate in rural China, which is generally characterised by surplus of labour and consequent underemployment and a thin land rental market.

Second, this study develops a theoretical framework to investigate the interaction of land and labour markets and to examine the determinants of joint land and labour market

participation. Previous studies on the determinants of land and labour market participation in China have generally focused on either the land or the labour market. As pointed out previously, it is crucial to take joint land and labour market participation into account, given land and labour market imperfections. The insights gained from such an analysis may lead to conclusions and policy recommendations that differ significantly from those obtained from studies focusing on each of these two markets separately.

Third, this study analyses the allocative efficiency and (non-)separability of household decision making for households classified according to land and labour market participation regimes. By allowing for joint consumption and production decision making, and by distinguishing households according to land and labour market participation regimes, it extends previous research on allocative efficiency and separability for different land participation regimes in China. This distinction also enables identification of the effects on allocative efficiency of both the development of land rental markets and off-farm employment.

Finally, this study examines households' agricultural production decisions, taking into account their decisions about land rental market participation and off-farm employment. Previous studies on the effect of land rental market development and off-farm employment on agricultural production in China have focused mostly on off-farm employment, but only few studies have focused on land rental market development. This study provides a comprehensive investigation into the effects of land rental market participation and off-farm employment on household land investment, input use, and land productivity.

This study concludes with a number of policy suggestions for further improving the development of land rental markets and off-farm employment and stimulating the growth of agricultural productivity and rural household incomes and reducing rural-urban income inequality. Three policy suggestions are distinguished. They are: (1) to reform the household registration system (*hukou*) and land tenure system, such as removing *hukou* restrictions, providing a social safety net and equal employment rights for rural households, improving tenure security, and reducing restrictions on land transfer rights; (2) to build local institutions, such as providing credit and building information networks, and (3) to implement pro-poor policy interventions, such as increasing public investment in improving rural infrastructure and social services and providing free education and training.

Samenvatting (Summary in Dutch)

Als resultaat van 25 jaar economische hervormingen, kent China een snelle vooruitgang in de groei van landbouwproductiviteit en inkomen van boeren evenals een snelle vermindering van rurale armoede. Gedurende de laatste jaren is de groei van de landbouwproductiviteit en de rurale industrie echter vertraagd en is de inkomensongelijkheid tussen rurale en urbane huishoudens snel gegroeid. Voor ruraal China bestaat er overtuigend empirisch bewijs dat factormarkten in de landbouw, zoals voor land en arbeid, geconfronteerd worden met vele institutionele belemmeringen en dus onderontwikkeld blijven. De ontwikkeling van markten voor land en arbeid zou zowel kunnen bijdragen tot het verhogen van de landbouwproductiviteit en inkomens van rurale huishoudens als tot het verminderen van de inkomensongelijkheid tussen rurale en urbane gebieden.

Werkzaamheden buiten het eigen bedrijf zijn sinds midden jaren 80 een significant fenomeen geworden in ruraal China en hebben de aandacht getrokken van onderzoekers en beleidsmakers. Deze ontwikkeling is belangrijk voor het absorberen van het arbeidsoverschot in de landbouw, het verhogen en diversifiëren van gezinsinkomens en het verminderen van de rurale armoede. De ontwikkeling van de markt voor het pachten van land in ruraal China heeft recentelijk de aandacht getrokken vanwege de snelle groei in deze markt en vanwege het belang voor een stijgende allocatieve efficiëntie en landbouwproductiviteit. Onderzoek naar de ontwikkeling van factormarkten en landbouwproductie in ruraal China is vaak gericht op ofwel de landmarkt ofwel de arbeidsmarkt. Het steeds groter wordend belang van beide tijdens de laatste jaren doet echter vermoeden dat huishoudens de beslissingen over het deelnemen in land- en arbeidsmarkten gezamenlijk nemen. Het analyseren van deze fenomenen vereist daarom een simultane aanpak.

Het doel van deze studie is om een beter inzicht te krijgen in de factoren die het deelnemen van landbouwhuishoudens in rurale landmarkten en in arbeidsmarkten buiten het bedrijf bepalen, evenals in de gevolgen van het deelnemen in deze markten op de allocatieve efficiëntie en de landbouwproductiviteit in Zuid-Oost China.

Om dit doel te bereiken maakt deze studie gebruik van een landbouwhuishoudmodel. Data verzameld in 2000 en 2002 in drie dorpen in de Noordoost Jiangxi provincie worden gebruikt om een antwoord te geven op de volgende specifieke onderzoeksvragen:

1. Beïnvloeden het deelnemen in rurale landpacht markten en werkzaamheden buiten het bedrijf elkaar wederzijds?

2. Wat zijn de belangrijkste factoren die de verschillen in besluitvorming bepalen met betrekking tot gezamenlijke participatie in land- en arbeidsmarkten door rurale huishoudens die opereren onder imperfecte marktomstandigheden?

3. Wat is het effect van gezamenlijke participatie in land- en arbeidsmarkten op de allocatieve efficiëntie en de (on)deelbaarheid van huishoudbeslissingen?

4. Wat zijn de effecten van het deelnemen in landpacht markten, en de resulterende alternatieve pachtcontracten, en participatie in arbeidsmarkten buiten het bedrijf op de landbouwproductie?

In Hoofdstuk 2 worden een model met een enkele vergelijking en een model met simultane vergelijkingen geschat om de interrelatie tussen het deelnemen in landpacht markten en werkzaamheden buiten het bedrijf te onderzoeken (Vraag 1). Het aantal afhankelijke gezinsleden heeft een positieve invloed op de hoeveelheid land die door een huishouden wordt gepacht en een negatieve invloed op de beslissingen van het gezin tot migratie; de gemiddelde leeftijd van de volwassenen en de beschikbaarheid van land vertonen een U-vormig verband met de hoeveelheid gepacht land en een verloop gelijkend op een omgekeerde U met migratie. Dit wijst op een sterk negatief verband tussen het pachten van land en migratie. Het is dus van belang om beslissingen met betrekking tot participatie in de landpacht markten en werkzaamheden buiten het bedrijf gezamelijke te analyseren in de context van imperfecties in land- en arbeidsmarkten.

In Hoofdstuk 3 wordt een *multinomial probit model* geschat om de determinanten te bepalen van de zeven meest voorkomende gezamenlijke beslissingen van participatie in de land- en arbeidsmarkt (Vraag 2). De empirische resultaten geven aan dat een groter gezin en een kleiner aantal afhankelijke gezinsleden een positieve invloed hebben op migratie, maar niet op lokale werkzaamheden buiten het bedrijf. Voor lokale werkzaamheden buiten het bedrijf wordt het effect op de beschikbare tijd gecompenseerd door het effect op de voedselconsumptie. Het feit dat, in tegenstelling tot migratie, mensen die lokaal buiten het bedrijf werken over het algemeen thuis wonen en er voedsel verbruiken blijkt hier een belangrijke rol te spelen. Het aantal duurzame bezittingen van een huishouden heeft een positief effect op de kans dat het gezin betrokken is bij lokale werkzaamheden buiten het

bedrijf. Dit suggereert dat rijke huishoudens een betere toegang hebben tot lokale jobs buiten het bedrijf dan armere huishoudens.

Het verband tussen de gemiddelde leeftijd van de volwassenen en de waarschijnlijkheid om betrokken te zijn bij migratie vertoont een verloop gelijkend op een omgekeerde U. Verschillen in de geschatte omslagpunten geven aan dat huishoudens betrokken bij migratie en het pachten van land voornamelijk jonge migranten zijn die naar huis terugkeren nadat ze een paar jaar elders hebben gewerkt en vervolgens in landbouw investeren. Huishoudens met ofwel een lage of een grote landbeschikbaarheid vertonen een lage waarschijnlijkheid om te participeren in werkzaamheden buiten het bedrijf. Dit resultaat suggereert dat huishoudens met weinig land mogelijk niet voldoende middelen bezitten om buiten het bedrijf te werken, terwijl huishoudens met relatief veel land mogelijk problemen ondervinden om hun land te verpachten en daarom verkiezen om op het landbouwbedrijf te blijven werken. De resultaten tonen ook aan dat het bezitten van een landcontract en van een sociaal netwerk een positief effect hebben op migratie. Het bezitten van een groter aantal land transferrechten heeft een positief effect op het pachten van land. Dit resultaat bevestigt dat de waarschijnlijkheid om deel te nemen aan deze markten groter is bij huishoudens met lagere transactiekosten in land- en arbeidsmarkten.

In Hoofdstuk 4 wordt een *endogeneous switching regression model* geschat met als doel de allocatieve efficiëntie en de (on)deelbaarheid van de besluitvorming van de huishoudens te analyseren waarbij huishoudens gegroepeerd zijn naar hun participatie regime in de land- en arbeidsmarkt (Vraag 3). De empirische analyse geeft aan dat huishoudens die niet deelnemen in zowel de landmarkt als de arbeidsmarkt allocatief inefficiënt zijn. Er wordt verder aangetoond dat huishoudens die deelnemen in de landpacht markt allocatief efficiënt zijn ongeacht of ze deelnemen in werkzaamheden buiten het bedrijf, terwijl huishoudens die participeren in de arbeidsmarkt maar niet in de landpacht markt niet allocatief efficiënt zijn. Dit resultaat geeft aan dat huishoudens met werkzaamheden buiten het bedrijf belemmerd worden in hun mogelijkheden om de arbeid op het landbouwbedrijf aan te passen tot op het door hen gewenste niveau. Dit is te wijten aan de imperfecties in de arbeidsmarkt buiten het bedrijf en/of in de markt voor het inhuren van arbeidskrachten in de landbouw. Allocatieve inefficiëntie is het hoogst bij huishoudens die in geen van de markten participeren en is hoger voor de huishoudens die lokaal buiten het bedrijf werkzaam zijn ten opzichte van huishoudens

met een of meer leden die migreren. Er is ook overtuigend bewijs dat beslissingen voor consumptie en productie ondeelbaar zijn voor gezinnen die niet deelnemen in de land- en arbeidsmarkt. Voor huishoudens in andere land- of arbeidsregimes kan de deelbaarheidshypothese niet verworpen worden.

In Hoofdstuk 5 werd een *instrumental variable* techniek gebruikt om landbouwproductie op niveau van het perceel te schatten, rekening houdend met de beslissingen van het huishouden ten aanzien van het deelnemen in de landpacht markt en werkzaamheden buiten het bedrijf (Vraag 4). De empirische resultaten duiden aan dat er minder wordt geïnvesteerd in land dat wordt gepacht dan in gecontracteerd land. Er is echter geen verschil tussen gepacht en gecontracteerd land in het gebruik van kunstmest en arbeid en in de rijstopbrengst. Dit resultaat geeft aan dat een grotere zekerheid in gebruiksrecht een positief effect heeft op de investeringen in land op lange termijn, maar dat het geen effect heeft op het gebruik van inputs op de korte termijn en op de opbrengst. Participatie in de landpacht markt heeft een positief effect op de rijstopbrengst, wat erop duidt dat het ontwikkelen van een pachtmarkt het mogelijk maakt dat land wordt getransfereerd naar huishoudens die beter in staat zijn een hogere opbrengst te realiseren.

Huishoudens die land pachten gebruiken meer kunstmest op de gepachte percelen dan op de percelen onder contract. Dit zou een gevolg kunnen zijn van de relatieve onzekerheid in pachtovereenkomsten, waardoor huishoudens trachten de opbrengst te maximaliseren op de korte termijn, met als gevolg dat ze meer kunstmest gebruiken om de rijstopbrengst te verhogen. Toch vinden we dat huishoudens evenveel investeren in percelen die ze pachten als in percelen die ze contracteren, dat ze een zelfde hoeveelheid arbeid gebruiken en dat ze vergelijkbare rijstopbrengsten hebben op beide soorten percelen. Dit resultaat bevestigt dat er geen verlies is in opbrengstefficiëntie voor gepachte percelen ten opzichte van gecontracteerde percelen.

Participatie in lokale werkzaamheden buiten het bedrijf blijkt een negatief effect te hebben op beplanting met groenbemesters, maar een positief effect op het gebruik van stalmest. Dit resultaat geeft aan dat huishoudens die deelnemen in lokale werkzaamheden buiten het bedrijf, hun lokale betrekking buiten het bedrijf weten te combineren met hun werk op het landbouwbedrijf. Daardoor verminderen ze de groenbemesting om de intensiteit van het grondgebruik en het gebruik van stalmest te vergroten. Participatie in werkzaamheden buiten

het bedrijf heeft echter geen effect op het gebruik van kunstmest, gebruik van arbeid en op de rijstopbrengst. In termen van het model hebben werkzaamheden buiten het bedrijf geen arbeids-, inkomens- of consumptie verminderend effect. Een mogelijke verklaring van dit resultaat is dat landbouwproductie in het onderzoeksgebied gekenmerkt wordt door kleine bedrijfsoppervlakten en een groot overschot aan arbeid en dat het geld dat door de migranten wordt gestuurd voornamelijk wordt gebruikt voor doeleinden buiten de landbouw zoals, onder andere, het bouwen van een huis en een bruiloft.

Deze studie draagt op verschillende manieren bij tot de bestaande literatuur. Ten eerste bestudeert het de interrelaties tussen het deelnemen in de landpacht markt en werkzaamheden buiten het bedrijf. Het breidt bestaand werk over de relatie tussen de ontwikkeling van rurale land en arbeidsmarkten uit door rekening te houden met endogene besluitvorming over deelname in land- en arbeidsmarkten. In de context van imperfecties van land- en arbeidsmarkten worden beslissingen van rurale huishoudens ten aanzien van het deelnemen in landpacht markten en werkzaamheden buiten het bedrijf mogelijk gezamenlijk genomen. Het testen van deze interrelatie is erg relevant voor ruraal China dat algemeen gekarakteriseerd wordt door een surplus aan arbeid, met verborgen werkloosheid en een onderontwikkelde landpacht markt als gevolg.

Ten tweede wordt in deze studie een theoretisch raamwerk ontwikkeld om de interrelatie tussen landpacht en arbeidsmarkten te bestuderen en gezamenlijke besluitvorming ten aanzien van deelname aan de landpacht markt en de arbeidsmarkt te analyseren. Voorgaand onderzoek naar de determinanten van participatie in land- en arbeidsmarkten in China is over het algemeen gericht op ofwel de landmarkt of de arbeidsmarkt. Zoals ook voorheen aangegeven, is het van cruciaal belang participatie in land- en arbeidsmarkten gezamenlijk te bestuderen, gegeven de imperfecties in de land- en arbeidsmarkten. De inzichten die verkregen worden uit dergelijk onderzoek kunnen aanleiding geven tot conclusies en beleidsaanbevelingen die significant verschillen van conclusies en aanbevelingen voortkomend uit onderzoek van elk van deze markten apart.

Ten derde bestudeert deze studie de allocatieve efficiëntie en de (on)deelbaarheid van gezinsbeslissingen, waarbij huishoudens zijn gegroepeerd naar gelang het regime van participatie in de land- en arbeidsmarkt. Door gezamenlijke consumptie- en productiebesluitvorming in aanmerking te nemen en door huishoudens te onderscheiden naar

gelang het land- en arbeidsmarkt participatie regime, is deze studie een extensie van voorafgaand onderzoek naar allocatieve efficiëntie en (on)deelbaarheid voor landmarkt participatie regimes in China. Dit onderscheid maakt het ook mogelijk om de effecten op allocatieve efficiëntie van de ontwikkeling van de landpacht markt en van werkzaamheden buiten het bedrijf te identificeren.

Tenslotte bestudeert deze studie de landbouwproductie beslissingen van huishoudens rekening houdend met hun beslissingen ten aanzien van deelname in de landpacht markt en werkzaamheid buiten het bedrijf. Voorafgaande studies naar de effecten van de ontwikkeling van een landpacht markt en werkzaamheden buiten het bedrijf op landbouwproductie in China hebben zich voornamelijk gericht op werkzaamheden buiten het bedrijf; maar enkele studies onderzoeken de ontwikkeling van de landpacht markt. Deze studie onderscheidt zich van voorafgaande studies door zowel de effecten van deelname in de landpacht markt als werkzaamheden buiten het bedrijf op huishoudinvesteringen in land, gebruik van inputs en land productiviteit te analyseren.

De studie besluit met een aantal beleidsvoorstellen voor een verdere verbetering van de ontwikkeling van landpacht markten en werkzaamheden buiten het bedrijf, het stimuleren van de groei van landbouwproductiviteit en rurale gezinsinkomens, en het verminderen van de ongelijkheden tussen urbane en rurale inkomens. Drie suggesties voor beleid worden gegeven. Deze zijn: (1) het registratie systeem voor huishoudens *(hukou)* en het pachtsysteem te hervormen, bijvoorbeeld door het opheffen van de restricties van het *hukou*systeem en het verschaffen van een sociaal vangnet en gelijke rechten voor rurale huishoudens die werkzaam zijn in urbane gebieden, het verbeteren van de zekerheid van pacht, en het verminderen van de restricties op de rechten om land te transfereren; (2) het opbouwen van lokale instituties, bijvoorbeeld door het verschaffen van krediet en het opbouwen van informatie netwerken; en (3) het implementeren van een beleid voor minderbedeelden, bijvoorbeeld door het verhogen van publieke investeringen ter verbetering van rurale infrastructuur en sociale diensten en het verschaffen van gratis onderwijs en training.

Curriculum Vitae

Shuyi Feng was born on October 24th, 1973 in Dongtai, Jiangsu Province, P.R. China. She studied at the College of Land Management of Nanjing Agricultural University from 1992 to 1996, and from 1996 to 1999, obtaining a B.Sc. and a M.Sc. degree with the major in Resource Economics and Land Management. When writing her M.Sc. thesis on the effect of agricultural price policy reforms on sustainable land use, she spent seven months at Development Economics Group of Wageningen University with a Tinbergen Scholarship. She was awarded the Best M.Sc. Thesis of Jiangsu Province in 2000.

Between 1999 and 2001, she was appointed as a Ph.D. researcher at the same university. Her research has focused on the effect of industrialisation and urbanisation on farmland conversion in the fast growing cities of Jiangsu Province. In September 2001 she was appointed as a Ph.D. researcher at the Development Economics Group of Wageningen University. The Ph.D. research was conducted within the context of the RESPONSE project, collaboration between Wageningen University and the International Food Policy Research Institute (IFPRI). Her Ph.D. research was largely based on farm household and plot level surveys in three villages in Jiangxi Province, carried out within the SERENA project, collaboration between Nanjing Agricultural University, Wageningen University, and the Institute of Social Studies. In 2005 she successfully completed the training and supervision plan of Mansholt Graduate School. She has more than 10 papers published in Chinese journals and Chinese and international books.

Her Ph.D. research has been combined with other research activities. Between 2003 and 2004, she was appointed to the SEARUSYN project, collaboration between Wageningen University and Research Centre, Hanoi Agricultural University, and Nanjing Agricultural University to analyse urban growth, horticulture, and the environment in Nanjing City.

Training and supervision plan

Description	*Institute*	*Year*	*Credits*[36]
General courses			
Writing and Presenting a Scientific Paper	Mansholt Graduate School	2001	1
Social Science Research Methods	Mansholt Graduate School	2001	1
Mansholt-specific courses			
Mansholt Introduction Course	Mansholt Graduate School	2001	1
Mansholt Multidisciplinary Seminar	Mansholt Graduate School	2005	1
Discipline-specific courses			
Multi-Agents Systems for Natural Resource Management	Mansholt Graduate School	2001	2
Pathways for Agricultural Intensification	Mansholt Graduate School	2001	2
Applied Microeconomics	Tilburg University	2001	4
Agro-ecological Approaches for Rural Development	The C.T. de Wit Graduate School	2001	1
Bio-economic Household Modelling	Mansholt Graduate School	2002	1
Farm Household Economics	Wageningen University	2002	3
Macroeconomic Analysis and Policy	Wageningen University	2002	3
Quantitative Analysis of Development Policy	Wageningen University	2002	3
Models in Agricultural Economics	Wageningen University	2002	5
Resource Economics	EEPSEA (Economy and Environment Program for Southeast Asia)	2003	3
Presentations at conferences and workshops			2
Seminar on Final PhD Thesis Proposal, The Netherlands		2002	
EEPSEA Biannual Workshop, Singapore		2003	
7th European Conference on Agriculture and Rural Development in China, London, UK		2004	
International Workshop on Sustainable Poverty Reduction in Less Favoured Areas, The Netherlands		2005	
Governing Rapid Growth in China: Efficiency, Equity and Institutions, Shanghai, China		2006	
Total (min 20 credits)			33

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[36] 1 credit represents 40 hours.
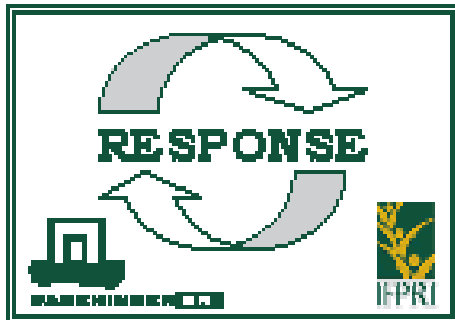
Regional Food Security Policies for Natural Resource Management and Sustainable Economies

The research presented in this study was carried out within the framework of the RESPONSE (Regional Food Security Policies for Natural Resource Management and Sustainable Economies) programme, a joint initiative of Mansholt Graduate School of Social Sciences (MGS), the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC), and Wageningen Institute of Animal Sciences (WIAS) of Wageningen University and Research Centre (WUR) in the Netherlands and the International Food Policy Research Institute (IFPRI) in Washington D.C. The programme aims at identifying policy alternatives for addressing poverty, food security, and sustainable natural resource management in less-favoured areas.

RESPONSE is one of the six multi-annual research programmes of the Interdisciplinary Research and Education Fund (INREF) of WUR launched in 2000. INREF enables international cooperation in conducting interdisciplinary (beta-gamma) and comparative (north-south, south-south) researches and contributing to policy development. The RESPONSE programme includes 10 sandwich Ph.D. students from East Africa and Southeast Asia. Field research activities have been carried out in co-operation with local universities, research institutes and (non-)governmental agencies.