# Grain Market Liberalization

## and Deregulation in China

The Mediating Role of Markets for Farm Households in Jiangxi Province

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Farm Households in Jiangxi Province

Le Chen

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## PREFACE

I have finished my thesis. Thinking about what to write, I find that to write the preface is to review and summarize my PhD life of these years.

All of these, from having the idea of doing a PhD project on poverty till being a PhD, originate from the idea of wanting to save the world. Or "farmers in Jiangxi Province" instead of "the world" is more proper. However, after all these years, I found I could hardly save myself, let alone those farmers in Jiangxi Province.

It took me five years to finish this thesis and it has not been easy. There were moments of excitement and depression, but there was never a moment of doubt. Much have I learned and I have grown. Growing up as a well-protected daughter, I was struggling on my way to independency. To know what I want and why I want it is most confronting but also most precious to me. However, the way to reach it is not always straightforward. Wanting to be perfect sometimes does not bring perfect outcomes but put me into difficult situations. Then I learned to make choices. So here I am, writing the preface before the new job starts at the bright beginning of 2007.

Seeing what I have reached, no doubt I was not alone on my way. Yes, time to say thanks, which every Chinese is good at... Jack, you know me the most since you are my daily supervisor. You taught me much and pushed me hard. It wasn't always easy to deal with but I learned the profession from you. Working with you, I also got to know you. You were strict but you were also helpful when needed. So thank you for being supportive in your way. Arie, you've always encouraged me to be assertive and independent. The dinners with you and Mirjam were always close to my heart. I will always remember those PhD brunches on Sunday morning and the visit to the farm of your brother. You brought us not only the Dutch culture but also cultures from other countries. Nico, although I didn't work with you much, you were always very responsible for commenting on and improving my thesis. You were also assuring and encouraging, which I really appreciated.

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Last and the most, I want to thank my parents. Papa and mama, you brought me to this world and showed me what love was. You are always there with me to share my joy and my pain. I am always your little girl and you want the best for me. Maybe my dream is different from yours but you've always encouraged and supported me to pursue it. Thank you for bringing me up to who I am, which is the greatest gift I have ever received!

Le Wageningen, 19 December 2006

## ABSTRACT

Chen, L., 2006. Grain market liberalization and deregulation in China: The mediating role of markets for farm households in Jiangxi Province. PhD Thesis, Wageningen University, The Netherlands, 187p.

This thesis analyzes the effects of market liberalization and deregulation in the grain marketing channel on farm households in three villages in a less favored area in China, taking into account the effects of market access. Market access is defined as the distance between the village that farm households reside in and the closest consumer markets. It is measured by the costs that private traders make to transport rice from the village to their buyers. The marketing channel models used in this study are extensions of simple models of competition, i.e. monopsony, Cournot, quantity leadership, price leadership, and perfect competition. To account for other factors than rice market liberalization and deregulation affecting village rice exports a nonseparable household CGE (Computable General Equilibrium) model is developed. The model accounts for non-separability of household decision making and for imperfect competition in the village rice export market (rice purchase market). Data used in this study are collected through personal interviews conducted in the study areas by the SERENA (Strengthening Environmental and Resource Economics at Nanjing Agricultural University) and RESPONSE (Regional Food Security Policies for Natural Resource Management and Sustainable Economies) projects. This thesis shows that China's government has gradually liberalized and deregulated its grain market and relieved the fiscal budget from subsidizing the SGTCs (State Grain Trading Companies). Competition between the private traders and the SGTCs has become more intensive in the rice purchase market in 2000-03. State grain policies favored the SGTCs, which created an unfair competition environment for private traders. The pressure for further reforms to create a fair competition environment remains. Rice producers benefit from market liberalization and deregulation. How much they benefit depends on the degree of market imperfections before market liberalization and deregulation and the degree of market access. It is found the degree of competition in the rice purchase market is already intense in 2000. The effects of market liberalization and deregulation on farm households are less when taking into account the production of other farm products and off-farm employment.

Keywords: China, market liberalization and deregulation, grain policy, marketing channel, price transmission, farm households.

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## 1 GENERAL INTRODUCTION

#### 1.1 Background

Agricultural policies in developing countries can be considered as measures used by governments to influence the social and economic context within which agricultural production takes place (Ellis, 1992: 3). In terms of state intervention, agricultural policies can be divided into three categories, i.e. intervention in *prices* of farm inputs and outputs, intervention in the *institutions* such as in the marketing of agricultural commodities or in the delivery of farm inputs, intervention in *technology* creation and transmission to farm households (Ellis, 1992: 4). In this study, we focus on agricultural policies in the first two categories, i.e. price policies and institutional policies.

State intervention by China's government in its agricultural markets started since the early 1950s (Zhong, 2001: 7; Ji, 2003: 18). In order to assure food security, China's government has been purchasing grain at a high price from farm households and supplying grain at a low price to urban consumers (Zhong, 2001: 1, 16). The state grain trading companies (SGTCs)<sup>1</sup> were the means of state intervention, i.e. they had to purchase certain amounts of grain (known as grain quotas) from farm households at high prices (Zhong, 2001: 7) and sell it to consumers at low prices, with both prices being fixed by the government<sup>2</sup> (Zhong, 2001: 6). Therefore, China's agricultural policies that are concerned in this study can be divided in policies aimed at market intervention in order to secure food supply and support farm prices and policies with respect to market structure, i.e. marketing of agricultural commodities. The former policies refer to state intervention in both prices and quantities of farm outputs; the latter policies refer to the degree SGTCs have a monopsony position in China's grain marketing channel and the barriers of entry set by the government for private traders.

Subsidizing the SGTCs to support high farm prices and low consumer prices put a heavy burden on China's fiscal budget (Cheng et al., 1997: 7; Zhong, 2001: 2, 12). For decades, reducing the financial burden has been the motivation of China's government to remove state intervention (Cheng et al., 1997: 7; Zhong, 2001: 14). Removing state intervention includes a combination of market liberalization and deregulation measures. In this study, market liberalization indicates withdrawal of the government from direct control over prices. Market

<sup>&</sup>lt;sup>1</sup> The commercialization of state grain bureaus that were involved in grain trade started in 1992. Since then, they were called state grain trading companies (SGTCs). For consistency, the abbreviation "SGTC" will be used throughout this thesis.

deregulation indicates improvement of the competitiveness and functioning of agricultural markets, i.e. engaging the private sector in agricultural markets and privatizing the SGTCs.

The process of market liberalization and deregulation in China started at the end of 1970s and has undergone a series of back-and-forth transitions. Every time after a reform (1985 and 1993), falling grain production and rising grain prices made China's government stop its attempts and return to its monopsony position (Sicular, 1995:1023-1025; Huang and Rozelle, 2002:4-5). The reason lying behind is to ensure grain supply for food self-sufficiency. In 1998, a new round of reforms attempted to create monopsony profits of the SGTCs to recoup the losses (Zhong, 2001:22; Duncan and Jiang, 2001:8). Many studies have shown that the policy failed and the financial burden increased instead of decreased (Lu, 1999:6-7; Zhong, 2001:27-29)<sup>3</sup>. In 2000, China's central government opened the grain purchase market for low-quality grain (such as early rice) to individual private traders and private enterprises (Zhong, 2001:28). Meanwhile, the SGTCs were supposed to remain monopsonists in the grain purchase market for high-quality grain (such as late rice and one-season rice) and purchase rice from farm households at the protective price fixed by the government before harvest. This system is called 'the system of protective purchasing'. Losses of the SGTCs caused by the protective purchasing were supposed to be subsidized by the central and the local government. At the end of 2002, the procurement of grain quota was abolished in some provinces in China but the system of protective purchasing remained. Grain prices have increased rapidly in 2003 (PDO, 2003). Early 2004, China's government officially abolished the system of protective purchasing. In 2004-05, China's government issued a series of policies facilitating further market liberalization and deregulation, e.g. the qualifications for private traders to enter the grain purchase market were relaxed.

Although it has undergone several back-and-forth transitions, the structure of China's grain marketing channel has gradually changed. Competition between private traders and the SGTCs in the grain purchase market emerged and has been increasing (Rozelle et al., 2000: 245-6). The elimination of the fixed purchase prices for low-quality grain in 2000 has linked farm households directly to the market. The shift in domestic grain consumption due to income growth and rapid urbanization (Hsu et al., 2002) and China's entry into the World Trade Organization (WTO) have been causing changes in the level and fluctuations of grain consumer prices<sup>4</sup>. The consumer price changes that are transmitted through the grain marketing channel lead to changes of farm prices. The degree of price transmission, in other words, to what extent price changes at the retail level are transmitted to the farm gate, depends on the structure of the marketing channel (Negassa, 1998: 4; Winters, 2002: 1345; London Economics, 2004: 51). In an efficient marketing channel price changes at the farm gate are

 $<sup>^{2}</sup>$  The policy of selling grain to consumers at the price fixed by the government was eliminated in the early 1990s. For more information see Sicular (1995) on grain quota price at the national level in 1980-92, Yamamoto (2000) on grain quota price and retail price at the national level in 1950-90.

<sup>&</sup>lt;sup>3</sup> The market reform in 1998 will be further explored in the next chapter of this study.

<sup>&</sup>lt;sup>4</sup> Huang et al. (2002) predict that China's entry into WTO leads to an increase in its grain import except rice. The export of rice will increase and China may become one of the rice export leaders in the world market.

ceteris paribus transmitted, at more or less similar magnitude, to the consumer level. Any deviation may reveal the inefficiency of the marketing channel (Negassa, 1998: 4). Therefore analyzing the degree of price transmission may provide an indication for the efficiency of the marketing channel.

Less-favored areas (LFAs) are defined as lands with limited agricultural potential that are sensitive to environment (e.g. limited and uncertain rainfall, poor soils, steep slopes, etc.), or lands with higher agricultural potential but are in uses of low value due to facts like limited access to infrastructure and markets, low population density or other socio-economic constraints (Ruben et al., 2004: 295). LFAs are often neglected by policy-makers due to their limited agricultural potential and/or their remoteness (Ruben et al., 2004: 296). Chronic and persistent poverty is likely to be severe in LFAs (Ruben and Pender, 2004: 304). Policies targeting at poverty alleviation and ensuring food security of LFAs require more a tailored approach than a one-seize-fits-all type of policy due to the diversity and heterogeneity of the farm households in these areas (Ruben et al., 2004: 296-97). Such an approach claims the understanding of policy-makers, especially those from local government, on the responses of farm households in LFAs to changes (e.g. in farm price) caused by market liberalization and deregulation (Ruben et al., 2004: 297). In China, the majority of the rural poor reside in areas with poor agricultural land and/or weak infrastructure. In these LFAs, agricultural activity is still the major source of income of the farm households (Fan and Chan-Kang, 2005).

Grain supply to markets of farm households is one of the important indicators for food security both at the national level and the household level (McCulloch et al., 2001: 194-95; FAO, 2003: 245). Adequate grain supply at the national level ensures grain consumption in the urban areas (McCulloch et al., 2001: 194-95). An increase in grain supply has positive effects on farm household welfare and therefore contributes to poverty alleviation (FAO, 2003: 245). Important in this case is how price changes in consumer markets are transmitted via the marketing channel to farm households (McCulloch et al., 2001: 73). Therefore, the well functioning of the marketing channel is essential for poverty alleviation and food security.

There are several studies analyzing the effects of liberalization and deregulation in China's grain markets such as Rozelle et al. (1997), Park et al. (2002), Wu (2002), and Huang et al. (2004). Using cointegration analysis and parity bounds analysis, Rozelle et al. (1997) found that rice price transmission between provincial markets (horizontal market integration) in China had increased in 1988-93. They also found decreasing transaction costs in moving rice between provincial markets indicating increasing market efficiency in 1988-93. Park et al. (2002) estimated arbitrage rates, transaction costs, and autarky rates using a parity-bounds model of interregional grain trade in China in 1988-95. They found that, although market development had been uneven between regions, due to policy changes the grain markets in southern China had matured to a level that traditional policy interventions were less effective and more costly. Instead of analyzing price transmission between provinces, Wu (2002) analyzed price transmission from farm gate to retail markets in China in 1996-2000. Taking rice, wheat, maize, and soybean) were integrated in 1996-2000. Taking rice,

maize, and soybean as examples, Huang et al. (2004) showed that prices in different markets between provinces in China showed a similar development in 1996-2000. They also found that China's markets had continued to develop in the late 1990s.

What is common in the study of Rozelle et al. (1997), Wu (2002), and part of Huang et al. (2004) is that they used data at the provincial level so that their analyses were at the macro and the meso level. What is missing in these studies is special focus on the effects of market liberalization and deregulation at the micro level, i.e. on farm households, particularly those in LFAs where grain is the major agricultural product. Although Huang et al. (2004) also analyzed the price transmission at the village level; they used price data that covered 6 provinces from the South to the North of China in 2000. Such a study that covered provinces with major differences in their economic development only provides policy recommendations for all the provinces as a whole. As mentioned before, LFAs need additional attention to form tailored approaches for their economic development. Moreover, Huang et al. (2004) shows the effects of the distance of a village from the regional market on farm price. It is thus interesting to further investigate the effects of market liberalization and deregulation taking into account market access of the villages in LFAs. In addition, none of those studies paid special attention on the grain purchase market. Most of the policy changes in 2000 were related to the grain purchase market. This suggests that an analysis focusing on how the grain purchase market in LFAs is affected by those policy changes provides useful insights on the relations between the functioning of the grain purchase market and the rural poverty in LFAs.

### 1.2 Research objective

The general objective of this study is to analyze the effects of market liberalization and deregulation in the grain marketing channel on farm households in a LFA in China, taking into account the effects of market access. Market access in this study is defined as the distance between the village that farm households reside in and the closest consumer markets.

Since the path of China's market liberalization and deregulation has not always been straightforward, it is necessary to understand how China's grain policies evolved since the 1950s. This study pays special attention on market liberalization and deregulation policies. Data for this study are collected in 2000 and 2003. In 2000 the grain purchase market in China was still largely dominated by the system of protective purchasing. Since then markets have been liberalized and deregulated. Market liberalization and deregulation affected the structure of the grain marketing channel. Hence, the general objective of this study can be further divided into five research questions:

- (1) What have been China's grain policies since the 1950s?
- (2) What is the structure of the grain marketing channels (especially grain purchase markets) in the LFA studied in 2000 and how is the structure affected by the policy changes since then?
- (3) What are the possible outcomes of protective purchasing (situation in 2000) for private traders and SGTCs?

- (4) What are the effects of grain market liberalization and deregulation for farm households with different market access?
- (5) What are the effects of grain market liberalization and deregulation on farm households taking into account possible effects on grain production of other farm products and off-farm employment?

#### 1.3 Study area

Economic reforms provided a major stimulus to agricultural development and economic growth since the early 1980s in China. Not all regions, however, benefited equally. Although poverty and food insecurity declined considerably during these decades, about 102 million people in China are estimated to live in poverty (using the international poverty line of \$1 per day) at present (Ravallion and Chen, 2004), while an estimated 140 million people lack secure access to sufficient food for an active and healthy life (World Bank 2005; FAO 2000). Most of the poor and food insecure people live in rural areas in China where agriculture is the predominant economic activity. Agriculture in these areas is often constrained by poor and fragile soils which are vulnerable to degradation, absence of township and village enterprises (TVEs)<sup>5</sup> and private enterprises that stimulated rural development in the coastal provinces, and lagging market development due to infrastructural, physical, market and other constraints (Sicular, 1995).

Jiangxi Province is a typical example of a province where agriculture faces these constraints (Kuiper et al., 2001). Jiangxi Province covers 166,900 square kilometers that is considered a relatively large province in China. It had a population of 41.4 million in 2000 (Buhl et al., 2004). Jiangxi province is a poor, and to a large extent, hilly region (36% mountainous area and 42% hilly land) in Southeast China. The GDP per capita of Jiangxi Province in 2001 was 4,903 Yuan<sup>6</sup>, which was below the national average GDP per capita of 7,210 Yuan (Buhl et al., 2004). Agriculture plays an important role in the economy of this province. It produces 4% of the national grain output using 2.5% of the national arable land (Buhl et al., 2004). Rice is its main agricultural product. Rice output accounts for about 95% of its grain output in 2004 (NBSC, 2005).

The study areas locate in the Northeast of Jiangxi Province. The areas are suffering from problems such as soil erosion and deterioration, droughts and floods, loss of biodiversity, and pollution (Kuiper et al., 2001), and can be identified as LFAs in Jiangxi Province. Three villages were selected in this study, namely Banqiao, Shangzhu, and Gangyan. The villages were selected using a series of criteria, which include economic development level, market access and geographical conditions, and after consulting local researchers and policy makers and making several site visits. The three villages are considered representative of the diversity of rural conditions that can be found in Northeast Jiangxi Province and in a much larger hilly area with

<sup>&</sup>lt;sup>5</sup> Township and Village Enterprises (TVEs) are entrepreneurial communities that are established by township and village based communities. In other words, TVEs are owned by households/farmers who pool their resources together for production.

<sup>&</sup>lt;sup>6</sup> Yuan, Chinese currency. 1 Yuan = 0.125349 US dollars (exchange rate in 2000).

rice-based production systems in Southeast China (Kuiper et al. 2001). Rice is the main crop produced in all three villages. Therefore, rice is taken as an example in this study. Gangyan has the best market access while Shangzhu has the worst, and Banqiao has an intermediate position.

## 1.4 Data and methodology

Detailed data on the production and consumption of the sample farm households in the three selected villages was collected by the SERENA project<sup>7</sup> in 2000-01 (Kuiper et al., 2001). Data and information on other players in the marketing channels was collected by a survey in July 2003. For consistency, most of the information collected in 2003 was for the year 2000. Some additional information was also collected for 2003. Farm households, the heads of the villages, private traders, and the heads of the SGTCs were interviewed. Questionnaires were designed to collect data on rice prices at different levels of the marketing channel, players involved in the rice marketing channel, costs of these players, etc.

The study uses literature research to obtain the information needed to make a description of grain policies since the 1950s. The description of the marketing channels is based on data and information collected by the survey mentioned in the previous paragraph. Market access is measured in this study by the costs that private traders make to transport rice from the village to their buyers. The marketing channel models used in this study are extensions of simple models of competition, i.e. monopsony, Cournot, quantity leadership, price leadership, and perfect competition (see Varian, 1992: 285-300; Deneckere and Kovenock, 1992; Tirole, 1988). Changes in prices and quantities of the intermediates (the private traders and the SGTCs), farm profits and the profits of the intermediates between 2000 and 2003 are calculated for each village. Simulation results are compared between the villages with different market access. To account for other factors than rice market liberalization and deregulation affecting village rice exports a village CGE model is developed. The model accounts for non-separability of household decision making and for imperfect competition in the village rice export market (rice purchase market).

### 1.5 Structure of the thesis

There are six other chapters in this thesis besides this introduction. Chapter 2 provides an overview of policies in China's grain market since the 1950s. It addresses and discusses the evolution of grain policies as well as China's grain market reforms implemented during the last 25 years. In addition, Chapter 2 puts a special focus on policies directed towards the SGTCs and the shifts in the role of the SGTCs in grain trade.

Policy changes described in Chapter 2 have influenced the structure of the rice marketing channels. Chapter 3 therefore examines the structure of the rice marketing channels in 2000-03

<sup>&</sup>lt;sup>7</sup> The SERENA project aimed at strengthening environmental and resource economics at Nanjing Agricultural University (NAU) and was the cooperation between the College of Land Management (NAU), the Development Economics Group (Wageningen University) and the Institute of Social Studies (ISS). The project was financed by the Netherlands Development Assistance (SAIL) program and was carried out in 1997-2003.

in the selected three villages putting special attention on rice assemblers (i.e. the private traders and the SGTCs). Based on the description of the rice purchase market, Chapter 3 also discusses the effects of policy changes in 2000-03 on the private traders and the SGTCs.

Using the information provided by Chapter 2 and 3, Chapter 4 first presents a model of protective purchasing, capturing all possible outcomes under the system. Following the most likely outcome, Chapter 4 develops and applies a marketing channel model to analyze the effects of market liberalization and deregulation on farm households in the three villages (with different market access) in 2000 and in 2003. Cournot competition in the rice purchase market is applied for Banqiao and Shangzhu in 2000. A two-stage competition model with monopsony in the first stage and Cournot competition in the second stage is developed and applied for Gangyan in 2000. Perfect competition is assumed for all the three villages in 2003. Scenarios simulated in Chapter 4 compare the rice purchase market in 2000 with that in 2003. The simulation results demonstrate the effects of market liberalization and deregulation on farm households with different market access.

As a continuation of Chapter 4, Chapter 5 analyzes other possible outcomes under the system of protective purchasing, i.e. quantity leadership and price leadership competition between the intermediates in the rice purchase market. Chapter 5 applies quantity leadership and price leadership competition for all the three villages in 2000 and assumes perfect competition in 2003. Following Chapter 4, scenarios simulated in Chapter 5 compare the rice purchase market in 2000 with that in 2003. The simulation results demonstrate the effects of market liberalization and deregulation on farm households with different market access.

The marketing channel models developed in Chapter 4 and 5 are subject to some qualifications, e.g. the effects of rice production and the effects of consumption of other goods on marketable supply of rice are not taken into account, farm profits are used instead of utility as a welfare measure, and the effect of off-farm employment on rice supply is not included. A nonseparable household Computable General Equilibrium (CGE) model, that takes these qualifications into account, is therefore developed in Chapter 6. The model is for Gangyan, data are from a Social Accounting Matrix constructed by Kuiper (2005). The village CGE model developed by Kuiper (2005) differs from the model developed here. For example, the model developed here has a higher level of aggregation (one representative household). In addition, imperfect competition between the intermediates in the village rice export market (rice purchase market) is taken into account. The scenarios simulated in Chapter 6 focus on the effects of market liberalization and deregulation, namely, the transition from imperfect competition to perfect competition in the rice export market, the increase in consumer price, the introduction of a land-based income subsidy for rice producers and the removal of the agricultural tax.

The last chapter (Chapter 7) first synthesizes the main findings of this study. It then discusses the contributions of this study to the relevant economic literature, and provides recommendations for further research.

## 2 CHINA'S GRAIN MARKET POLICIES

#### 2.1 Introduction

In order to achieve the goal of providing sufficient food at low prices for urban consumers (Rozelle et al., 2000: 227) and the goal of reducing the financial burden caused by subsidies (Cheng et al., 1997: 4), China's central government has been switching its agricultural policy a few times over the last decades (Rozelle et al., 2000: 227; Huang and Rozelle, 2002: 4-5). Agricultural policies can be divided in policies aimed at market intervention in order to secure food supply and support farm prices and policies with respect to market structure, i.e. the way trade is organized. Here, the latter policies refer to the degree the SGTCs have a monopoly/monopsony position and the barriers of entry set by the government for private traders. Policy reform on China's grain market refers to market liberalization and market deregulation. Market liberalization implies less market intervention and the removal of price control. Market deregulation implies a smaller role of the government in grain trade and the removal of entry barriers for private traders.

To analyze the effects of grain market liberalization and deregulation on farm households, it is important to understand China's grain market policies and how they have changed over time. Therefore, the aim of this chapter is to describe and discuss China's grain market policies since the 1950s.

Section 2.2 describes China's grain policies since the 1950s. Section 2.3 then describes the policies directed towards the SGTCs and private traders. Finally section 2.4 presents some conclusions.

#### 2.2 Grain policy at national level

To understand China's current policy with respect to grain, it is essential to look at the evolution of these policies that started in the 1950s.

#### 1950s - 60s

In the early 1950s, grain procurement at farm gate and grain rationing in urban areas were introduced to ensure growth of grain production at the planned rate and optimal distribution of the produced grain among the non-agricultural population in urban areas (Zhong, 2001:1). Under the grain-rationing system, China's consumers were issued coupons giving them the right to buy a set amount of grain per person at a low price called the grain-rationing price. Grain above the ration amount could be purchased in free markets. Under the grain

procurement system, production teams<sup>8</sup> were obligated to deliver a certain amount of their grain output, the grain quota, to the local SGTCs at quota prices that were fixed by the government. This grain quota included an agricultural tax<sup>9</sup> that accounted for 20-35 percent of the grain output in the 1950s and 60s (Hsu, 1984:1231).

The above-quota delivery emerged in the 1960s and was not compulsory in the beginning (Cheng and Tsang, 1994:1084). In order to acquire the desired amount of grain, the government set the above-quota prices 30 percent higher than the quota prices and made abovequota delivery compulsory after the mid 1970s (Zhong, 2001:8). According to Cheng and Tsang (1994:1085), the amount of above-quota delivery varied throughout the country. Some provinces set the above-quota amount before production started and the actual procured amount could be 10 percent to 30 percent (Cheng and Tsang, 1994:1085; Zhong, 2001:8) more or less than the pre-set amount. Other provinces set the above-quota amount at a fixed proportion of the grain that was left after fulfilling the quota procurement and selfconsumption of production teams (Cheng and Tsang, 1994:1085). The surplus, the amount of grain that was left after the production team had kept the grain for self-consumption, delivered quota and above quota grain to the government, production teams could sell to the local SGTCs at prices that were negotiated with the local SGTCs (Zhong, 2001:8). The "negotiated prices" were rather flexible and sometimes higher than the above-quota prices (Zhong, 2001:8). The SGTCs were in this period the only authorized buyer (and seller to consumers) in China's grain market. Since grain-rationing prices were lower than quota prices, China's SGTCs were subsidized by the central and local governments.

### 1970s - 80s

The first reform in the agricultural sector took place in 1978 by the adoption of the Household Responsibility System<sup>10</sup>. Meanwhile, the central government increased average quota prices by 20 percent and above-quota prices from 30 percent to 50 percent higher than the quota prices,

<sup>&</sup>lt;sup>8</sup> In May 1956, about 90% of China's rural households joined co-operatives (with on average 30 to 40 farm households) and collectives (with on average 100 to 300 farm households) (Walker, 1966). In 1958, all the co-operatives and collectives were replaced by communes, which had on average 5000 farm households (Ahn, 1975). A commune consisted of production brigades (with about 250 farm households). A production brigade consisted of production teams (with about 40 farm households) (Ahn, 1975). Two kinds of public ownership existed in a commune, i.e. collective ownership and the "ownership by the entire people". A commune collectivized all the means of production and centralized all decision-making functions (Ahn, 1975). A production team was the basic unit of production in a commune. After 1979, the individual farm household became the basic unit of production and management instead of the production team (Walker, 1968).

<sup>&</sup>lt;sup>9</sup> According to 'Stipulation of the People's Republic of China regarding the agricultural tax', tax payers refer to units and individuals that engage in agricultural production and obtain agricultural revenue. The agricultural tax is levied on agricultural revenues. The nationwide average agricultural tax rate is 25-30 percent of the normal grain yield. From 1949-84, farm households had to pay the agricultural tax in the form of grain. From 1985-92, farm households had to pay an equivalent amount of cash as agricultural tax. From 1993 onwards, farm households can pay the agricultural tax either in the form of grain or in the form of cash. Since 2004, China's central government announced a gradual abolishment of the agricultural tax in three years time (SC, 2004a).

<sup>&</sup>lt;sup>10</sup> The household Responsibility System (HRS) is a contracting system that started at the end of 1978. While the land was still owned by the agricultural collectives, the user rights of the land were contracted to individual farm households for one to three years. Under the HRS farm households could retain the remaining output after paying agricultural tax, fulfilling quota and above quota delivery. In 1984, China's central government extended the contract to 15 years or more. In 1993, the contract was further extended to 30 years (Wang and Davis, 2000).

which provided substantial production incentives (Sicular, 1988:672; Zhong, 2001:12). The central government also started subsidizing diesel fuel and fertilizers to farm households (Yap, 1994:368). This brought rapid growth in grain production. In 1984, leases of land to farm households were extended up to 15 years and could be passed on to the children of farm households (Yap, 1994:368). Supported by the extension service, technological innovation also contributed to the growth of grain production (Yap, 1994:370; Yang, 1999:2145). Grain production in 1983 and 1984 was 27 percent higher than in 1978 (Oi, 1986:273). China's farm households became self-sufficient<sup>11</sup>.

During the market liberalization and deregulation period in 1979-84, the central government relaxed the restriction that only the SGTCs can be involved in buying and selling activities of grain. Farm households were allowed to sell their grain surpluses in free markets; individuals, non-commercial state agencies, enterprises and collectives were allowed to buy and sell grain (Sicular, 1995:1022). At this time, the SGTCs became one of the, instead of the only, players in the grain market. Thus in 1984, farm households had several options to sell their grain surplus. First, they could sell to the SGTCs at the above-quota prices, which were about 50 percent higher than the quota prices. The above-quota delivery was no longer compulsory. Second, they could sell to the SGTCs at negotiated prices. Third, they could sell to other buyers at market prices (Sicular, 1995). Therefore, farm households faced four categories of prices: quota prices, above-quota prices, negotiated prices and market prices. Farm households could choose among above-quota prices, negotiated prices and market prices. Some wholesale markets started in 1980-81 and after 1983, the number of wholesale markets increased rapidly (Watson, 1988:18).

The actual situation in 1984 was that the grain surplus pushed the market price below the above-quota prices, which gave farm households the incentive to sell their surplus grain to the SGTCs. Storage facilities of the SGTCs were overloaded and they were not allowed to engage in free trade (no selling without permission). At the same time the government subsidy was delayed; the SGTCs refused to purchase grain anymore and at the end of 1984, farm households had difficulties to sell their grain.

In the beginning of 1985, China's central government converted the grain procurement into "contracted grain purchasing". Under the new system, farm households were expected, therefore not obligated, to sign a contract with the local SGTCs for the delivery of an agreed amount of grain. The purchase price was a weighted average, with 30 percent of the delivery at the previous quota price and 70 percent at the previous above-quota price. It was higher than the previous quota price but lower than the previous above-quota price. The state guaranteed to purchase the contracted grain. For the grain delivery that exceeded the contracted target, farm households could sell it to the SGTCs at the prices equal to the previous quota prices (Zhong, 2001:14), or directly to buyers on the free market at the market prices (Duncan and Jiang, 2001:3). However, for the extra grain delivery to the SGTCs, the prices that were equal to

<sup>&</sup>lt;sup>11</sup> Before the HRS was applied, China's agriculture was a commune system, i.e. rural population was divided into production

previous quota prices, were less than the quota prices at that time, which implied that farm households would be paid less for any incremental grain delivery (Zhong, 2001:14). Farm households became reluctant to sign contracts with the local SGTCs. At the same time, the central government reduced subsides on farm inputs, which implied a reduction in farm profit (Yap, 1994:371). Accompanied with the development of the industrial sector, the opportunity cost of grain production increased, which pushed farm households from on-farm to off-farm employment (Yap, 1994:371; Yang, 1999:2147). In combination with poor weather, grain production fell 7 percent at the end of 1985 (Cheng and Tsang, 1994:1093, 95). At the end of 1985, the food prices increased (Huang and Rozelle, 2002:4; Lu, 1999:9), and the implementation of the new policy stalled (Huang and Rozelle, 2002:4).

In 1986, the "contracted grain purchasing" was reversed into "state contract purchasing", which meant that voluntary contracts became compulsory for farm households. At the same time, the government decreased the total planned procurement amount from 75 million tons in 1985 to 50 million tons in 1987. This amount was fixed until 1993 (Cheng and Tsang, 1994:1093; Duncan and Jiang, 2001:4). The government also provided material incentives to farm households by supplying fertilizers at subsidized prices (Duncan and Jiang, 2001:4). In 1988, the central government prohibited individuals, non-commercial state agencies, enterprises and collectives from purchasing grain from farm households and decided to continue its monopsony position as it was before the market liberalization and deregulation (Cheng and Tsang, 1994:1094). However, this could not cease the growth of the free market. A persistent increase in free trade (Sicular, 1995:1023) and in informal relationships between private traders and administrative officials (Watson, 1988:28) could be observed.

### 1990 – 93

In 1991, under the compulsory "state contract purchasing" system, grain production increased and grain prices fell, and farm households faced difficulty in selling grain (Duncan and Jiang, 2001:4). Facing the grain surplus, China's central government planned to reduce the financial burden of subsidies by abolishing the grain-rationing system and the "state contract purchasing" system. From 1991-92, the central government raised grain-rationing prices twice and put them equal to quota prices (Cheng and Tsang, 1994:1100; Duncan and Jiang, 2001:5). This removed part of the subsidies, which made grain-rationing prices lower than quota prices, from the total subsidies going to the SGTCs. Now the central government only needed to subsidize the transaction costs of the SGTCs such as transport cost and processing cost (Zhong, 2001:16). At the same time, the grain-rationing prices were only slightly below the retail market prices so that it stimulated consumers to purchase grain from the free market.

In 1992, the central government decided that fixed grain quota prices needed to be eliminated although the quota procurement remained compulsory (Cheng and Tsang, 1994:1101; Zhong, 2001:17). This meant that farm households could deliver the grain quota at

teams. Everyone worked together in a team and the team made production and consumption decisions.

the market prices. Each province could decide about the time to remove the quota prices depending on its own situation. After the policy being announced, some provinces removed the quota prices immediately while others did not (Cheng and Tsang, 1994:1101). By the end of 1993, almost all the provinces in China had eliminated fixed quota prices (Cheng and Tsang, 1994:1101). This was to prepare for the removal of grain procurement (Sicular, 1995:1024). In the same year, grain rationing was abolished by most local governments in China (Zhong, 2001:16). So, farm households could sell their grain to the SGTCs at the market prices and consumers could purchase grain at the market retail prices. The introduction of private traders into the grain marketing channel had changed the role and function of the SGTCs.

In 1992, the central government announced major reforms on the SGTCs (Sicular, 1995:1025; Rozelle et al., 1997:636). Grain administrations at township levels, which used to conduct grain procurement in rural areas, were converted into commercial grain trading companies. Moreover they became financially self-supporting and managerially independent from the government administration. These grain trading companies were given greater authority to set prices, make personnel decisions and diversify into other lines of business (Sicular, 1995:1025). These changes were targeted at deficit reduction. Once again, the local SGTCs became just one of the players in the grain marketing channel although with greater market power than other players.

In order to reduce the financial burden, the central government decreased the subsidies for farm inputs (Yap, 1994:371). At the same time, the IOUs<sup>12</sup> that the SGTCs paid to farm households instead of cash had a very negative impact on production (Yap, 1994:371). As a result, grain production declined in 1991, 1992, and 1993 (Yap, 1994:372). In November 1993 market prices started to increase rapidly which was continued in 1994. This contributed to the already high inflation during this period. Farm households withheld grain deliveries to expect higher prices (Zhong, 2001:17). The central government considered the grain market price hike as a sign of possible grain shortage.

#### 1994 – 99

In 1994, the central government made a U-turn in its reforms by reintroducing compulsory grain quota and above-quota procurement in rural areas (Rozelle et al., 1997:637). Besides, a series of constraints and regulations on non-SGTCs were imposed (Duncan and Jiang, 2001:6). Non-SGTCs were not allowed to purchase grain directly from farm households, the SGTCs were expected to return to their old monopsony position of being the only player in grain purchase market (Zhong, 2001:18). In 1995, a new system the "Governor Responsibility

<sup>&</sup>lt;sup>12</sup> IOUs are the promissory notes for payment that the SGTCs give to farm households for their grain delivery instead of cash. According to Cheng and Tsang (1994:1080), IOUs appeared as early as 1985. And by 1988, IOUs amounted about 8 to 11 percent of the total funds paid for grain purchases (Cheng, 1997:633). The situation worsened in 1992, which caused widespread discontent among farm households. China's central government pushed hard to ban the issuance of IOUs in 1993 (Cheng and Tsang, 1994:1081). The problem was to a large extent diminished, but not eliminated.

System"<sup>13</sup> was introduced to balance grain supply and demand in each province in China (Zhong, 2001:18). However, Sicular (1995:1035) and Rozelle et al. (2000:228) pointed out that the central government should have considered whether it is possible for the SGTCs to return to their old monopsony position in the grain market.

In 1994-96, the increase of quota prices and the good weather conditions contributed to a bumper grain harvest. At the same time the grain consumption did not increase (Zhong, 2001:19-20). At the end of 1996, the imbalance of grain production and consumption brought an unexpected sharp drop of grain market prices (40 percent in a month across the country). Suddenly, farm households had difficulties selling their grain again (Zhong, 2001:20). To ensure income of farm households, China's central government decided that the SGTCs had to purchase grain above-quota delivery at so-called protective prices<sup>14</sup>, which were lower than quota prices but higher than market prices (Zhong, 2001:21). This tremendously increased the subsidies provided to the SGTCs to fulfill their political tasks.

Being burdened by a huge financial deficit, China's central government implemented a series of new policies to try to recover losses in 1998. The core of the policies was to reinstate the monopsony position of the SGTCs in the grain market. Any individuals and private grain enterprises were prohibited to purchase grain directly from farm households. Apart from purchasing quota and above-quota grain at prices fixed by the government, the SGTCs had to sell grain at prices that cover the cost, and if possible make profits. At the same time, the policies continued to encourage the development of grain wholesale and retail markets both in urban and rural areas (SC, 1998a - c; SC, 1999a - b). However, central and local governments could not afford the high cost to prevent all private activities from purchasing grain from farm households. This phenomenon had already been demonstrated by Sicular (1995:1035) early in 1995 that the fact that the SGTCs were no longer dominant indicated that the cost of enforcing monopsony controls had risen tremendously given the increase of market participants. Private trading kept on growing in 1998-99 (Huang, 1998:1-2). The blooming parallel free market failed the implementation of the policies. Low market prices made it impossible for the SGTCs to avoid losses when they conducted any business (Huang, 1998:4; Zhong, 2001:27). On the other hand, the SGTCs had very high operational costs, e.g. because they were overstaffed. The financial deficit was still accumulating. In 1999 China's central government decided that the quota prices, paid for compulsory grain procurement, should be reduced to the level of protective prices by local governments, i.e. quota prices were abolished.

<sup>&</sup>lt;sup>13</sup> The Governor Responsibility System (GRS) means a decentralization of grain policy by giving responsibility to the governor of a province to balance grain demand and supply at the provincial level. To reach this objective, provincial governors have to a) stabilize the grain sown area; b) stimulate grain production; c) stabilize grain prices; d) guarantee grain reserves; e) carry out a strict plan of grain import and export at the provincial level; f) control grain market; g) guarantee grain self-sufficiency (OECD, 1997:53, 59).

<sup>&</sup>lt;sup>14</sup> Apart from purchasing grain quota at the quota prices, the SGTCs also had to purchase the above-quota grain at the protective prices, i.e. above-quota prices, as much as farm households wanted to sell. In 1999, both prices were equalized and the SGTCs had to purchase grain at the protective price for both quota and above-quota grain delivery. When market prices were lower than protective prices, the SGTCs had to purchase grain at protective prices. When the market prices were higher than the protective prices, the SGTCs had to purchase grain at market prices.

#### 2000 - 03

In 2000, grain procurement was no longer mentioned in state policy documents, which implied it was no longer compulsory (SC, 2000). The central government decided that the protective prices would be removed for certain varieties of grain, e.g. low-quality grain such as early rice. Legally licensed individuals and private companies were allowed to purchase the low-quality grain at market prices and compete with the SGTCs (SC, 2000). On the other hand, the SGTCs had to purchase the high-quality grain at the protective prices (the system of protective purchasing) and losses would be subsidized. In 2001, China's central government decided that grain deficit regions<sup>15</sup> could reduce or abolish grain procurement (SC, 2001). In 2002, most grain surplus regions in China also abolished the grain procurement system. Following 2002, grain sown area and grain production in 2003 continued decreasing. This brought increases in grain prices. This was partly caused by the rapid growth of the real estate market that increased the demand for construction workers in the city. These workers came from farm households leading to a fall in grain production. In November 2003, in some provinces in China, grain purchase prices had gone up 10 percent (PDO, 2003). This time, the central government stayed calm to the price increase and no policy withdraw has been observed. In the same year, the national grain reserve system was established after two years preparation, which aimed at stabilizing grain prices and political situation, and assuring food security (SC, 2003).

#### 2004 - 05

The first document issued by the central government in 2004 focused on issues such as stimulating grain production, grain market liberalization and deregulation, and enhancing income of farm households (SC, 2004a). Further grain market liberalization and deregulation was stressed in this document. The introduction of a direct land subsidy<sup>16</sup> to farm households and a reduction of the agricultural tax were remarkable changes. Restrictions on private traders entering the high-quality rice purchase markets were removed, protective prices were no longer mentioned, yet a so-called "floor price" was introduced for all types of rice (mentioned in a document released by the State Council in May 2004 (SC, 2004b)). The so called "floor price" applies for late rice and one-season rice. It is fixed by the government and becomes effective when the market price is lower than the floor price. The floor price fixed by the central government applies mainly in grain surplus regions and only for enterprises that were qualified for grain reserve purchasing (SC, 2004b). In the same document, the central government emphasized the importance of the market mechanism for efficient resource allocation and the importance of market liberalization and deregulation. Moreover, special attention was given on establishing regulations assuring the well functioning of the grain market (SC, 2004b).

<sup>&</sup>lt;sup>15</sup> In a grain deficit (surplus) region grain production is less (larger) than grain consumption.

<sup>&</sup>lt;sup>16</sup> There are different ways to subsidize farm households. Some provinces provide a subsidy per unit of land used for grain production. Some provinces provide a subsidy per unit of production sold to the SGTCs.

http://www.sjzxj.heagri.gov.cn/default3.aspx?id=622

Grain market policies

A few days later, the administrative ordinance of grain circulation was released (SC, 2004c). The ordinance was meant to further liberalize and deregulate China's grain market, especially the grain purchase market. Guidelines of entering the grain purchase market and regulations on individuals and private companies engaged in grain purchase were stressed (SC, 2004c). Soon after this document was released, the State Grain Administration (SGA) announced the corresponding qualifications for private traders to enter the grain purchase market (SGA, 2004a). The criteria indicated that private traders whose trade volume was less than 50 tons annually did not have to register, which gave room for small-scale private traders to grow in the just-opened grain purchase market (SGA, 2004a). At the end of 2004, China's central government released monitoring measures for the grain marketing channel (SGA, 2004c) and grain quality (SGA, 2004d).

In the beginning of 2005, the SGA released regulations on monitoring grain administrations at different administrative levels to assure a correct enforcement of regulations (SGA, 2005a). Later, a statistical system for the grain marketing channel was established (NDRC, 2005). After almost 5 years' preparation, a system of monitoring and forecasting the market price was introduced in July 2005. Nevertheless, this system only serves the central and local government instead of the private traders in the markets. The grain information center releasing information on grain demand and supply, grain quality and grain price was established at the same time. However, the information was only accessible when a certain amount of fee was paid. It was therefore very expensive for the private traders (farm households) to benefit this information system. In the same month, regulations on how local government or grain administration at a higher level reconsiders inappropriate decisions made by grain administrations at certain administrative level were released (SGA, 2005b).

Therefore, the policy regime in 2004-05 can be summarized as follows: The grain procurement system is abolished. Grain purchase markets are open to the private sector, i.e. private traders are allowed to compete with the SGTCs in the grain purchase market. Protective prices only apply for grain reserve purchasing. For example, enterprises that are qualified for national grain reservation are obliged to purchase at the protective price fixed by the central government even when it is higher than the market price. In the grain marketing channel, producers can sell their product at the local free market to private traders, the SGTCs or other enterprises such as grain processing factories. Private traders and the SGTCs can sell grain to wholesalers. Through retailers, consumers purchase grain. Studies on the efficiency of China's grain markets demonstrate that China's markets are becoming more integrated<sup>17</sup> and efficient (Rozelle et al., 1997:640; Rozelle et al., 2000:237; Park et al., 2002:80; Huang and Rozelle, 2002:5). Table 2B.1 in Appendix 2B summarizes the policy reforms in China's grain market from 1950 to 2005.

<sup>&</sup>lt;sup>17</sup> Rozelle et al. (1997:638) showed that China's rice and maize markets have become increasingly integrated after the liberalization policies of the early 1990s using a cointegration analysis.

## 2.3 Policies for State Grain Trading Companies

Being a means of market intervention, the SGTCs had to assure food self-sufficiency, e.g. support high farm prices and support low consumer prices. The SGTCs have gone through a series of policy reforms. This section concentrates on the policies directed towards the SGTCs and the shifts of the role of the SGTCs in grain trade.

## 1992 – 97

Beginning in 1992, the central government converted local grain bureaus at county and township levels that had previously carried out grain procurement in rural areas into commercial SGTCs (Sicular, 1995:1025). These SGTCs had to conduct grain trade and had to hire the employees and provide the pensions for the retirees of the local grain bureaus. They also had to carry out certain policy tasks such as quota procurement and storage of grain reserves. Like other commercial firms, these SGTCs had to cover operational costs and pay income tax. In return, grain managers could control state-owned assets, such as storage facilities and fleets of trucks, and were provided contractual incentives to make profits (Rozelle et al., 2000:234-35).

In 1994, the central government pushed the reform further by deciding that the commercialized SGTCs had to separate their policy-oriented businesses from their commercialoriented businesses (SC, 1994). When the SGTCs carried out policy-oriented businesses, they were financially supported by the central and local government. When conducting commercialoriented businesses, they were supposed to be financially self-supporting (SC, 1994). In order to realize the separation, the SGTCs had to separate their employees and capital for the two different oriented businesses. During the separation, a series of problems appeared that slowed down the reform. For example, because of the complicated social network in China, it was very difficult for the SGTCs to decide who would be involved in policy-oriented businesses and who would be involved in commercial-oriented businesses. Furthermore, the fact proved that separating the policy-oriented businesses from commercial-oriented businesses without leadership separation did not led to profit improvements (Ji, 2001). In 1998, the central government announced further policy reform for the SGTCs. Apart from the continuance of the policy of 1994, the SGTCs had to reduce overhead costs by reducing the number of employees (SC, 1998a).

### 1998 - 99

The new policies released in 1998-99 were formed under the assumption that the SGTCs could monopsonize the grain purchase market (SC, 1998b – c; SC, 1999a – b), which was opposite to the actual situation. Facing the gradually liberalized and deregulated agricultural market, the SGTCs were losing their monopsony position and struggling to compete with private traders. For example, the SGTCs were obligated to purchase grain from farm households at the protective prices that were fixed by the provincial governments. However the protective prices were higher than the market purchase prices. So the SGTCs had to buy grain at a high price.

According to the reform (SC, 1998b), the SGTCs were supposed to sell grain at prices that cover costs. However, because these prices were higher than the prices offered by private traders it was impossible to sell grain (Huang, 1998:4). Therefore, the existence of private traders made that the SGTCs could only store the grain that was purchased at the protective prices. This led to large grain stocks exceeding the storage capacity and the value of the grain stored decreased which made the selling more difficult (Huang, 1998:3). To solve this problem, the central government admitted that the SGTCs could sell their old grain at free market prices and the local government would cover the losses (SC, 1998b). However, the local government budget could not afford the huge losses, which made the solution infeasible. Facing these problems, the SGTCs from all over China reacted differently. Some still followed the policies and their warehouses were overloaded (Huang, 1998:3). Some stopped purchasing from farm households and came in a situation of closing down because they could not pay their employees anymore.

#### 2000 - 03

In 2000, China's central government realized that it was impossible to block all the businesses by private traders and the SGTCs were no longer monopsonists in the grain purchase market. The modified policy removed the constraint of protective purchasing of certain varieties of grain that proved difficult to resell (namely early rice) and the SGTCs were allowed to purchase these varieties of grain at market prices. Consequently, the SGTCs would no longer receive any subsidy for early rice exchange. Meanwhile, private traders were allowed to enter the grain purchase market officially but could only trade limited varieties of grain (SC, 2000). Moreover, these private traders had to register at the grain administrations. For the high-quality grain (i.e. late rice and one-season rice), where the protective purchasing still applied, the central government expected that the SGTCs still would be monopsonists. Losses caused by protective purchasing were expected to be subsidized. Therefore for these varieties the same problems stayed. In 2001, the central government started preparation to establish a national grain reserve system, which was supposed to take over the functions of the SGTCs for food self-sufficiency and grain prices stabilization. In addition, reduction of redundant employees is further stressed in policies released in the second half of 2001 (SC, 2001). As mentioned before, by 2002, grain procurement was abolished both in deficit regions and surplus regions in China. Policies focusing on commercialization of the SGTCs that were released in the same year again emphasized the necessity of reducing the number of employees (NDRC, 2002). In August 2003, the central government released regulations concerning the established national grain reserve system (SC, 2003). These regulations indicated that enterprises that were qualified could contract with the government for national grain reservation (SC, 2003). The removal of grain procurement and the contracting with other commercial enterprises for grain reserves indicated that the major functions of the SGTCs had faded out.

#### 2004 – 05

In 2004, the central government announced a new set of policies, among which the abolition of the monopsony of the SGTCs in the high-quality grain market (SC, 2004b). Moreover, the SGA announced further commercialization of the SGTCs (SGA, 2004b). The SGTCs were expected to be financially independent and to make profits (SGA, 2004b). Administratively, the SGTCs were affiliated with grain administrations at higher (county) level. The grain administrations should only provide coordination and services to the SGTCs without interfering in their trading business (SGA, 2004b). Once again, reduction of redundant employees was stressed (SGA, 2004b). In October 2004, the National Development and Reform Commission (NDRC) released policies on qualifications of enterprises that participate in national grain reserves (NDRC, 2004). In 2005, the direction of commercialization of the SGTCs remains the same as 2004 (SC, 2005). As mentioned before, regulations to ensure the compliance of grain administrations with relevant policies were released by the SGA (2005a). Table 2B.2 in Appendix 2B summarizes the policies for the SGTCs since 1992.

### 2.4 Concluding remarks

This chapter provides insight in the process of China's grain market liberalization and deregulation by reviewing policy changes since the 1950s with special focus on the policy evolution with respect to the SGTCs. In summary, China's government has gradually brought the market mechanism into play, which has, to a large extent, relieved the fiscal budget from the burden of subsidizing the SGTCs. Nevertheless, the road towards market liberalization and deregulation has not yet reached the end.

The policy changes since 2000 influenced and will influence in the future the structure of the grain marketing channel. The next chapter therefore describes the grain marketing channel in the study areas in 2000-03.

### Appendix 2A Glossary and China's grain market policies

- Above-quota The above-quota delivery emerged in the 1960s and was not compulsory in the beginning. The amount of above-quota delivery varied throughout the country. Some provinces set the above-quota amount before production started and the actual procured amount could be 10 percent to 30 percent more or less than the pre-set amount. Other provinces set the above-quota amount at a fixed proportion of the grain that was left after fulfilling the quota procurement and self-consumption of farm households. In 1979 and 1994, the above-quota delivery was set as compulsory. In 1984 and 1997, it was set as voluntary.
- Above-quota price The above-quota price was fixed by the central government depending on the grain supply and demand situation. In 60s, it was 30 percent higher than the quota prices. By the end of 70s, it became 50 percent higher. In the middle of the 1980s, it was lower than the quota prices. It was named "protective price" in the late 90s.
  - Agricultural tax According to the 'Stipulation of the People's Republic of China regarding the agricultural tax', tax payers refer to units such as state-owned farms and enterprises with agricultural income, and individuals that engage in agricultural production and obtain agricultural revenue. The agricultural tax is levied on agricultural revenues. The nationwide average agricultural tax rate is 25-30 percent of the normal grain yield. From 1949-84, farm households had to pay the agricultural tax in the form of grain. From 1985-92, farm households had to pay an equivalent amount of cash as agricultural tax. From 1993 onwards, farm households can pay the agricultural tax either in the form of grain or in the form of cash. Since 2004, China's central government announced gradual abolishment of the agricultural tax in three years time.
- **Contracted grain purchasing / state contract purchasing con** 
  - **Direct subsidy** In 2004, China's government introduced direct subsidy to farm households. According to the central government, the local government at the provincial level could decide how to subsidize. Some provinces provide a subsidy per unit of land used for grain production. Some provinces provide a subsidy per unit of production sold to the SGTCs.
**Floor price** Floor price was introduced in 2004. It applies for late rice and one-season rice. It is fixed by the government and becomes effective when the market price is lower than the floor price. The floor price fixed by the central government applies mainly in grain surplus regions and only for enterprises that were qualified for grain reserves purchasing.

Governor Responsibility System (GRS) The GRS was introduced in 1995. GRS decentralized grain policy by giving responsibility to the governors of the provinces to balance grain demand and supply at the provincial level. To reach this objective, provincial governors have to a) stabilize grain sown area; b) stimulate grain production; c) stabilize grain prices; d) guarantee grain reserves; e) carry out a strict plan of grain import and export at the provincial level; f) control the grain market; g) guarantee grain self-sufficiency.

Grain procurement aims to ensure production growth, balance grain supply procurement/ Grain quota Grai

- **Grain rationing** Under the grain-rationing system, China's consumers were issued coupons giving them the right to buy a set amount of grain per person at a low price. Grain above the ration amount could be purchased in free markets. Grain rationing was introduced in the 1950s and abolished in 1993.
- **Grain-rationing** The grain-rationing price was fixed by the government at a very low level for a set **price** amount of grain that could be purchased by urban consumers.
  - Grain reserve The functions of the grain reserve system are to assure food security, to stabilize grain prices and political situation. In 1990, China's central government decided to establish the state grain reserve system. Since 2001, the central government has put special attention on developing the system. In 2003, the administrative ordinance of the state grain reserve was issued.

Household A contracting system that started at the end of 1978. While land was still owned by
Responsibility System (HRS)
System (HRS)
A contracting system that started at the end of 1978. While land was still owned by the agricultural collectives, the user rights of the land were contracted to individual farm households for one to three years. HRS linked the income generating capacity of land to farm households – farm households could retain the remaining output after paying the agricultural tax, fulfilling quota and above quota delivery. In 1984, China's central government extended the contract to 15 years or more. In 1993, the contract was further extended to 30 years.

- **Negotiated price** The negotiated price was set by the SGTCs according to grain demand and supply conditions. It was not mentioned anymore by the central government after 1990.
- Procurement price/The SGTCs procured grain quota from farm households at the price that is fixedQuota priceby the central government.
  - **Protective price** The price was fixed by the central government to insure the income of farm households. It was introduced in 1996. Apart from purchasing grain at the quota prices, the SGTCs also had to purchase the above-quota grain at the protective prices, i.e. above-quota prices, as much as farm households wanted to sell. The protective prices were lower than the quota prices and higher than the market prices. In 1998, quota prices and protective prices were equalized and the SGTCs had to purchase grain at protective prices for both quota and above-quota grain delivery. When market prices were lower than protective prices, the SGTCs had to purchase grain at protective prices. When the market prices were higher than the protective prices, the SGTCs had to purchase grain at protective prices. It was no longer mentioned in documents released by the government in 2004.

State contract	It is the same as	"grain procurement".
purchasing		

Surplus/deficitSurplus/deficit region means a region that produces more/less grain than itregionconsumes so that it exports/imports grain to a deficit/surplus region.

# Appendix 2B China's grain market policies

# Table 2B.1Policy reform in China's grain market from 1950-2005

Year	Policy	Price categories	Actual situation
1950-77	<ul> <li>grain procurement</li> <li>grain rationing</li> <li>State monopoly &amp; monopsony</li> <li>Compulsory quota and above-quota delivery for farm households</li> </ul>	Quota price Above-quota price Negotiated price Rationing price	<ul> <li>Supply does not meet demand</li> <li>The SGTCs were subsidized to supply grain at prices lower than quota prices</li> </ul>
1978	<ul> <li>Household Responsibility System</li> <li>Quota prices are increased</li> <li>Above-quota prices are increased</li> </ul>	Quota price Above-quota price Negotiated price Rationing price	<ul><li>Technology innovation</li><li>Rapid growth in grain production</li></ul>
1979-84	<ul> <li>Farm input subsidies</li> <li>Lease land up to 15 years</li> <li>Agriculture extension</li> <li>Rural and urban free markets are allowed</li> <li>Wholesale market is opened</li> </ul>	Quota price Above quota price Negotiated price Market price Rationing price	<ul> <li>Boost of free markets</li> <li>Grain surplus led to budget burden</li> <li>Farm households had difficulties to sell their grain</li> </ul>
1985-86	<ul> <li>Grain procurement → contracted grain purchasing</li> <li>Voluntary quota and above-quota delivery for farm households</li> <li>Quota prices are increased</li> <li>Above-quota prices are decreased and are less than the quota prices</li> <li>Decrease in farm input subsidies</li> </ul>	Quota price Above quota price Market price Rationing price	<ul> <li>Farm households became reluctant to sign contracts</li> <li>Increase in opportunity cost of grain production</li> <li>Sharp drop of grain production (7%)</li> <li>Food price inflation</li> </ul>

(Table continued)

Year	Policy	Price categories	Actual situation
1986-90	<ul> <li>Contracted grain purchasing → state contract purchasing</li> <li>Compulsory quota and above-quota delivery for farm households</li> <li>State monopoly &amp; monopsony</li> <li>Provide production incentives by supplying fertilizers at subsidized prices</li> </ul>	Quota price Above quota price Negotiated price Market price Rationing price	<ul><li>Increase in grain production</li><li>Persistent increase in free trade</li></ul>
1991-92	<ul> <li>Increase grain-rationing prices</li> <li>Compulsory quota delivery</li> <li>Each province can decide when to remove the quota prices</li> <li>Commercialization of the SGTCs</li> <li>Decrease in subsidy or farm inputs</li> </ul>	Quota price Above quota price Negotiated price Market price Rationing price	<ul> <li>Removal of part of the subsidies</li> <li>Elimination of the quota prices in some provinces</li> <li>IOUs become serious problem</li> </ul>
1993	<ul> <li>Grain rationing is abolished</li> <li>Fixed quota prices are eliminated</li> <li>Grain retail &amp; wholesale markets are opened (private traders are allowed)</li> </ul>	Quota price = market price Rationing price = market retail price	<ul> <li>Consumer purchase of grain at market retail prices</li> <li>Elimination of quota prices in all provinces</li> <li>Decreasing grain output</li> <li>Sharp increase in grain prices</li> <li>High inflation</li> </ul>
1994-95	<ul> <li>Compulsory quota and above-quota delivery</li> <li>Strict state monopsony in grain purchase market</li> <li>Private traders are prohibited</li> <li>Governor Responsibility System</li> </ul>	Quota price Above quota price Market price Retail market price	- Difficult for the government to dominate the grain purchase market

(Table continued)

Year	Policy	Price categories	Actual situation
1996-97 -	Implementation of protective price for above-quota delivery	Quota price Protective price Market price Retail market price	<ul> <li>Increase in grain output</li> <li>Unchanged or even decrease in grain consumption</li> <li>Surplus in grain production</li> <li>Market price decreases 40% over a month across the country</li> <li>Sharp increase in subsidy to the SGTCs due to the implementation of protective price</li> </ul>
1998 - - -	Reinstate state monopsony in grain purchase market to cover losses Individuals and private enterprises are strictly prohibited entering the grain purchase market The SGTCs should make profit from monopsony position Development of grain wholesale and retail markets are further stimulated	Quota price Protective price Market price Retail market price	<ul> <li>Very costly to prohibit private trade</li> <li>Parallel free markets keep on growing</li> <li>Grain market prices are lower than the protective prices, and the protective prices are lower than the quota prices</li> <li>Losses of the SGTCs keep on increasing</li> </ul>
1999 -	Reduce quota prices to the level of protective prices	Quota price = Protective price Market price Retail market price	- The SGTCs cannot earn profit

(Table continued)

Year	Policy	Price categories	Actual situation
2000-03	<ul> <li>No protective prices for low-quality grain</li> <li>Individuals and private enterprises are allowed to enter the grain purchase market of low quality grain</li> <li>Grain procurement is abolished by some provinces (Jiangxi Province included)</li> <li>Administrative ordinance of national grain reserve system is released</li> </ul>	Protective price Market price Retail market price	<ul> <li>Decrease in grain sown areas</li> <li>Decrease in grain production</li> <li>Increase in grain prices</li> </ul>
2004	<ul> <li>Direct subsidy to farm households</li> <li>Reduction in agricultural tax</li> <li>Individuals and private enterprises are allowed to enter the grain purchase market of high quality grain</li> <li>Protective price applies for grain reserve enterprises in grain surplus regions</li> <li>Administrative ordinance of grain circulation is released</li> <li>Qualifications for private traders to enter grain purchase market are introduced</li> <li>Monitoring measures on grain marketing channel</li> <li>Monitoring measures on grain quality</li> </ul>	Protective price Market price Retail market price	<ul> <li>Increase in grain prices, but the speed has slowed down</li> <li>Increase in grain sown areas</li> <li>Slight increase in grain production</li> <li>The SGTCs freed of political tasks</li> </ul>
2005	<ul> <li>Regulations on monitoring grain administrations</li> <li>Establishment of a statistical system for the grain marketing channel</li> <li>Establishment of a monitoring system for the market price</li> <li>Regulations on how to reconsider inappropriate decisions made by grain administrations</li> </ul>	Protective price Market price Retail market price	<ul> <li>Grain prices remain stable</li> <li>Increase in grain sown area</li> <li>Increase in grain production</li> </ul>

# Table 2B.2Policies for the SGTCs

Year	Policy	Actual situation
1950-78 -	State owned and centrally planned	
1978-92 -	No reform policies	<ul> <li>Not encouraged to pursue potential profits from out-of-plan grain trade</li> </ul>
1992-93 -	Commercialization of the SGTCs: - Policy-oriented businesses - Commercial-oriented businesses	
1994-97 - -	Separation of businesses to serve different goals to reduce budget deficit Reduction of redundant employees	<ul><li>Separation is not successfully implemented</li><li>Budget burden is not reduced</li></ul>
1998-99 - - -	Regain monopsony position in grain purchase market Purchase the above quota grain as much as farm households want to sell at protective price Sell grain at the price that can cover the costs Continue to reduce redundant employees	<ul> <li>Some refuse to purchase</li> <li>Some cannot purchase anymore because the warehouses are full</li> <li>Cannot sell and thus cannot make profit</li> <li>Local subsidies do not arrive</li> <li>Employees are not paid</li> </ul>

(Table continued)

Year	Policy	Actual situation
2000-03	<ul> <li>Remove protective price for low-quality grain</li> <li>Private traders are allowed to enter the grain purchase market for low-quality grain</li> <li>Monopsony remains in grain market for high-quality grain</li> <li>Abolishment of grain procurement</li> <li>Establishment of national grain reserve system, of which the SGTCs were no longer involved</li> </ul>	<ul> <li>Could gain some profit from selling grain for which protective prices do not apply anymore</li> <li>Competition emerges</li> <li>Still face difficult situation of maintaining periodical monopsony</li> <li>Major functions of the SGTCs were fading out</li> </ul>

2004	-	Remove monopsony of the SGTCs in high-quality grain purchase
		market

- Private traders are allowed to enter the grain purchase market for highquality grain
- Protective price applies for enterprises qualified for purchasing national grain reserves
- Compete with private sector
- Grain administrations at higher level should not interfere in trading business of the SGTCs
- Reduction of redundant employees
- Announcement of qualifications of enterprises involved in national grain reserves

- Free from political tasks
- Competition becomes more intense
- Gradually losing its market power

# **3** Rice marketing channel in the study areas in 2000-03

#### 3.1 Introduction

Since rice is one of the main agricultural products in the study areas, we limit ourselves in this chapter to the rice marketing channel. The previous chapter described the process of market-oriented reform in policies and institutions in China's rice market in the past 25 years. In 2000-03, China's government has abolished the direct controls over the price of early rice, removed the quota procurement for rice, further commercialized the SGTCs, and permitted the private sector to participate in the rice market. Corresponding with these adjustments, the structure of the rice purchase market in 2000-03 has been changed, i.e. the number of participants in the market (state-owned and private companies) has gone up that increases competition and therefore market efficiency.

The degree of price transmission describes the extent to which price changes at the consumer level affect prices at the farm gate. It depends on the structure of the marketing channel. Therefore, the first aim of this chapter is to describe the rice marketing channel in the study areas in 2000-03 based on information collected from a survey, giving special attention to two actors in rice purchase market – private traders and the SGTCs. The second aim of this chapter is to describe the effects of market liberalization and deregulation on the rice marketing channel. More particular the effects of policies from 2000-03 on private traders and the SGTCs are presented. This chapter starts with a description of the grain marketing channels in 2000-03 in the study areas (Section 3.2). Section 3.3 discusses the effects of policy changes in 2000-03 on the marketing channel. Concluding remarks and policy implications are given in Section 3.4.

#### 3.2 Rice marketing channel in 2000-03

Taking the selected villages as examples, we first describe the rice marketing channels in 2000 in the areas that these villages are located, followed by assessments of the performance of the traders in the rice purchase market. In China, a township<sup>18</sup> has a SGTC, the township grain trading company.

The content of this section is based on data at household level collected by the SERENA project in 2000 (SERENA, 2000) and information and data on other players in the marketing channel that was gathered during interviews held in March and July 2003 (Chen, 2003 unpublished summary). Data at household level are for 2000. For consistency, most information and data collected in 2003 was for the year 2000. Farm households, the heads of

<sup>&</sup>lt;sup>18</sup> Currently, there are five levels of local government in China. They are province, municipality, county, township, and village.

the administrative villages, private traders, the heads of the SGTCs and other players (e.g. rice processor, rice wholesaler, and rice retailer) in the marketing channel were interviewed (see Appendix 3A). Questionnaires (see Appendix 3B) were designed to collect data on rice prices at different levels of the marketing channel, players involved in the rice marketing channel, costs of these players, etc. Besides information for the year 2000, some additional information was also collected for the year 2003.

### 3.2.1 Market access

In this study, market access is defined as the distance between the village that farm households reside in and the closest consumer markets. Market access is measured by the costs private traders make to transport the rice from the village to their next buyers.

Jiangxi Province is one of the main agricultural provinces in China. Rice is its most important cultivated crop. The main topography in Jiangxi Province is hilly and mountainous. These natural conditions result in transportation disadvantages and soil degradation (Shen and Wu, 2004). This study focuses on three administrative villages in the Northeast part of the province. In China, a township consists of administrative villages. An administrative village consists of several natural villages, which are naturally formed residential areas that consist of one or several families. These three villages were selected using a series of criteria, which include economic development level, market access and geographical conditions (see Table 3.1 for a summary of the characteristics of the three villages).

Characteristic	Banqiao	Shangzhu	Gangyan
Natural villages	4	16	7
Households	257	529	721
Population	1007	2064	3120
Agricultural land (mu <sup>19</sup> )	1234	2358	3875
Main crops	Rice, peanut, watermelon	Rice, sweet potato	Rice, peanut, watermelon
Landscape	Hilly	Mountainous	Plain
Market access	Good	Very limited	Best

Table 3.1A summary of the characteristics of the three villages

Source: SERENA, 2000; Chen, 2003.

The three selected administrative villages<sup>20</sup> have different degrees of market access. The first administrative village is called Banqiao, which locates in a hilly area. Banqiao has 4 natural villages that locate close to each other. The distance from each natural village to the nearest market is on average about 15 minutes by truck. One advantage of Banqiao is that it only takes 20 minutes by truck for farm households to go from Banqiao to Yingtan, which is the city with

<sup>&</sup>lt;sup>19</sup> One mu is 1/15 of a hectare, i.e. 1 mu = 0.067 hectare.

<sup>&</sup>lt;sup>20</sup> These three villages were selected according to criteria such as environmental indicators, market access, and geographical conditions by the SERENA project (Kuiper et al., 2001). In this study, the effects of differences in market access on the outcomes of market liberalization are of interest.

the main market. The second administrative village is called Shangzhu, which locates in a mountainous area. Shangzhu has 16 natural villages, which are scattered upon several mountains. It takes 3 to 4 hours walking from the furthest natural villages to the natural village where trucks can arrive. From there, it takes half an hour driving to the nearest markets in the neighbor administrative village and one hour to the nearest township. The third administrative village is called Gangyan, which locates at a relatively flat area. Gangyan has 7 natural villages, which are distributed along a straight line on the map. There are markets at both ends of the line; on average it takes 10 minutes by truck to the nearest market (see Figure 3B.1 in Appendix 3B for maps of the study areas).

	Banqiao	Shangzhu	Gangyan
Within township	17	17	8
Within county	17	33	17
Within province	NA	NA	41

Table 3.2Unit transport cost of each village in 2000 in Yuan/ton

Source: Chen, 2003.

NA = Not Available.

Table 3.2 lists unit cost of transporting rice from each village to different destinations. Table 3.2 shows differences in market access of the villages. We see that Gangyan has the best market access while Shangzhu has the worst, and Banqiao is in between.

During the survey, we observed that a new road on which tractors and trucks could drive was constructed in 2000-03 by farm households in Shangzhu. This has improved market access of Shangzhu. It was the second road that connected Shangzhu with its neighbor administrative village.

#### 3.2.2 Actors

The rice marketing channel in the study areas covers farm households, assemblers, processors, wholesalers, and retailers. Prices at different levels allow the calculation of price margins between levels.

A price margin is defined as the difference between buying price and selling price at one level of the marketing channel. Price margins provide insights on the importance of a certain level of the marketing channel in determining consumer prices. Moreover, they give insights in the efficiency of a marketing channel, i.e. a more efficient marketing channel has lower price margins. The price margins consist of variable costs (excluding the buying price of rice) such as transport costs, processing costs, search and information costs and value added (the reward for labor and capital used). Price margins can include monopsony/oligopsony or monopoly/oligopoly profits. Price margins therefore depend on the market structure (such as number of intermediates and degree of competition).

#### Farm households

There are in total 331 farm households selected that on average cover 22% of the total number of households in the three selected villages, i.e. 56 households from Banqiao; 107 households from Shangzhu; and 168 households from Gangyan. Table 3.3 shows that most of the farm households in Banqiao and Gangyan grow both early and late rice; while most of the farm households in Shangzhu grow one-season rice. The crop rotation system (in one year) between early rice and late rice indicates that households growing early rice also grow late rice.

	Banqiao	Shangzhu	Gangyan	Total
Early rice	100	40	97	79
Late rice	100	41	94	78
One-season rice	18	90	61	63

 Table 3.3
 Share of sample households growing rice in 2000 (%)

Source: SERENA, 2000-01.

Rice produced by farm households is distributed over own rice consumption, rice paid as agricultural tax, and rice sold at the market (to the SGTCs and private traders)<sup>21</sup>. During the interviews with farm households conducted in 2003, it is found that none of the farm households in the three villages sells rice directly to consumers at local markets. This is because harvested rice needs to be husked before it can be sold to consumers and farm households cannot compete with processing factories that are specialized in rice husking<sup>22</sup>. Table 3.4 lists how rice is distributed over different categories in each village. Rice output, rice own consumption, rice as agricultural tax, and rice supplied to the market (the SGTCs and private traders) are summated over the sample farm households. Shares are then calculated by dividing the sum of each category over the sum of rice output. On average all three villages keep 80% of their early rice production for own consumption. One of the reasons is that market prices for early rice are lower than that of late rice (see Table 3.7). Moreover, survey information shows that the same amount of early rice feeds more persons than one-season rice and late rice (Chen, 2003). Since market prices for one-season rice and late rice are higher, Banqiao and Gangyan sell more than 50% of their one-season and late rice production and keep about 30% as own consumption<sup>23</sup>. Shangzhu keeps about 90% of its rice production as own consumption and sells only about 10% of its one-season rice and late rice. Low market access of Shangzhu might be one of the reasons explaining the low share of marketed rice.

<sup>&</sup>lt;sup>21</sup> During the survey we found that the obligation of grain procurement was already eliminated in 1998 in the study areas.

<sup>&</sup>lt;sup>22</sup> In each natural village, there is a village-owned thresher so that farm households can unhusk their own paddy rice for self-consumption.

<sup>&</sup>lt;sup>23</sup> This does not include the case of late rice in Gangyan, i.e. Gangyan sells about 30% of its late rice and keeps about 60% as own consumption.

	Categories	Banqiao	Shangzhu	Gangyan	Total
	Own consumption	83	99	77	80
Forly rice	Agricultural tax	6	1	4	4
Early fice	SGTC	1	0	3	2
	Private trader	10	0	16	14
Late rice	Own consumption	33	89	63	56
	Agricultural tax	1	3	5	3
	SGTC	0	0	7	4
	Private trader	66	8	25	37
One-season rice	Own consumption	30	85	39	60
	Agricultural tax	1	4	3	4
	SGTC	0	0	7	4
	Private trader	69	11	51	32

 Table 3.4
 Share of rice distributed over different categories in 2000 (%)

Source: SERENA, 2000.

#### Rice assemblers

In the rice purchase market, farm households sell their rice mostly to rice assemblers, i.e. private traders and the SGTCs. Farm households living close to grain processing factories or unhusked rice wholesalers deliver their rice directly to them when their transport costs are covered by their selling prices. Due to the fact that selling rice to processing factories and wholesalers is hardly observed from our dataset, we only focus on assemblers, i.e. private traders and the SGTCs<sup>24</sup>.

*Private traders* Thirteen respondents were interviewed during the survey conducted in 2003, among which 12 were self-employed and 1 was the head of a TVE. Ten respondents were involved in rice exchange in 2000 and 3 respondents started their businesses in the period of 2000-03. Among the 10 private traders, 2 are from Banqiao, 2 from Shangzhu, 5 from Gangyan and the TVE locates in the closest town to Gangyan. The TVE was established in 1993 as a rice processing factory. It stopped as a processing factory because of intense competition in the processing sector in 1999. Since 2000 the TVE has been operating as a rice assembler<sup>25</sup> (Table 3.5). None of the private traders possessed a cell phone in 2000 while 6 out of the 13 respondents bought a cell phone in the period of 2000-03. One of the private traders from Shangzhu mentioned during the interview that he was using a business package with lower prices provided by China Unicom<sup>26</sup> in 2000-03 targeting at farmers in the rural areas.

<sup>&</sup>lt;sup>24</sup> Only 1 farm household in Banqiao and 1 farm household in Gangyan sold their rice directly to a processing factory instead to private traders or SGTC.

<sup>&</sup>lt;sup>25</sup> According to the interview, the TVE has three employees and its exchange operation is similar to that of private traders. Nevertheless, differences exist between the TVE and private traders, e.g. the TVE has storage facilities.

<sup>&</sup>lt;sup>26</sup> China Unicom is one of the four largest state-owned telecommunication companies in China.

According to him, the offer of this kind of business package was one of the main reasons that he bought the cell phone.

As shown in Table 3.5, almost all traders are self-employed. Except the TVE, none of the traders had registered officially at county level. They are rice farmers themselves. Most traders perform on their own while some are involved in a partnership. Most traders regard late rice and one-season rice as the same type due to their similarities in quality (Table 3.5). A private trader not only purchases rice from its own natural village but also from nearby natural villages or natural villages from other administrative villages. Normally, before purchasing activities really happen, a private trader visits the farm households that he knows and informs them that he will come at a specific day to collect rice. In this way, those farm households who are willing to trade with the private trader can be prepared when he comes. At the selected day, the private trader trades with the households and brings the rice to the truck he hired. When the truck is full, the private trader transfers the rice directly to his next buyer, which could be the local SGTC, the SGTCs from different regions, rice processing factories, or rice wholesalers. Since 10 out of 13 private traders were already active in 2000, this implies that their unofficial exchange activities have survived the different government policies in recent years (Table 3.5).

Table 3.5Characteristics of private traders in 2000 (numbers in parentheses are numbers of<br/>private traders)

Network type	Selling direction	Rice type	Partnership	Business type
Relatives (2)	SGTC (4)	ER, LR, OR (3)	On his own (7)	Self-employed (9)
Business contact (8)	Processing factory (3)	ER, LR/OR (5)	One partner (2)	TVE (1)
	Wholesaler (3)	LR/OR (2)	TVE (1)	

Source: Chen, 2003.

Notes: ER = Early Rice; LR = Late Rice; OR = One-season Rice; SGTC = State Grain Trading Company;

TVE = Township and Village Enterprise.

There are two ways how the private trader pays farm households. One way is that if the private trader knows the farm household well, for example, the farm household is from the same natural village where the private trader lives, he makes an oral agreement to pay after he has sold the rice to his next buyer. Therefore, his reputation is very important for his business. The other way is that when the private trader purchases rice from a farm household that he does not know well, e.g. a farm household from another natural village; he has to pay cash immediately after the transaction. The cash that the private trader pays could be the prepayment from rice processing factories, rice wholesalers, or the SGTCs. The prepayment requires close contacts between the private trader and his buyers. In other words, certain

transaction costs, such as search and information costs and networking costs<sup>27</sup>, exist before potential private traders can enter the rice purchase market.

Data collected in 2003 for 2000 are based on the memory collection of respondents. Therefore, the information on prices for 2000 is not suitable for a comparison between traders. Instead price margins of each trader are calculated and their means for each village are presented in Table 3.6. In addition, we also list means of transport costs in Table 3.6. Other costs such as search and information costs and additional costs (networking costs like cigarette, drinks, and meals) were difficult to obtain during the interviews. Table 3.6 shows that price margins are in general higher for late rice and one-season rice exchange. Transport costs might explain the relatively high price margin in Shangzhu. On average, the price margin at farm-to-assembler level of the marketing channel is about 50 Yuan per ton. All traders interviewed exchanged more late rice and one-season rice than early rice. For each type of rice, exchange quantities of each trader in 2000 vary from 3 tons up to 150 tons. The TVE operates on the largest scale with 1000 tons exchanged in 2000. According to Chapter 2, new policy released in 2004 indicated that a private trader with an annual trading volume under 50 tons was not obliged to register. However, among all 13 private traders that were interviewed, only 2 traded less than 50 tons in 2000-03. Hence, the effectiveness of this policy is put into question.

	Banqiao	Shangzhu	Gangyan
Early rice			
Price margin	50	NA	41
Transport costs	17	NA	8
Late rice			
Price margin	50	58	50
Transport costs	17	25	17
One-season rice			
Price margin	58	NA	50
Transport costs	17	NA	17

Table 3.6 Mean price margins in the rice purchase market in 2000 in Yuan/ton

Source: Chen, 2003.

NA = not available

During the interview one of the private traders from Banqiao also provided data on his rice exchange in 2001, which allows us to compare changes of prices, quantities, and price margins between 2000 and 2001 (Table 3.7). Although Table 3.7 only shows data for one private trader, it provides some information on trends of the rice trade between 2000 and 2001. Table 3.7 shows that exchange quantities of the private trader have increased sharply from 2000

<sup>&</sup>lt;sup>27</sup> Search and information costs of private traders are costs incurred during looking for farm households (who are willing to sell) and buyers (who are willing to purchase), such as costs of making phone calls and costs of traveling for personal visits and so on. Networking costs are costs of maintaining such personal contacts, such as costs of making phone calls and costs of necessary visits (e.g. traveling costs and costs of gifts like cigarettes) and so on.

to 2001. Transport costs and price margins remained the same while all rice prices have been increasing. This leads to a decrease in the proportion of price margins over selling prices, which implies that there was more competition in the rice purchase market in 2001. The proportion decreased more for early rice than for late rice, which implies a larger increase in competition in the early rice market. This is due to policies released in 2000 opened the early rice market to the private sector. The policies increased competition in 2001. Survey information also shows that about half of the private traders interviewed purchased a cell phone in 2000-03. More than half of them also possess a motorbike.

	2000	2001
Early rice		
Exchange quantity	25	100
Buying price	555	762
Selling price	596	803
Price margin	41	41
Transport costs	17	17
Price margin/selling price	6.9%	5.1%
Late rice		
Exchange quantity	30	180
Buying price	902	1002
Selling price	943	1043
Price margin	41	41
Transport costs	17	17
Price margin/selling price	4.4%	3.9%

Table 3.7Rice exchange data of a private trader from Banqiao in 2000 and 2001, quantities<br/>in tons and prices in Yuan/ton

Source: Chen, 2003.

State grain trading companies Three SGTCs geographically corresponded with the three selected villages in the study areas. Heads of the SGTCs were interviewed. Table 3.8 lists some characteristics of the SGTCs that are relevant to the policies mentioned in Section 2.3. After reorganization, the number of employees in all the SGTCs has been reduced largely and was in 2003 on average around 10. The procurement obligation was eliminated in 1998 by the local government. The protective purchasing mentioned in Chapter 2 for early rice was removed by the local governments in 2000 so that all the three SGTCs were no longer obliged to purchase early rice at the protective price in 2000-03. Nevertheless, the protective price still applied for late rice for all the three SGTCs in 2000-03.

The participation of private traders in the rice market has threatened the survival of the SGTCs. In order to compete with private traders, each SGTC has its own strategy. In 2000, in Banqiao and Shangzhu the SGTCs follow the same strategy as private traders. For example, the SGTC signs contracts with its employees that every employee has to go to the villages during the

harvest season and purchase certain amounts of rice from farm households. Table 3.8 shows that the SGTC of Banqiao fixed the amount of rice that must be purchased in the contracts while the SGTC of Shangzhu left it open. To create incentives for the employees, the SGTCs allow price differences between the purchase price farm households receive and the price the employees receive from the SGTC. While in Gangyan, supported by the local government, the SGTC still behaved as a monopsonist in the local rice purchase market for a short period, e.g. one month, after the rice harvest season. During that period, transactions of private traders are prohibited. Checkpoints consisting of employees from the SGTC and the local government are placed at all the main roads entering or exiting all the villages in the township. However, the cost of enforcing prohibition is too high for the local government to maintain prohibition for a long time. Some SGTCs also purchase rice from private traders, or from the SGTCs in other regions where the purchase price of rice is lower. Trading strategies of the SGTCs in 2003 are also listed in Table 3.8. All the SGTCs adopted the same strategies, which implies competition in rice purchase market has become more intense in 2000-03.

		8	1	
	Unit	Banqiao	Shangzhu	Gangyan
Number of employees 2000	person	47	60	70
Number of employees 2003	person	13	9	9
Storage capacity	ton	4000	5500	16000
Year of procurement elimination	year	1998	1998	2000
Protective price 2000-03 (early rice)		Removed	Removed	Removed
Protective price 2000-03 (late rice)		Effective	Effective	Effective
Competition Strategy 2000		Contracts with employees: 7 tons/person	Contracts with employees: no fixed amount	One month monopsony
Competition Strategy 2003		Contracts with employees: 90 tons/person	Contracts with employees: no fixed amount	Contracts with employees: 100 tons/person

 Table 3.8
 Characteristics of the State Grain Trading Companies

Source: Chen, 2003.

Table 3.9 presents the price margins in rice exchange conducted by the SGTCs in 2000. All three SGTCs regarded one-season rice and late rice as the same type and purchased them together. Since we could not access data on the costs of the SGTCs such as storage costs and transport costs, they are not presented in Table 3.9. Early rice exchanges of the SGTCs of Banqiao and Shangzhu have positive price margins while the SGTC of Gangyan has a zero price margin. This is because the protective purchasing is removed for early rice in 2000 so that the SGTCs can purchase early rice at the market price. We could not obtain the selling price for late rice from the SGTC of Gangyan. Table 3.9 shows for the SGTCs of Banqiao and Shangzhu

there was no positive price margin for late rice in 2000. Due to policies that set the selling price higher than the buying price and that the selling price of private traders was lower than the buying price of the SGTCs, the SGTCs could not sell. The SGTC of Banqiao sold the late rice they purchased in 2000 a year later at a much lower price, which led to a negative price margin. According to, the SGTC of Banqiao the loss was due to policy-oriented businesses so that it was reported and subsidies were expected. Nevertheless, subsidies compensating for the negative price margin had not arrived at the time the interview was carried out. The SGTC of Shangzhu had an assignment to reserve 1000 tons of rice for the provincial reservation system. It was unable to sell the other 1600 tons and transferred it to warehouses of the grain administration at county level. It was therefore considered as being 'sold' at the price equivalent to the buying price.

		Banqiao	Shangzhu	Gangyan
Early rice				
	Trading quantity	200	400	1300
	Buying price	704 <sup>1</sup>	720	902
	Selling price	803	745	902
	Price margin	99	25	0
Late rice				
	Trading quantity	2000 <sup>3</sup>	2600	2500
	Buying price	1200 <sup>2</sup>	1159	1002
	Selling price	960	1159	NA
	Price margin	-240	0	NA

Table 3.9	Price	margins	for	State	Grain	Trading	Companies	in	rice	exchange	in	2000,
	quant	tities in to	ons a	nd pri	ces in Y	'uan/ton						

Source: Chen, 2003.

Notes: NA = Not Available;

<sup>1</sup>: Market purchase price.

<sup>2</sup>: The protective price.

<sup>3</sup>: Among these 2000 tons, 200 tons was one-season rice.

#### Rice processing factories

Rice processing factories are one of the buyers that rice assemblers sell rice to. Most of them are located in townships or in counties. Owners of 11 rice processing factories were interviewed in 2003, among which 9 were involved in rice exchange in 2000. As shown in Table 3.10, one processing factory is state-owned, the rest are private owned factories. Apart from selling processed rice to wholesalers, 1 processing factory out of 9 also sells directly to consumers. Trucks are the most common means of transportation within Jiangxi Province, while trains are the most common means of transportation to neighbor provinces. Slightly more than half of

the factories only process unhusked paddy rice into husked rice<sup>28</sup> and the rest process husked rice into polished rice<sup>29</sup>. Processing capacity varies from 5 tons to 3000 tons in 2000 among private factories. The state-owned processing factory has a capacity of 25000 tons in 2000.

Table 3.10 Characteristics of rice processing factories in 2000 (numbers in parentheses are numbers of processing factories)

Business type	Selling to	Selling distance	Means of transportation	Processing type
Private (8)	Wholesaler (8)	Inside province (2)	Truck (2)	Husked rice (5)
State-owned (1)	Consumer (1)	Outside province (7)	Train (7)	Polished rice (4)

Source: Chen, 2003.

Due to the processing costs and added value of rice after being processed, higher price margins are expected for processing factories than for rice assemblers. Table 3.11 confirms our expectation. On average, the price margin of rice processing factories is around 712 Yuan per ton. Transport cost and processing costs account for 9% (husked rice is transported by truck) to 31% (polished rice is transported by train) of the average price margin (Table 3.12). Late rice has a higher price margin than early rice. Rice processing factories located in the region of Shangzhu have the highest price margin. This might be associated with higher transport costs in that region.

Table 3.11	Price margins	of rice	processing	factories	in	2000 i	n	Yuan/	<i>t</i> on
------------	---------------	---------	------------	-----------	----	--------	---	-------	-------------

		Region of Banqiao	Region of Shangzhu	Region of Gangyan
Early rice				
	Price margin	447	712	621
Late rice				
	Price margin	671	1043	762
One-season rice				
	Price margin	637	NA	NA

Source: Chen, 2003.

Notes: NA = Not Available.

 $<sup>^{28}</sup>$  Husked rice is also called brown rice. It is the least processed form of rice. It has the outer hull removed but still retains the bran layers that give it a characteristic tan color and nut-like flavor.

<sup>(</sup>source: http://www.knowledgebank.irri.org/ppfm/riceMilling/WebHelp/Milling\_lesson01.htm)

<sup>&</sup>lt;sup>29</sup> Polished rice is also called milled rice or white rice. It is rice after milling which includes removing all or part of the bran and germ from the husked rice.

<sup>(</sup>Source: http://www.knowledgebank.irri.org/ppfm/riceMilling/WebHelp/Milling\_lesson01.htm)

	Inside province (truck)	Outside province (train)
Transport cost	25	83
	Husked rice	Polished rice
Processing cost	41	141

# Table 3.12 Mean transport and processing costs of rice processing factories in 2000 in Yuan/ton

Source: Chen, 2003.

#### Rice wholesalers

Five wholesalers were interviewed in 2003. Four of them were involved in rice exchange in 2000. They are all located in counties. Trading quantities of wholesalers range from 75 tons per wholesaler in 2000 up to 1400 tons per wholesaler in 2000. Buying sources of wholesalers are either processing factories or wholesalers from other regions. They sold rice to processing factories, wholesalers, retailers, or consumers. In the case of husked rice a rice wholesaler could be the intermediate between processing factories that only produce husked rice and processing factories that also produce polished rice.

Price margins of rice wholesalers differ greatly among regions (Table 3.13). Transport costs are similar to the transport costs of the processing factories. The average price margin of wholesalers is around 99 Yuan per ton, which is higher than that of rice assemblers but lower than that of processing factories. Price margins in the region of Banqiao are higher than in the other two regions. This might be due to an important hub of the national railway system located in the region of Banqiao that leads to more inter-provincial rice exchanges than in the other two regions.

		Region of Banqiao	Region of Shangzhu	Region of Gangyan
Early rice				
	Price margin	99	41	NA
Late rice				
	Price margin	149	33	83
One-season rice				
	Price margin	199	NA	NA

Table 3.13 Price margins of rice wholesalers in 2000 in Yuan/ton

Source: Chen, 2003.

Notes: NA = Not Available.

#### Rice retailers

Twenty-one rice retailers were interviewed in 2003, among which 17 were involved in rice exchange in 2000. Each retailer could sell on average 0.4 tons of rice per day. In general, rice

processing factories and wholesalers sold rice to the retailers. The average price margin of retailers was about 75 Yuan per ton, which is higher than the price margin of rice assemblers but lower than the price margin of wholesalers. Price margins of late rice and one-season rice exchanges are in general higher than that of early rice exchange (Table 3.14).

		Region of Banqiao	Region of Shangzhu	Region of Gangyan
Early rice				
	Price margin	66	75	50
Late rice				
	Price margin	66	58	83
One-season rice				
	Price margin	99	NA	NA

Table 3.14 Price margins of rice retailers in 2000 in Yuan/ton

Source: Chen, 2003.

Notes: NA = Not Available.

### 3.2.3 Rice marketing channels

We can now obtain a complete picture of the rice marketing channel in the study areas (Figure 3.1). Figure 3.1 shows that the rice outlets for farm households (A) are private traders (B), the SGTCs (C), unhusked rice wholesalers (D), and rice processing factories (E). The outlets of private traders (B) are the SGTCs (C), unhusked rice wholesalers (D), and rice processing factories (E). The outlets of the SGTCs (C) are unhusked rice wholesalers (D) and rice processing factories (E). Unhusked rice wholesalers (D) could be private traders (B) or the SGTCs (C), who trade unhusked rice locally or regionally. All unhusked rice is processed into consumption rice (husked/polished rice) in rice processing factories (E). Processing factories (E) sell husked/polished rice to husked/polished rice wholesalers (F), rice retailers (G), and consumers (H). Husked/polished rice wholesalers (F) could be private entrepreneurs or state-owned factories that trade husked/polished rice locally or regionally.





Source: Original design by author, adapted by Nico Heerink, 2003.

Table 3.15 lists the average price margins in the selected regions of the study areas. Due to policy constraints, the SGTCs were restricted in their trading activities leading to zero or negative price margins. Therefore price margins of the SGTCs are not included in Table 3.15. The total price margin is the difference between consumer price and off-farm price. This price margin includes variable costs (excluding the buying price of rice) and value added. Part of this value added can be monopsony/oligopsony and monopoly/oligopoly profits. Table 3.15 shows that price margins of rice processing factory are the highest indicating the importance of this level of the marketing channel for price determination. Price margins at other levels of the marketing channel are more equal. This could be explained by differences in transport costs or by market imperfections (degrees of competition).

Table 3.15 Average price margins in the marketing channel in 2000 in the study areas in Yuan/ton

	Region of	Region of	Region of
	Banqiao	Shangzhu	Gangyan
Rice assembler	50	58	50
Rice processing factory	588	877	695
Rice wholesaler	149	41	83
Rice retailer	75	66	66
Total margin	862	1042	894

Source: Chen, 2003.

Combining Figure 3.1 with Table 3.15 provides a clear overview of prices and price margins at different levels of the marketing channels in the regions where the three villages locate. Starting from the farm price, i.e. the selling price of the farm households or the buying price of the private traders, price at the next level of the marketing channel is formed by adding the price margins presented in Table 3.15 to the price from the previous level. As prices collected in 2003 for 2000 were based on the memory of the respondents, we choose the selling price of the farm households collected by SERENA in 2000-01 for 2000 instead of the buying price of the private traders collected in 2003. In order to combine Figure 3.1 with Table 3.15, we provide three simplified rice marketing channels in the study areas in 2000. That is the rice flow from farm households to rice assemblers (the SGTC or private traders), then to rice processing factories and rice wholesalers, finally to rice retailers. Figure 3.2 provides the simplified marketing channels in the study areas.

1935



1123



Rice marketing channel in the region of Banqiao

<u>C</u> 1073



1711

1860

Rice marketing channel in the region of Shangzhu



Rice marketing channel in the region of Gangyan



Note: Numbers on top of the arrow lines are price margins; numbers at the bottom of each marketing channel are rice prices.

Source: SERENA, 2000; Chen, 2003.

Although we find that the level of rice processing factory is important for price determination in the rice marketing channel, we remain focused on rice assemblers (the SGTCs and private traders) in the rice purchase market of the marketing channels due to the objective of this study.

#### 3.3 Policy effects in 2000-03

In this section the effects of the policies presented in Section 2.2 and 2.3 on the private traders and the SGTCs in the study area in 2000-03 are discussed. In this thesis we mainly look at efficiency as a criterion to evaluate policies.

### Private traders

Policies announced in 2000 stated all private traders should be registered at county-level. According to the central government non-registration has a negative effect on the quality of grain and therefore on food security. Nevertheless, all private traders interviewed during our survey (those that were active in 2000-03) were not registered. In other words, they bare risks of being prosecuted. Nevertheless, these non-registered private traders not only existed but also traded with SGTCs that were supposed to comply with government policies in 2000-03.

Several reasons exist why non-registered private traders were active. First, it would be too expensive for local governments to search for all the private traders and stop their illegal businesses. Second, according to the interviews, the required qualifications for a private trader were too high for farm households to meet. For example, it was stated that to enroll in the purchase business, a private trader must possess a certain amount of financial resources, which was usually far beyond the entire wealth of a farm household. Like in other developing countries, provision of agricultural credit to small-scale business was problematic due to problems like razor-thin profit of agricultural business, deficient initial wealth, asymmetric information and not well-defined property rights, e.g. land was not owned by the farm household so it could not be used as collateral. Third, according to the interviewed private traders, different kinds of local taxes left very little profit to registered private traders, which was also one of the incentives for them not to register.

#### State Grain Trading Companies

In 2000, the dual goals for the SGTCs put them into a dilemma. Policies released made it very difficult for the SGTCs to make profits or even reduce losses. Our survey showed that as long as the SGTCs had to purchase grain at the protective price, financial losses could not be avoided. In order to survive, the SGTCs did not follow the policies announced in 2000-03.

Normally, the SGTCs coped with the situation in two ways. One way was to purchase grain from farm households at lower prices than the protective price by down-grading their grain. For example, the SGTCs would declare that the grain sold by farm households did not meet certain criteria for preservation (humidity), and therefore they received a lower price. The other way was to sell the grain (mainly late rice and one season rice since the early rice market was opened in 2000 and subsidy for early rice no longer applied) that was purchased at the protective price at the same or even lower price and report that the loss was due to policy-oriented businesses so that it could be subsidized. However, subsidies were not or not fully provided, which made survival difficult, e.g. employees that worked at the SGTCs were often not paid. Subsidies had to come from both local and central budgets. In most cases, local

budgets could not bear this heavy burden and this part of the subsidies was often not provided. Although part of the subsidies from the central budget was granted, they did not arrive at the level of the SGTCs at its 100 percent amount. The reason was that the subsidy from the central government was transferred to the SGTC through grain administrations at different levels. This gave chances for these higher level grain administrations to divert part of the subsidy to other purposes.

All the heads of the SGTCs interviewed told that the SGTCs made profits on trading the varieties of grain for which protective buying was no longer required. However, this profit was not high enough to cover total losses.

#### Private traders versus State Grain Trading Companies

Although the central government prohibited private traders to enter the grain purchase market of high-quality varieties, the opening of the purchase market for other varieties made the prohibition impossible. Private traders and the SGTCs therefore competed with each other in 2000-03.

However, the competition environment was not the same for private traders and the SGTCs in 2000-03. In order to push further the commercialization of the SGTCs (improve efficiency and reduce losses), government policies were inclined to them. For example, after the commercialization, the SGTCs were supposed to be financially independent. To reach this goal, the SGTCs were allowed to use storage facilities and fleets of trucks, etc. However, it was not possible for private traders to use these state-owned assets. Apart from being able to use stateowned assets, the SGTCs could keep on using their social networks and having access to the marketing information system that was provided by the central and local governments. Searching and information costs were often an entrance barrier for potential private traders. China's agricultural development bank only offered loans to the SGTCs but not to private traders for grain purchase. Therefore, purchase capacity of private traders was limited. Moreover, the cumbersome licensing procedures mentioned before are more likely to be an entrance barrier for the private traders. Since they were not recognized by the government, they did not benefit from a system of grain standardization<sup>30</sup> and had limited access to legal means for enforcing contracts. These constraints increased risks of their trade. However, policy-oriented business and protective buying had prevented the SGTCs from competing with private traders freely.

During grain purchase, there were two major differences between private traders and the SGTCs in 2000. First, private traders went to villages to purchase grain, which saved transport costs for the farm households. Although some SGTCs (e.g. of Banqiao and Shangzhu) adopted the same strategy as private traders, there were still some SGTCs (e.g. the one of Gangyan) following their traditional way of grain purchase, i.e. farm households had to deliver their grain to the purchase points of the SGTCs. However, this was under the assistance of the local

<sup>&</sup>lt;sup>30</sup> The grain standardization system is a system that classifies grain into different grades according to a series of criteria that are specified by the relevant policies.

governments by prohibiting transactions of private traders so that the SGTCs were the only one to sell to. Due to large enforcement costs, the prohibition within the domain of a township could only last one month after harvest season. Therefore, farm households could still sell their grain to private traders after the prohibition period. This had negative effects on grain sold to the SGTCs from the farm households in the prohibition period. The large enforcement costs and the little effects of the prohibition led to the abolishment of this strategy by the SGTC in Gangyan in 2003. Hence in 2003, all the three SGTCs adopted the same strategy as private traders.

Second, most private traders did not store the grain and sold it immediately after they had purchased it in 2000-03. So they did not require a low humidity of the grain when purchasing. However, the SGTCs only purchased grain when humidity met certain criteria for preservation, which required not only good weather but also time from farm households. Therefore, although private traders purchased the grain at market prices that were slightly lower than the protective prices, most of the farm households preferred selling to private traders instead of the SGTCs <sup>31</sup>.

Furthermore, the SGTCs were used to be subsidized and thus were often inefficient in 2000. First, the SGTCs had higher buying costs than private traders. They were overstaffed, had storage costs and capital depreciation costs, had to pay pensions of retirees etc. Second, conflicts between farm households and the SGTCs (Wedeman, 1997: 822) made farm households favor the private traders. This were due to the past monopsony position of the SGTCs and the system of protective purchasing. For example since the protective price was higher than the market selling price and the subsidies could not arrive with full amount, the SGTCs had to depress purchase prices by declaring that the grain sold by the farm households did not meet the purchase criteria (Zhong, 2001: 28). This had negatively affected reputations of the SGTCs and pushed farm households towards their competitor – private traders.

Despite the unfair competition environment, low storage costs and overhead costs of the private traders made them strong competitors against the SGTCs, which indicated private traders were more efficient in 2000. The increasing competition forced the SGTCs to reduce costs in order to survive in 2000-03. According to all the SGTCs interviewed, by adopting the same strategy as the private traders and making full use of their former network, the SGTCs reduced their transaction costs to the same level as private traders in 2000-03. The development in road construction in the three villages and the development in telecommunication (such as special price offers from China Unicom to farmers in rural areas) had reduced the search and information costs of the private traders in 2000-03. Therefore, the emerged competition enhanced the efficiency of the grain market.

<sup>&</sup>lt;sup>31</sup> When grain is just harvested from the field, it is very wet. Farm households usually spend two to three days to dry the grain under the sun. Private traders also require certain humidity criteria but these are less strict than that of the SGTCs. If the weather were cloudy instead of sunny, private traders would accept the grain dried under this kind of weather but not the SGTCs.

#### 3.4 Concluding remarks

The objective of this chapter is to describe the marketing channel for rice and its actors in the study areas and how policies have been affecting the private traders and the SGTCs in the rice purchase market in 2000-03. Information is collected from interviews in the three selected villages and their associated regions in Jiangxi Province in 2000 and 2003.

Although the focus of this chapter is on the rice purchase market, we find that rice processing factories are very important for price determination in the rice marketing channel in 2000-03. In 2000-2003 the wholesale and retail markets in the marketing channel for rice were deregulated so that private companies and individuals could play an active role in rice exchange.

According to policies released in 2000 (Chapter 2), the rice purchase market should be:

- (1) For low-quality rice (early rice), registered private traders conduct rice trade; the SGTCs purchase low-quality rice at the market price;
- (2) For high-quality rice (late rice and one-season rice) the SGTCs are the only buyers in the purchase market and they purchase high-quality rice at the protective price fixed by the local government.

Survey results from this chapter show that the actual situation in the rice purchase markets in the study areas in 2000-03 were:

- (1) For low-quality rice, private traders were competing with the SGTCs. But most of them were not registered.
- (2) For high-quality rice, the SGTCs were not the only buyer; non-registered private traders were competing with the SGTCs; the protective price was much higher than the market price so that the SGTCs were not applying the protective price.

This chapter further concludes that in the period of 2000-03:

- (1) State grain policies were not functioning.
- (2) Competition has become more intensive in the rice purchase market.
- (3) State grain policies favored the SGTCs, which created an unfair competition environment for private traders.
- (4) Despite this, private trade survived and has grown. The pressure for further reforms to create a fair competition environment remains.

Some policy implications could be drawn from this chapter. Most important is to create a fair competition environment for private traders and the SGTCs. The central government has removed policy obligations such as protective purchasing (for low-quality grain) and national grain reservation for the SGTCs, which has given the SGTCs more freedom in grain markets. Nevertheless, the protective purchasing in the high-quality grain purchase market remained till 2004. Private traders should not be burdened by cumbersome registration requirements or other implicit entry barriers. For example, the central government could give local governments

the freedom to set the minimum purchase amount needed for registration so that it is better adjusted to local situations, i.e. in the case of the study areas the minimum purchase could be increased from 50 tons to 300 tons per year. Private traders should also be treated equally in the credit market, i.e. they should have access to loans provided by the agricultural development bank. Moreover, policy evaluations could provide information on the effectiveness and efficiency of policy and help to improve its quality. An example from this study is that field information suggests that 50 tons as the minimum purchase amount needed for registration negatively influences the effectiveness of the registration policy. Finally, China's central government could improve the technical (e.g. roads) and social infrastructure (e.g. institutional and legal system) to reduce transaction costs of both private traders and the SGTCs and to facilitate market exchange. For example, the central government should establish legislation to ensure fair competition, e.g. a regulatory apparatus providing rules and guidelines governing the behavior of buyers, sellers, and intermediaries.

#### Appendix 3A Survey conducted in the study area

#### Introduction

The survey was designed to provide data and information about the rice marketing channel in the study area in Jiangxi Province. The information and data collected included buying and selling prices, traded quantities, transport costs, buying and selling sources of players at different levels in the rice marketing channel. The household data collected by the SERENA project were for 2000. For consistency purposes, we decided also to collect data for 2000. An additional reason for collecting data of 2000 is that 2000 is a more interesting year for this study due to policy changes. Finally, we expected fewer problems getting the information because data for 2000 are less sensitive than the most recent data. We collected information and data through personal interviews following questions listed in the questionnaires. Respondents were members of farm households, heads of the villages, private traders, heads of the SGTCs, owners (heads) of rice processing factories, wholesalers, and retailers. For the selection of the three villages in the study area, see "Report of village selection for three villages survey" (Kuiper et. al., 2001).

This appendix provides detailed information concerning: (1) the survey design; (2) the data-collection procedures; (3) the survey questionnaires; (4) the survey interviews; and (5) data entering procedures.

#### Data and information collection

The survey was conducted in July 2003. The pilot survey was conducted in a period of 10 days in March 2003. The purpose of the pilot survey was to test the designed questionnaires. According to the information collected in the pilot survey, the questionnaires were improved. The official survey took 20 days in July 2003.

#### Survey questionnaires

Six types of questionnaires were designed corresponding with different respondents. Interviews with the heads of the villages focused on general information of the village, e.g. the amount of rice sold in the village, names of the private traders living in the village, rice selling activities in the nearest consumer market, etc. Interviews with the other respondents focused on information of the rice trading activity, e.g. purchasing and selling prices, quantities, transport and storage costs, information sources, etc.

#### Survey interviews

We chose the head of the village to be the first one interviewed. From the information provided by the head of the village, we then interviewed all the farm households living in the village that are engaged as private traders after rice harvesting. From these traders, we obtained information on the next level in the rice marketing channel, i.e. (the name and telephone number of) the person that they sold rice to. We adopted the same method to identify respondents at all levels of the rice marketing channel. Each interview took approximately 5-10 minutes. Since information on prices and quantities was confidential to the respondent, additional time and effort were needed to build trust between interviewer and respondent before the interview took place.

During the official survey, 14 farm households, 14 private traders, 11 owners of processing factories, 5 wholesalers, and 21 retailers were interviewed. Table 3A.1 presents the number of respondents under different categories of correspondents for each village.

	SGTC	Head of village	Farm household	Private trader	Processing factory	Wholesaler	Retailer
Banqiao	1	1	1	3	8	2	4
Shangzhu	1	1	8	3	2	2	7
Gangyan	1	1	5	8	1	1	10
Total	3	3	14	14	11	5	21

Table 3A.1Number of respondents

Most information was collected using questionnaires. Additional information was obtained during informal conversations with employees of the SGTCs, farm households we met during resting hours, and the accountant of a village (see Table 3A.2).

## Data and information editing procedures

The following steps were undertaken to ensure the accuracy of the data. In step one every evening during the survey period questionnaires filled in during the day were reviewed by the interviewers between each other to verify the consistency and accuracy of the information. Any inconsistencies were automatically noted and resolved by the correspondent interviewer. In the second step, the data were entered by the interviewers into the computer using Microsoft Excel. Finally, the information collected in the survey was reorganized to reveal the local rice marketing channel.

Gangyan	Shangzhu	Banqiao	
Liao (GYSGTC01)	Liao (SZSGTC01)	Sun (BQSGTC01)	Head of SGTC
Ye (GYH01)	Wu (SZH01)	Chen (BQH01)	Head of village
Zhang (GYFH01)	Chen (SZFH01)	Wu (BQFH01)	Farm household
Ye (GYFH02)	Chen (SZFH02)		
Chen (GYFH03)	Dang (SZFH03)		
Chen (GYFH04)	Li (SZFH04)		
Huang (GYFH05)	He (SZFH05)		
_	Chen (SZFH06)		
	Rao (SZFH07)		
	Wang (SZFH08)		
Su (GYPT01)	Zhang (SZPT011)	Wu (BQPT01)	Private trader
Chen (GYPT02)	Ai (SZPT012)	Wu (BQPT02)	
Lv (GYPT03)	Fang (SZPT02)	Chen (BQPT03)	
Li (GYPT04)	Chen (SZPT03)		
Tong (GYPT05)			
Mao (GYPT06)			
Chen (GYPT07)			
Yu (GYPT08)			
Mao (GYPF01)	Anonymous (SZPF01)	Hu (BQPF01)	Processing factory
	Wang (SZPF02)	Chen (BQPF02)	
		Guan (BQPF03)	
		Wu (BQPF04)	
		Wang (BQPF05)	
		Wang (BQPF06)	
		Wang (BQPF07)	
		Li (BQPF08)	
Anonymous (GYWS01)	Huang (SZWS01)	Wu (BQWS01)	Wholesaler
	Anonymous (SZWS02)	Xu (BQWS02)	
Anonymous (GYRT01)	Anonymous (SZRT01)	Xu (BQRT01)	Retailer
Mao (GYRT02)	Huang (SZRT02)	Hu (BQRT02)	
Zhu (GYRT03)	Zhou (SZRT03)	Zhou (BQRT03)	
Anonymous (GYRT04)	Dong (SZRT04)	Deng (BQRT04)	
Anonymous (GYRT05)	Anonymous (SZRT05)		
Li (GYRT06)	Yao (SZRT06)		
Zhu (GYRT07)	Anonymous (SZRT07)		
Anonymous (GYRT08)			
Zhang (GYRT09)			
He (GYRT10)			

# Table 3A.2A list of family names and codes of the respondents

## Appendix 3B Questionnaires for actors in the rice marketing channel in Jiangxi Province

Table 3B.1Questionnaire for township grain stations (2000)

#### Declare: Data obtained from this questionnaire is only for research purpose.

	Name	Survey date
Inquirer 1		
Inquirer 2		

City: County: Twonship: Administrative village: Natural village:

Affiliation													
Year of privatization													
Profit/deficit situation													
Year of separating with	grain proce	essing factory											
		Early	v rice			La	te rice			One-se	eason rice		
If protective price													
applies Protective price					-								
(yuan/50kg)													
If purchase or not													
(explain if not)	<b>D</b> (	(5.01.)	-	(522)	<b>D</b> (	(5.01.)		(522)		( (501 )		(500)	
Rice purchase	Price (yu	Price (yuan/ 50kg) Quan.(500g)			Price (y	uan/50kg)	Ç	2uan.(500g)	Price (	yuan/50kg	) Quar	n.(500g)	
come to sell													
Employees go to													
villages to purchase													
(number)													
township grain													
station													
Ways of payment													
The amount													
purchased from													
village (unit: 500g)	Dricolumo	0. Ouron (50)	л т	im o	Drice(man	Quan (500	~ т	ima		Ouen (50	ю т	ima	
(from purchase point	/bag or	g/bag or	Minu	line	/bag or	/bag or	g 1 Minu	lille	Price(yuan/b	g/bag of	Minu	Minu	
to warehouse)	truck)	truck)	/trip	trip	truck)	truck)	/trip	trip	ag or truck)	truck)	/trip	trip	
Storage before sale	Price(y	/uan/500g)	Tin	ie(day)	Price(yu	an/500g)	Tim	e(day)	Price(yua	n/500g)	Tim	ie(day)	
The amount of rice											•		
for state reservation													
(500g)	Price(vua	Ouan.		Phone	Price(vua	Quan.		Phone	price(vua	Quan.		Phon	
Trade partner	n/50kg)	(500g)	Location	number	n/50kg)	(500g)	Location	number	n/50kg	(500g)	Location	num	
- Wholesaler													
- Grain proc. factory		_											
- Other township													
Storage after slae	Price(vi	ian/500g)	Time	(dav)	Price(vu	n/500g)	Time	e(dav)	Price(vuan	(500g)	Time	(dav)	
		/ 8/							eet, aut				
Subsidies for:													
Rice purchase(2000)													
Rice storage (2000)													

		Early ri	ce			Late ri	ce		One-season rice				
Filtered (Y/N)													
Dried (Y/N)													
Rice purchase	price(yuan/50kg)		Quan.(500g)		price(yuan/50kg)		Quan.(500g)		price(yuan/50kg)		Quan.(500g)		
Payment type													
Transport	Price(yuan Quan.(500 Time		ne	Price(yuan	Quan.(500	Time		Price(yu	Quan.(50	Tir	ne		
costs	/bag or truck)	g/bag or truck)	Minu./tri p	trip	/bag or truck)	g/bag or truck)	Minu./tri p	trip	an/bag or truck)	0g/bag or truck)	Minu./tri p	trip	
Location:													
Trade partner	price(yuan /50kg)	Quan. (500g)	Location	Phone numb.	price(yua n/50kg)	Quan. (500g)	Location	Phone numb	price(yua n/50kg)	Quan. (500g)	Location	Phone numb	
-wholesaler													
-Grain proc. Fact.													
Info. Source													
-Old contacts													
-Telephone													
-Others (indicate)													
Changes in rice price (2001-03)													
Name and phone number of other private traders that													

#### Table 3B.2 Questionnaire for private traders (2000)

Table 3B.3	Questionnaire f	for grain	processing	factories	(2000)
------------	-----------------	-----------	------------	-----------	--------

		Early	rice		Late	rice		One-season rice				
	price(yuan /50kg)	Quan.( 500g)	Location Phone numb	Price(yuan /50kg)	Quan (500g	() I	Location Phone numb	price(yuan /50kg)	Qua: (500	n. g)	Location Phone numb	
Private trader	, 8,	b,		, 0,				, 0,		<i></i>		
Township grain station												
Transport cost	Price(yuan/b or truck)	pag (	Quan.(500g/bag or truck)	Price(yuan/ or truck)	bag	Quan.	(500g/bag or truck)	Price(yuan/b truck)	ag or	Qu	an.(500g/bag or truck)	
Storage before sale	Price(yuan/5 g)	00	Time(day)	Price(yuan/5	00g)	Ti	ime(day)	Price(yuan/5	600g)	Time(day)		
Processing cost	price(yuan/5 g)	n/50k Quan.(500g)		Price(yuan/5	Okg)	Qu	an.(500g)	price(yuan/5	i0kg)		Quan.(500g)	
Stor. after proc.	Price(yuan/5 g)	00	Time(day)	Price(yuan/500g)		Time(day)		Price(yuan/500g)		Time(day)		
Transport costs	Price(yuan/b or truck)	bag (	Quan.(500g/bag or truck)	Price(yuan/ or truck)	bag	Quan.(500g/bag or truck)		Price(yuan/bag or truck)		Qu	an.(500g/bag or truck)	
Trade partner	price(yuan/ 50kg)	Quan. (500g)	Location Phone numb	Price(yuan /50kg)	Quan. 500g)	Quan.( Locatio 500g) Phone nu		price(yuan Qu /50kg) C		ı.(5 ;)	Location Phone numb	
- wholesaler												
-grain proc. Fact.												
- others												
Info. source												
contacts												
-Telephone												
- Others(indi cate)												
If private company (Y/N)				1								
Other business												

		Early rice	2		Late rice			One-season 1	rice		
	price(yuan /50kg)	Quan.(5 00g)	Location Phone numb	price(yuan /50kg)	Quan.(500 g)	Location Phone numb	price(yuan/5 0kg)	Quan.(500g	g) Location Phone numb		
Private trader											
Township grain station											
Grain proc. fact.											
Transport cost	Price(yuan/ truck)	bag or	Quan.(500g/b ag or truck)	Price(yuan/	Price(yuan/bag or truck)		n.(500g/ Price(yuan/bag or truck)		Quan.(500g/bag or truck)		
(from seller)											
Storage before sale	Price(yuan/	′500g)	Time(day)	Price(yı	1an/500g)	Time(day)	Price(yuan	Price(yuan/500g)		1/500g) Time(day)	
Transport cost	Price(yuan/ truck)	bag or	Quan.(500g/b ag or truck)	Price(yuan/	/bag or truck)	Quan.(500g/ bag or truck)	Price(yuan/ba	ıg or truck)	Quan.(500g/bag or truck)		
(to buyer)											
Trade partner	price(yuan /50kg)	Quan.(5 00g)	Location Phone numb	price(yuan /50kg)	Quan.(500 g)	Location Phone numb	price(yuan/ 50kg)	Quan.(500g	y) Location Phone numb		
- wholesaler											
- retailer											
-grain proc. fact.											
- others											
Info. source											
-Old contacts	+										
-lelephone											
-Others(indicate)											

# Table 3B.4Questionnaire for grain wholesalers (2000)

- consumer -others (indicate)

		Early 1	rice			Late 1	rice		On	ne-seas	son ri	ce
	price(yuan /50kg)	Quan 00g)	.(5	Location Phone numb	price(yuan/ 50kg)	Quai 00g	Quan.(5 Location 00g) Phone price(yua 00g) numb 0kg)		price(yuan/5 0kg)	Qu: (50	an. Og)	Location Phone numb
wholesaler												
Grain proc. Fact.												
Transport cost	Price(yuan/b truck)	oag or	Qı	ian.(500g/bag or truck)	Price(yuan/b truck)	ag or	Qu	an.(500g/bag or truck)	Price(yuan/bag truck)	g or	Qu	an.(500g/bag or truck)
Trade partner	Price (yuan/	500g)	Ç	Quan. (500g)	Price (yuan/5	600g)	Q	uan. (500g)	Price (yuan/50	0g)	Ç	uan. (500g)

#### Table 3B.5 Questionnaire for grain retailers (2000)




# 4 PROTECTIVE PURCHASING AND COURNOT COMPETITION

#### 4.1 Introduction

As discussed in Chapter 2, China's central government has been implementing a series of policy reforms in its rice markets in the past 25 years. In 2000, China's government removed the grain procurement system and opened the purchase market of early rice to private traders. For the purchase markets of late and one-season rice, a system of protective purchasing remained, i.e. the SGTCs were supposed to purchase late and one-season rice from farm households at the protective prices fixed by the government before harvest. Accompanied with this fixed price, the SGTCs were supposed to receive subsidies to cover possible losses. However, setting fixed prices can conflict with underlying market forces and the SGTCs in practice did not always receive the promised subsidies. Chapter 3 found that the private traders that were active in the purchase market of early rice were also active in the purchase market of late rice. The activities of the private traders undermined the protective purchasing for late rice. As a result the system was officially abolished in early 2004. Since the expected outcomes of the policy (protective purchasing) was altered by the activities of the private traders, it is necessary to find out possible outcomes under the system of protective purchasing, taking into account the presence of private traders.

According to Hsu et al. (2002), strong income growth and rapid urbanization are diversifying the Chinese diet and increasing demands for high-value food products such as meet and fish. According to Huang et al. (2002), China's entry into the WTO leads to an increase in its rice export and China may become one of the rice export leaders in the world market. Shifts in domestic rice consumption and China's WTO accession may lead to fluctuations in the consumer price of rice. The participation of the private traders has changed the structure of the rice purchase markets. Price transmission is defined as the response of the price at farm gate to price changes at consumer level<sup>32</sup>. Changes in market structure influence the degree of price transmission. In other words, how price changes get transmitted down to farm households depends on the structure of the markets at different levels of the marketing channel. The removal of the grain procurement system and the opening of grain purchase market to private traders indicate less state control and farm households are linked more directly to consumer

<sup>&</sup>lt;sup>32</sup> There are three types of imperfect price transmission (London Economics, 2004). First, price changes may not be fully transmitted or more than fully transmitted along the marketing channel. Second, price changes may not be transmitted immediately but with some time lag. Third, price changes at one level depend on whether price changes at another level of the

markets. Since food security remains the prime concern of China's central government (Carter and Rozelle, 2002: 28), supply response of farm households to price changes remains an important issue for China's central government (Zong and Davis, 1998: 27). It is therefore important to analyze the impacts of market liberalization and deregulation on price transmission and its effects on farm households at the micro level.

There are a number of studies that look at the effects of market liberalization and deregulation at the macro level (Rozelle et al., 1997; Wu, 2002). However, analytical research that focuses on the rice marketing channel is needed in addition. Although Wu (2002) has analyzed price transmission in grain wholesale and retail markets in China, studies focusing on the grain purchase market are still scarce. An exemption is Huang et al. (2004) finding that China's village markets for grain (rice, wheat, maize and soybean) are highly integrated with regional markets. In their article, Huang et al. (2004) also found that the further a village is from a market the lower the price a farm household receives.

The first aim of this chapter is to develop a model of protective purchasing and define its possible outcomes starting in 2000. The second aim of this chapter is to analyze the effects of market liberalization and deregulation in the rice marketing channel on farm households under a system of protective purchasing, using information collected from three villages with different market access in Jiangxi Province.

In this chapter, a model of protective purchasing is discussed in Section 4.2. Section 4.3 presents the theoretical model of one of the possible outcomes under the system of protective purchasing. The empirical model and data are discussed in Section 4.4. The model will then be used to analyze the effects of imperfect competitive behavior of intermediates and consumer price changes on farm households and intermediates (Section 4.5). Finally conclusions are drawn in Section 4.6.

# 4.2 A model of protective purchasing

Under protective purchasing in 2000, the SGTCs were supposed to purchase late rice and oneseason rice at the protective price fixed by the government when it was higher than the market price. Losses caused by the protective purchasing were expected to be subsidized by the central and the local government. However, subsidies were either delayed or arrived partly. The SGTCs thus did not always apply the protective price during their businesses. This section presents the basic principles of a model incorporating the possible outcomes under the protective purchasing of the SGTCs taking the effects of the government subsidy into account. For the details of all possible outcomes of the model, see Appendix 4A.

In the model, for simplicity, we do not differentiate low quality rice (early rice) from high quality rice (late rice and one-season rice). So, all types of rice have the same farm price and

marketing channel are positive or negative. For example, price at one level responds more quickly to a price increase than to a price decrease at another level of the channel. In this study, we refer to the first type of imperfect price transmission.

consumer price and subsidies apply for trade of all types of rice. The consumer price  $(p)^{33}$  is

assumed to be given.

The total marginal costs of private trader *i* ( $tmc_{PT_i}$ ) equal the farm price (*w*) plus marginal other costs ( $c_{PT_i}$ ), i.e.  $tmc_{PT_i} = w + c_{PT_i}$ . Marginal other costs of private trader *i* include transport costs, search and information costs, e.g. costs of visiting farm households in the villages before purchasing, and networking costs such as cigarettes, drinks, and meals. We assume that all private traders have the same marginal other costs. There is a farm price ( $\tilde{w}_{PT}$ ) that equalizes the given consumer price (*p*) with the total marginal costs of private trader *i* ( $tmc_{PT_i}$ ), i.e.  $p = tmc_{PT_i}$ .

The total marginal costs of the SGTC ( $tmc_{SGTC}$ ) equal the farm price (w) plus marginal other costs ( $c_{SGTC}$ ) such as transport costs, storage costs, and the costs the SGTC pays to its employees to purchase rice in the village, i.e.  $tmc_{SGTC} = w + c_{SGTC}^{34}$ . There is a farm price ( $\hat{w}_{SGTC}$ ) that equalizes the given consumer price (p) with the total marginal costs of the SGTC ( $tmc_{SGTC}$ ), i.e.  $p = tmc_{SGTC}$ .

When  $\tilde{w}_{PT} \neq \tilde{w}_{SGTC}$ ,  $\tilde{w}_{PT}$  and  $\hat{w}_{SGTC}$  divide the set  $w \in (0, +\infty)$  into three intervals. We assume that the government fixes the farm price (protective price) at  $\overline{w}$ . When  $\overline{w}$  falls into different intervals, it leads to different results. We assume that the private traders and the SGTC maximize their profit. In case they make a loss they will not trade. We find that when both the private traders and the SGTC do not choose  $\overline{w}$  as their purchase price, the outcome of the model depends on the game they play, i.e. Cournot, quantity leadership, or price leadership competition. When  $\overline{w}$  is chosen by either the private traders or the SGTC, the outcome of the model depends on  $\tilde{w}_{PT}$  and  $\hat{w}_{SGTC}$ , the subsidies that the SGTC receives, and the trading capacity of the private traders (see Appendix 4A).

#### 4.3 Theoretical model

In 2000 the situation in the rice purchase market in the three villages was that private traders participated in rice purchasing together with the SGTC (Chapter 3). The rice purchase price

fixed by the government ( $\overline{w}$ ) was higher than both  $\hat{w}_{SGTC}$  and  $\tilde{w}_{PT}$ . The SGTCs did not receive

subsidies from the government, i.e. s = 0. Moreover, neither private traders nor the SGTCs choose  $\overline{w}$  as their purchase price. The application of the situation described above narrows us down to case (3.1) and (6.1) in Appendix 4A, namely, the outcomes of the model depend on the type of competition between the SGTCs and the private traders, e.g. Cournot, quantity leadership and price leadership competition. In this section one of the outcomes of case (3.1.2)<sup>35</sup> is discussed, i.e. we assume Cournot competition in Banqiao and Shangzhu and a two-

<sup>&</sup>lt;sup>33</sup> For simplicity we assume the consumer price to be equal to the price that the intermediates receive although in the real world this is not always true.

 $<sup>^{34}</sup>$  We do not include subsidies (s) in the total marginal costs of the SGTC here. Subsidies (s) are considered later in the specific cases of the model.

<sup>&</sup>lt;sup>35</sup> Since case (3.1) and case (6.1) have the same outcome, we only mention the outcome of case (3.1) from now on.

stage (monopsony and Cournot) competition in Gangyan. With Cournot competition, according to Tirole (1988: 218) and Varian (1992: 286), traders choose their profit-maximizing quantities simultaneously giving their beliefs about other traders' choice. Alternative outcomes of case (3.1.2), i.e. quantity leadership and price leadership competition, are discussed in Chapter 5.

The theoretical model is presented in this section. Marketable supply of rice is assumed to result from utility maximizing behavior of farm households given a certain level of rice production. So we have a short-term model since all the rice is already produced and production decisions are not taken into account. For simplicity, we assume that rice is a homogenous product. The consumer price of rice in the nearby consumption centers is assumed given and not influenced by the marketable supply of the selected villages, because marketable supply of the three villages is small compared to overall consumption. However, the farm price is affected by changes in the consumer price. The degree to which the farm price depends on the consumer price is determined by the degree of market access of the selected villages and market imperfections in the rice market channel. We assume that in a village the quantity of rice supplied by the farm households equals the quantity of rice purchased by the intermediates. Therefore, the supply response of farm households due to a price change is represented by the change in traded quantity of the intermediates.

## 4.3.1 Competition in Banqiao and Shangzhu in 2000

As mentioned in Section 3.2.2, SGTCs in Banqiao and Shangzhu adopt the same strategy as private traders in order to survive competition. Search and information costs and networking costs are high due to the underdevelopment of telecommunication and transportation<sup>36</sup>, which act as entry barrier for private traders to enter the purchase market. Therefore, we assume a limited number of private traders (*n*) in the market (oligopsony) competing with the SGTCs on quantity (Cournot). In this case, we assume the SGTC reduces its marginal other costs and equalizes it to the marginal other costs of the private traders. The profit function of intermediate *i* (SGTC and private traders) ( $\forall i = 1, ..., n+1$ ) is:

$$\pi_{i} = (p - c_{i} - w)q_{i} - f_{i}$$
(4.1)

where  $\pi_i$  is profit of intermediate *i*, *p* is consumer price of rice (price that intermediates receive),  $c_i$  is marginal other costs of intermediate *i*, *w* is farm price of rice (price that intermediates pay to farm households),  $q_i$  is quantity of rice purchased by intermediate *i*, and  $f_i$  is fixed costs of intermediate *i*, for example, the costs of cell phones for the private traders, and the overhead costs for the SGTC such as salaries to its employees. We assume that

<sup>&</sup>lt;sup>36</sup> As mentioned in Chapter 3 (footnote 27), search and information costs are costs of making phone calls and costs of traveling for personal visits. Networking costs are costs of making phone calls, traveling costs, and other costs like cigarette, drinks, and meals. During the survey, we found that some of the natural villages did not have a telephone in 2000 so that the private trader who did not have a cell phone had to either find a telephone that is closest to his residence (e.g. neighbor natural villages) or go to his buyer to acquire information on purchasing price and quantity. In the latter situation, costs of cigarettes were necessary.

*p* and  $c_i$  are constant. The total quantity purchased by the intermediates  $(Q^d)$  equals the total quantity supplied by farm households  $(Q^s)$ , i.e.  $Q^d = Q^s = \sum_{i=1}^{n+1} q_i = Q$ . We assume that the total quantity supplied by farm households  $(Q^s)$  depends on the farm price (w) so that the total quantity purchased by the intermediates  $(Q^d)$  also depends on the farm price (w).

Therefore, the first order condition of intermediate i is given by:

$$\frac{\partial \pi_i}{\partial q_i} = p - c_i - w - \frac{\partial w}{\partial Q} \frac{\partial Q}{\partial q_i} q_i = 0$$
(4.2)

This can be written as:

$$p = c_i + w + w \frac{\partial w}{\partial Q} \frac{\partial Q}{\partial q_i} \frac{q_i}{w}$$
(4.3)

where  $\frac{\partial Q}{\partial q_i}$  is private trader *i*'s beliefs about how total demand would change when its

own demand changes. Here, it is assumed that it equals 1, which indicates intermediates play Cournot. Therefore equation (4.3) can be written as:

$$p = c_i + w + \frac{w}{\mathcal{E}_i} \tag{4.4}$$

where  $\varepsilon_i$  is price elasticity that individual intermediate *i* faces ( $\varepsilon_i = \frac{\partial Q}{\partial w} \frac{w}{q_i}$ ). In other

words, it shows the percentage change in demand of intermediate *i* when the farm price changes 1%. Equation (4.4) shows that intermediate *i* receives a mark-up (extra profit above marginal costs of production) equal to:  $\frac{w}{\varepsilon_i}$ . From this equation, we see that the mark-up of an intermediate depends on the price he pays to farm households (farm price) and the price elasticity he faces. This mark-up decreases when the price elasticity that intermediate *i* faces becomes larger, namely, a larger effect of changes in farm price on the rice demand of intermediate *i* leads to a smaller mark-up. When the price elasticity that intermediate *i* faces becomes infinite, the mark-up of intermediate *i* becomes zero. In that case the farm price is

## 4.3.2 Competition in Gangyan in 2000

constant and the intermediates play perfect competition.

According to Section 3.2.2, the SGTC in Gangyan behaves as a monopsonist for a short period after harvest and private traders only enter the market afterwards. In this case, we assume that competition between the SGTC and private traders contains two stages. In the first stage, with the help of the local government, the SGTC is the only buyer (monopsony) in the purchase market one month after the harvest and decides the farm price ( $w_{SGTC}$ ) it offers. Farm households know that they could sell their rice to private traders after the one-month period but they do not know the price offered by private traders. In the second stage, private traders enter the purchase market. The strict control is eased but not eliminated. To a certain extent, private traders still bare risks of being prosecuted (Section 3.2.2). Moreover, they bare the costs

of searching information (e.g. phone bills and traveling costs) and the costs of maintaining their network (e.g. cigarettes, drinks, meals). Therefore, we assume there are only a limited number of private traders (oligopsony). We know that the SGTC stores rice after purchasing and therefore has storage costs<sup>37</sup>. Moreover, imposing temporary monopsony adds additional costs to the SGTC such as monitoring costs etc. Thus marginal other costs of the SGTC are assumed to be higher than that of private traders, i.e.  $c_{\text{SGTC}} > c_{\text{PTi}}$ . Because of the higher marginal other costs, the SGTC cannot increase the price it pays to farmers ( $w_{\text{SGTC}}$ ) to the level of the price private traders pay ( $w_{\text{PT}}$ ) and thus it does not attract any rice supply from farm households in the second stage. This indicates that the amount of rice purchased by the private traders as a whole ( $q_{\text{PT}}$ ) equals total rice supply minus rice purchased by the SGTC in the first period, i.e.  $q_{\text{PT}} = Q - q_{\text{SGTC}}$ .

We solve for the quantity sold by the private traders by looking first at the second stage. The profit function of private trader i ( $\forall i = 1,...,n$ ) is:

$$\pi_{p_{T_i}} = (p - c_{p_{T_i}} - w_{p_T})q_{p_{T_i}} - f_{p_{T_i}}$$
(4.5)

where  $\pi_{pT_i}$  is profit of private trader *i*, *p* is consumer price of rice (price that private traders receive),  $c_{pT_i}$  is marginal other costs of private trader *i* (e.g. transport costs, search and information costs, etc.),  $w_{pT}$  is farm price of rice offered by private trader *i*,  $f_{pT_i}$  is fixed costs of private trader *i* (e.g. the costs of cell phones),  $q_{pT_i}$  is quantity of rice purchased by private trader *i* and we have  $q_{pT} = \sum_{i=1}^{n} q_{pT_i} = \sum_{i=1}^{r} x_{pTh}$ , in which  $x_{pTh}$  is quantity of rice supplied to private trader trader by farm household h ( $\forall h = 1, ..., r$ ). We assume that  $c_{pT_i}$  is constant.

Private trader i maximizes its profit. The first order condition of equation (4.5) is:

$$\frac{\partial \pi_{_{PT_i}}}{\partial q_{_{PT_i}}} = p - c_{_{PT_i}} - w_{_{PT}} - \frac{\partial w_{_{PT}}}{\partial q_{_{PT}}} \frac{\partial q_{_{PT}}}{\partial q_{_{PT_i}}} q_{_{PT_i}} = 0$$
(4.6)

This can be written as:

$$p = c_{PT_i} + w_{PT} + w_{PT} \frac{\partial w_{PT}}{\partial q_{PT}} \frac{\partial q_{PT}}{\partial q_{PT_i}} \frac{q_{PT_i}}{w_{PT}}$$
(4.7)

where  $\frac{\partial q_{PT}}{\partial q_{PT_i}}$  is private trader *i*'s beliefs about how total demand of all the private traders

in the second stage would change when its own demand changes. Here, we assume it equals 1, which indicates intermediates play Cournot. Therefore equation (4.7) can be written as:

$$p = c_{PT_{i}} + w_{PT} + w_{PT} \frac{\partial w_{PT}}{\partial q_{PT}} \frac{q_{PT_{i}}}{w_{PT}}$$
(4.8)

Or:

$$p = c_{PT_i} + w_{PT} + \frac{w_{PT}}{\varepsilon_{PT_i}}$$
(4.9)

<sup>&</sup>lt;sup>37</sup> The SGTC might be able to obtain a higher selling price later in the season. However, the model does not consider this aspect.

where  $\varepsilon_{PT_i}$  represents the price elasticity that private trader *i* faces ( $\varepsilon_{PT_i} = \frac{\partial q_{PT}}{\partial w_{PT}} \frac{w_{PT}}{q_{PT_i}}$ ). Equation (4.9) shows that private trader *i* receives a mark-up equal to:  $\frac{w_{PT}}{\varepsilon_{PT_i}}$ . This indicates the mark-up of private trader *i* depends on the price he pays to farm households (farm price) and the price elasticity he faces. This mark-up increases when the price elasticity that private trader *i* faces becomes smaller.

From equation (4.9) the price paid by private traders  $(w_{PT})$  can be derived. The amount of rice supplied in the second stage  $(q_{PT})$  can be derived by writing aggregated rice supply of farm households as a function of the farm price offered by private traders, i.e.  $q_{PT} = \sum_{1}^{r} x_{PTh}(w_{PT})$ .

Now we look at the first stage. In the first stage, the SGTC is the only buyer of rice in a village. Since we know the aggregated rice supply to private traders  $(q_{PT})$ , the residual supply to the SGTC can be written as:  $q_{SGTC} = Q(w_{SGTC}, w_{PT}) - q_{PT}$ . Therefore, we have  $q_{SGTC} = q_{SGTC}(w_{SGTC}, w_{PT}, q_{PT})$ . We let  $x_{PTh} = x_{PT}(x_{SGTCh})$  be the supply function of household h that depicts the supply decision of household h to private traders given its supply to the SGTC in the previous stage. The aggregated rice supply to private traders can be written as  $\sum_{1}^{r} x_{PTh} = x_{PT}(\sum_{1}^{r} x_{SGTCh})$ , which is equivalent to  $q_{PT} = q_{PT}(q_{SGTC})$ . Finally, the residual supply function can be written as  $q_{SGTC} = q_{SGTC}(w_{SGTC}, w_{PT}, q_{PT}(q_{SGTC}))$ . The inversed residual supply function is then  $w_{SGTC} = w_{SGTC}(w_{PT}, q_{SGTC}, q_{PT}(q_{SGTC}))$ .

The profit function of the SGTC is:

$$\pi_{\rm sGTC} = (p - c_{\rm sGTC} - w_{\rm sGTC})q_{\rm sGTC} - f_{\rm sGTC}$$

$$\tag{4.10}$$

Or:

$$\pi_{\text{SGTC}} = (p - c_{\text{SGTC}} - w_{\text{SGTC}}(w_{\text{PT}}, q_{\text{SGTC}}, q_{\text{PT}}(q_{\text{SGTC}})))q_{\text{SGTC}} - f_{\text{SGTC}}$$
(4.11)

where  $\pi_{\rm SGTC}$  is profit of the SGTC,  $c_{\rm SGTC}$  is marginal other costs of the SGTC (e.g. transport costs, storage costs, etc.),  $w_{\rm SGTC}$  is farm price offered by the SGTC,  $q_{\rm SGTC}$  is the rice purchased by the SGTC,  $f_{\rm SGTC}$  is fixed costs of the SGTC (e.g. salaries to its employees). We assume  $c_{\rm SGTC}$  to be constant.

The first order condition of equation (4.10) is:

$$\frac{\partial \pi_{\rm SGTC}}{\partial q_{\rm SGTC}} = p - c_{\rm SGTC} - w_{\rm SGTC} - \left(\frac{\partial w_{\rm SGTC}}{\partial q_{\rm SGTC}} + \frac{\partial w_{\rm SGTC}}{\partial q_{\rm PT}} \frac{\partial q_{\rm PT}}{\partial q_{\rm SGTC}}\right) q_{\rm SGTC} = 0$$
(4.12)

This can be written as:

$$p = c_{SGTC} + w_{SGTC} + w_{SGTC} \left( \frac{\partial w_{SGTC}}{\partial q_{SGTC}} \frac{q_{SGTC}}{w_{SGTC}} + \frac{\frac{\partial q_{PT}}{\partial Q} \frac{Q}{q_{PT}}}{\frac{\partial q_{PT}}{\partial w_{SGTC}} \frac{w_{SGTC}}{q_{PT}} \cdot \frac{\partial q_{SGTC}}{\partial Q} \frac{Q}{q_{SGTC}}} \right)$$
(4.13)

Or:

$$p = w_{\text{SGTC}} \left(1 + \frac{1}{\varepsilon_{\text{SGTC}}} + \frac{\varepsilon_{\text{Q}}^{\text{PT}}}{\varepsilon_{\text{SGTC}}^{\text{PT}} \cdot \varepsilon_{\text{Q}}^{\text{SGTC}}}\right) + c_{\text{SGTC}}$$
(4.14)

where  $\varepsilon_{\rm SGTC} = \frac{\partial q_{\rm SGTC}}{\partial w_{\rm SGTC}} \frac{w_{\rm SGTC}}{q_{\rm SGTC}}$  represents the price elasticity that the SGTC faces (total marketable rice supply of farm households in this stage equals the demand from the SGTC).  $\varepsilon_{\rm SGTC}^{\rm PT} = \frac{\partial q_{\rm PT}}{\partial w_{\rm SGTC}} \frac{w_{\rm SGTC}}{q_{\rm PT}}$  represents the cross price elasticity of marketable rice supply to private traders.  $\varepsilon_{\rm Q}^{\rm SGTC} = \frac{\partial q_{\rm SGTC}}{\partial Q} \frac{Q}{q_{\rm SGTC}}$  represents the elasticity of supply to the SGTC ( $q_{\rm SGTC}$ ) with respect to the total marketable rice supply (Q).  $\varepsilon_{\rm PT}^{\rm Q} = \frac{\partial q_{\rm PT}}{\partial Q} \frac{Q}{q_{\rm PT}}$  represents the elasticity of supply to the elasticity of supply to the su

private traders ( $q_{PT}$ ) with respect to the total marketable rice supply (Q).

Equation (4.14) shows that the mark-up of the SGTC equals  $(\frac{1}{\varepsilon_{SGTC}} + \frac{\varepsilon_{Q}^{PT}}{\varepsilon_{SGTC}^{PT}})w_{SGTC}$ ,

among which  $\frac{w_{\text{SGTC}}}{\varepsilon_{\text{SGTC}}}$  is the monopsony mark-up. The second component of the mark-up includes the cross price elasticity of supply to private traders ( $\varepsilon_{\text{SGTC}}^{PT}$ ), which is expected to have a negative sign since an increase in  $w_{\text{SGTC}}$  results in a decrease in  $q_{\text{PT}}$ . The signs of  $\varepsilon_{\text{Q}}^{\text{SGTC}}$  and  $\varepsilon_{\text{Q}}^{PT}$  are expected to be positive since an increase in total marketable rice supply leads to an increase in supply to the SGTC or to the private traders. Hence, the second component has a negative sign, which counterbalances the monopsony mark-up. This indicates that the expected monopsonistic market power of the SGTC in Gangyan is offset by the participation of the private traders.

#### 4.3.3 Competition in 2003

China's government officially allowed private traders to enter the early rice purchase market in 2000 but not for late rice and one-season rice (Section 2.2). Nevertheless, free exchange of late rice and one-season rice emerged along with the free exchange of early rice in 2000 (Section 3.2). Moreover, due to the rapid development of China's telecommunication system, most of the private traders interviewed possess a cell phone in 2003, which has increased the accessibility of private traders to market information<sup>38</sup>. As a result, the number of private traders in the purchase market for all types of rice has increased in 2000-03. The SGTC is no longer subsidized by the government and has to compete with private traders in the purchase market<sup>39</sup>. During interviews with private traders in the study area, we found that the trading amount of an individual private trader is low, which indicates that the market share of an individual

<sup>&</sup>lt;sup>38</sup> For example, a private trader with a cell phone no longer needs to pay a visit to his buyer that saves traveling time and costs. Moreover, the private trader can be informed anytime by their network contacts about the price.

<sup>&</sup>lt;sup>39</sup> It is described in Section 3.3 that subsidies for early rice exchange were eliminated while subsidies for late rice exchange remained for the SGTCs in 2003. However, subsidies were often delayed or not paid fully. In this chapter we assume the SGTCs do not receive subsidies at all. This issue is dealt with in more detail in the next chapter.

private trader is also small so that the farm price is determined in a competitive market. We also found that the difference between the buying and selling price of private traders is small, again an indication of a competitive market. According to Baumol et al. (1982), when entry costs are sufficiently low, the threat of potential entry may already yield an efficient outcome. Given the large number of potential traders (farm households) in each selected village, we assume that the rice purchase market in 2003 in the study area is perfectly competitive<sup>40</sup>.

We assume that there are n private traders and the SGTC in the purchase market in one village. Thus we have n+1 intermediates competing in the market. The profit function of intermediate i equals:

$$\pi_{i} = (p - c_{i} - w)q_{i} - f_{i}$$
(4.15)

where  $\pi_i$  is profit of intermediate *i* (the SGTC or private trader *i*), *p* is consumer price received by intermediate *i*,  $c_i$  is marginal other costs of intermediate *i*, *w* is farm price,  $q_i$  is the amount of rice purchased by intermediate *i*, and  $f_i$  is fixed costs of intermediate *i* (e.g. costs of cell phones or overhead costs).

In a perfectly competitive market, intermediate i is a price-taker. Therefore, w is given. The first-order condition of equation (4.15) is:

$$p - c_i - w = 0 \tag{4.16}$$

$$p = c_i + w \tag{4.17}$$

Therefore, intermediate *i* receives zero profit, i.e.  $\pi_i = 0$ .

#### 4.4 Empirical model and data

#### Empirical model

In Section 4.3, the theoretical model is presented. It consists of the first order conditions of the oligopsonists (eq. 4.4 and 4.9) and monopsonist (eq. 4.14) in the purchase market of 2000; and the first order condition of the intermediates in the purchase market of 2003 (eq. 4.17).

## Data

The elasticities in equations (4.4), (4.9) and (4.14) are estimated using data from the SERENA project (Appendix 4B, Table 4B.5). All elasticities have the expected sign. In Banqiao and Shangzhu, marginal other costs of private traders consist of transport costs, search and information costs (e.g. costs of visiting farm households and costs of making phone calls), and

<sup>&</sup>lt;sup>40</sup> Models in Chapter 4 and 5 abstract from the reality on the rice purchase market in 2000 and 2003. Protective purchasing was not important anymore in 2003 (it was officially removed in 2004), therefore, we assume that the rice purchase market in 2003 was perfectly competitive.

networking costs (e.g. cigarettes, drinks, and meals) in 2000. As been discussed in Chapter 2, the SGTCs in Banqiao and Shangzhu adopted similar strategies as private traders in 2000, namely, they paid their employees to go to the village to purchase rice from the farm households. In addition, the SGTCs store rice they purchase so they bare storage costs. Therefore, the marginal other costs of the SGTCs include transport costs, costs they pay their employees to go to the villages to purchase rice, and storage costs<sup>41</sup>. Although the marginal other costs of the SGTCs and the private traders have a different composition, we assume that the marginal other costs of the SGTC and the private traders have the same value. For Gangyan in 2000, we assume that the marginal other costs of the SGTC are higher than that of private traders because it includes monitoring costs. Therefore, the marginal other costs of the SGTC in Gangyan include transport costs, storage costs, and monitoring costs. In 2003, since the rice purchase market is perfectly competitive, we assume that marginal other costs of intermediates (the SGTC and private traders) in Banqiao and Shangzhu are lower than that of intermediates in 2000 (due to developments in the telecommunication system and the improvement of roads). For Gangyan in 2003, since the SGTC has to reduce its marginal other costs in order to compete with private traders, we assume that the marginal other costs of the SGTC and the private traders have the same value<sup>42</sup>. We also assume the marginal other costs of intermediates in Gangyan in 2003 are lower than that of private traders in 2000 (see Table 4.1 for the composition of the marginal other costs of the SGTCs and the private traders in 2000 and in 2003).

	2000 (imperf	ect competition)	2003 (perfect	competition)
	SGTC	Private trader	SGTC	Private trader
Marginal other costs	c <sub>SGTC</sub> =	C <sub>PTi</sub>	c <sub>SGTC</sub> =	C <sub>PTi</sub>
BQ&SZ	Transport costs	Transport costs	Transport costs	Transport costs
	Employee costs	Search and information costs	Employee costs	Search and information costs
	Storage costs	Networking costs	Storage costs	Networking costs
Marginal other costs	c <sub>SGTC</sub> >	C <sub>PTi</sub>	c <sub>SGTC</sub> =	c <sub>PTi</sub>
GY	Transport costs	Transport costs	Transport costs	Transport costs
	Monitoring costs	Search and information costs	Employee costs	Search and information costs
	Storage costs	Networking costs	Storage costs	Networking costs

Table 4.1 Composition of marginal other costs

Note: BQ = Banqiao; SZ = Shangzhu; GY = Gangyan.

<sup>&</sup>lt;sup>41</sup> Other marginal costs could be the interest costs for the loans that SGTCs have access to. No information was available on the level of these costs.

<sup>&</sup>lt;sup>42</sup> Due to government investments in infrastructure (e.g. road construction) and the boom in the private transportation business, transport costs have been decreasing since 1996 (Luo and Crook, 1997).

Transport costs differ for the villages depending on the distance from the village to the next buyer of the intermediates. Transport costs are a measure for market access. As mentioned in Chapter 3, Gangyan has the best market access. Shangzhu locates in a mountainous area and is the most remote village. Banqiao takes an intermediate position. Transport costs are reflected in the marginal other costs.

Farm household's marketable rice supply in 2000 in the three selected villages is taken from a household survey carried out in the same villages in 2000 and 2001<sup>43</sup>. It is 853 tons in Banqiao and 413 tons in Shangzhu. The marketable rice supply of Gangyan in 2000 consists of supply to the SGTC (1045 tons) and supply to private traders (2596 tons). Farm prices are taken from the SERENA project. The farm price equaled 1073 Yuan per ton in Banqiao, while in Shangzhu the farm price equaled 977 Yuan per ton. In Gangyan the farm price offered by the SGTC was 960 Yuan per ton<sup>44</sup> and the farm price offered by private traders was 1024 Yuan per ton. Given the price margin of private traders presented in Table 3.15, the consumer price (price that private traders receive) in 2000 is calculated by the summation over farm price and the price margin. It equaled 1123 Yuan per ton in Banqiao, 1035 Yuan per ton in Shangzhu, and 1074 Yuan per ton in Gangyan (see Table 4.2).

	Banqiao	Shangzhu	Gan	gyan
	Intermediate	Intermediate	SGTC	Private Traders
Consumer price (Yuan/ton)	1123	1035	1074	
Farm price (Yuan/ton)	1073	977	960	1024
Rice production (ton)	1696	1502	63	38
Marketable rice supply (ton)	853	413	1045	2596
Marginal other costs 2000 (Yuan/ton)	23	28	86	20
Marginal other costs 2003 (Yuan/ton)	15	20	1	2

Table 4.2Other data used for the simulations

Source: SERENA, 2001; RESPONSE, 2003.

### 4.5 Scenarios and results

#### 4.5.1 Scenarios

Three scenarios are defined. All scenarios compare the situation in 2000 with that in 2003, but different assumptions are made with respect to the change in the consumer price.

<sup>&</sup>lt;sup>43</sup> The household survey was conducted in the SERENA project (Kuiper et. al., 2001).

<sup>&</sup>lt;sup>44</sup> The farm price offered by the SGTC in Gangyan was originally 1068 Yuan per ton. However, as mentioned in Section 3.3, the SGTC often reduces the farm price by down-grading the rice sold by farm households. Therefore, the price announced by the SGTC is not the price actually paid. We assume in our analysis that down-grading by the SGTC decreases the farm price by 10%.

(1) Comparison between 2000 and 2003 keeping the consumer price constant. First, we examine the changes for the intermediates (the SGTC and private traders) from 2000 to 2003. In the case of perfect competition (situation in 2003), there are several differences compared to the case of monopsony and oligopsony (situation in 2000). (1) Both first-order conditions of monopsony and oligopsony are changed such that the mark-ups become zero. It is expected that this leads to an increase in farm prices, an increase in total marketable supply, zero profits for the intermediates and an increase in profit for the farm households. (2) The marginal other costs of all the intermediates in all the villages are lower in 2003 than in 2000 due to increased competition and the development of telecommunication and the improvement of road conditions. We expect an increase in farm prices and marketable supply to the intermediates. (3) Since rice is a normal good in this study, there is a negative correlation between farm price and rice consumption, i.e. it is expected that an increase in farm prices leads to a decrease in rice consumption and therefore to an increase in total marketable rice supply. Second, we compare the differences between the SGTC and private traders of Gangyan in 2000. Notice that different mark-ups and marginal other costs result in different farm prices between the SGTC and private traders (see equations 4.9 and 4.14). Which mark-up is larger is an empirical issue, so that it is not clear beforehand whether the SGTC or private traders offer a higher farm price.

(2) Comparing 2000 with 2003 when the consumer price decreases 10%. The liberalization and deregulation of China's rice market has introduced price uncertainty. In this simulation the effects of a lower consumer price are examined. We expect the price decrease lowers the gain for farm households from more competition among the intermediates. There will be a smaller increase in farm prices and rice supply to the SGTC and private traders. In 2003 all intermediates do not make profits because of the perfect competition assumption.

(3) Comparing 2000 with 2003 when the consumer price increases 10%. The consumer price has been increasing since 2001, however, the speed of the price increase has slowed down in 2005 (PDO, 2005). We expect that the effects have the same sign as in the first scenario but that they will be larger.

# 4.5.2 Results

The first three columns of Table 4.3 report the results of the comparison of the rice marketing channel in 2000 with 2003 (scenario 1) for the three selected villages. Since the intermediates face perfect competition in all three villages in 2003, they have zero mark-ups. In 2000, intermediates have a higher mark-up (29.9 Yuan/ton) in Shangzhu than in Banqiao (27.1 Yuan/ton). This is because of the smaller price elasticity that an intermediate faces in Shangzhu than in Banqiao that leads to a higher mark-up. In Gangyan, the mark-up of the SGTC (27.2 Yuan/ton) is lower than the mark-up of private traders (30 Yuan/ton). This is because the monopsony market power of the SGTC is offset by the potential competition of private traders after the monopsony period. The slightly higher mark-up of private traders in Gangyan than in Banqiao and Shangzhu indicates more market power of private traders in Gangyan.

In Banqiao and Shangzhu, the farm price increases with 3.3% and 3.9% respectively. The higher price increase in Shangzhu is due to the loss of its higher mark-up. In Gangyan, the farm price for the SGTC and private traders increases with 10.5% and 3.7% respectively. The larger price increase of the SGTC is mainly due to the reduction of its marginal other costs.

The traded quantity for individual intermediates in Banqiao and Shangzhu decreases 20.5% and 27.5% respectively. However, because more intermediates participate in the purchase market in 2003, the total quantity supplied increases 0.6% and 1% in Banqiao and Shangzhu respectively. The increase in total quantity supplied is also due to the increase in farm price. The larger increase in Shangzhu represents the larger market power of intermediates. In Gangyan the trading quantity for the SGTC increases 8.9% and decreases 17.4% for private traders. The large increase in rice supplied to the SGTC is due to the large increase in farm price. Although rice supplied to private traders decreases 17.4%, the total rice supplied in Gangyan increases 3.3% due to increase in the number of private traders.

In all the villages, the loss in profit of the intermediates is smaller than the gain of farm households. Therefore, the overall profit increase is positive. The lower gain in overall profit in Shangzhu is due to its relative small trading quantity. In Gangyan, the loss in profit of private traders is the sum of profit loss of each individual private trader. Therefore, it is much higher than that the profit loss of the SGTC.

	(consumer price constant)			(consu	(consumer price -10%)			ner price +	10%)
	BQ	SZ	GY	BQ	SZ	GY	BQ	SZ	GY
Change in trac	de (%)								
$\Delta q_{ m SGTC}$	20.5	27.5	8.9	22.0	20.5	-0.5	18.0	25 5	18.3
$\Delta q_{PTi}$	-20.5	-21.5	-17.4	-22.0	-27.5	-21.9	-10.7	-23.5	-12.8
ΔQ	0.6	1.0	3.3	-1.4	-1.8	-3.2	2.6	3.8	9.8
Change in pri-	ce (%)								
$\Delta p$	0	0	0	-10	-10	-10	10	10	10
$\Delta w_{ m SGTC}$	2.2	2.0	10.5			-0.7	12.7	145	21.7
$\Delta w_{PT}$	3.3	3.9	3.7	3.7	-0.7	-6.8	13.7	14.5	14.2
Change in ma	rkup per uni	t (Yuan)							
$\Delta mk_{ m SGTC}$	27.1	20.0	-27.2	27.1	20.0	-27.2	27.1	20.0	-27.2
$\Delta m k_{PTi}$	-2(.1	-29.9	-30.0	-27.1	-29.9	-30.0	-27.1	-29.9	-30.0
Total profit ch	ange (1,000 \	Yuan)							
$\Delta \pi_{\rm SGTC}$ + $\Delta \pi_{\rm PT}$	-23.7	-11.9	-71.7	-23.7	-11.9	-71.7	-23.7	-11.9	-71.7
$\Delta \pi_{\!\scriptscriptstyle farm}$	28.7	13.9	301.9	-62.8	-23.7	-200.1	121.5	52.2	787.4
$\Delta \pi_{ m SGTC}$ + $\Delta \pi_{ m PT}$ + $\Delta \pi_{ m farm}$	5.0	2.0	230.2	-86.5	-35.6	-271.8	97.8	40.3	715.7

 Table 4.3
 Simulation results, comparison between 2000 and 2003

Note: BQ = Banqiao, SZ = Shangzhu, GY = Gangyan.

The middle three columns of Table 4.3 report the results of the comparison of 2000 and 2003 when the consumer price decreases 10% (scenario 2). According to equation (4.4), (4.9) and (4.14), the mark-ups of the intermediates do not include the consumer price so the change of mark-ups of the intermediates remains the same as in scenario 1. Farm prices decrease 7.2% and 6.7% for Banqiao and Shangzhu respectively. In Gangyan, farm prices decrease 0.7% for the SGTC and 6.8% for private traders. This implies a decrease in marketable rice supply and farm profits. As expected, profit loss of the intermediates remains the same as simulation 1 because they have zero profit in the case of perfect competition. Profit of farm households decreases for all villages. Therefore, the overall profit change is negative for all villages.

The last three columns of Table 4.3 present the results of the last simulation, a comparison of 2000 and 2003 when the consumer price increases 10%. The results look similar to scenario 1 but with a larger increase or smaller decrease in farm price, farm profits, and marketable rice supply. As mentioned above, the change of intermediates' profit stays the same as in scenario 1. Consequently, the overall profit increases more in all three villages.

Scenario 2 shows that the decrease of the consumer price (10%) is less than fully transmitted to farm households. Scenario 3 shows that the increase of the consumer price (10%) is more than fully transmitted to farm households. In scenario 2, the negative effects of a consumer price decrease are partly offset by the positive effects of an increase in competition from 2000 to 2003, which leads to a decrease in farm prices less than 10% for all villages.

## 4.6 Conclusions and policy implications

The first aim of this chapter is to develop a model of protective purchasing and define its possible outcomes in the period of 2000-03. We find that the outcomes under the protective purchasing system depend on the protective price fixed by the government, the subsidy supplied to the SGTC, and the capacity of the private traders. Given the situation of the rice purchase market in 2000 described in Chapter 2 and Chapter 3, we find that the possible outcomes under the protective purchasing system are that the SGTCs and the private traders play Cournot, quantity leadership, or price leadership competition.

The second aim of this chapter is to analyze the effects of market liberalization and deregulation in the rice marketing channel on farm households, using information collected from three villages with different market access in Jiangxi Province China. Results indicate that rice producers benefit from market liberalization and deregulation. How much rice producers benefit depends on the degree of market imperfections before market liberalization and deregulation and the degree of market access. For small villages in terms of production and villages far from consumer markets (limited market access) it is to be expected that the number of intermediates in a liberalized restructured market is small. Therefore the gains from market liberalization and deregulation will be smaller than for farm households in villages close to consumer markets and with a relatively large production. The competition with private traders forces the SGTC to reduce its marginal other costs, which reduces the subsidies going to the

SGTC. This indicates that the commercialization of the SGTCs has partly reached its objective – relieve the government from the budget burden caused by subsidies.

The results of our study are obviously subject to some qualifications. First, the model is a short-term model because we take production as given and the effects on rice production of a farm price change are not taken into account. Second, we only look at the effects on farm profits, which is not the same as utility of farm households. Effects on the supply and consumption of other goods are also not taken into account. Third, it is a strong assumption that the rice market is perfectly competitive in 2003. Finally, there is still uncertainty about the data especially the number of intermediates.

Using a household production model that includes production (instead of just marketable supply) decisions and consumption (including the consumption of other goods than rice and leisure) of farm households may enrich the analysis. With such a model also welfare analyses for farm households could be performed. The model presented here can serve as a building block in this type of extended analysis.

Some policy recommendations can be drawn from this study. Positive effects from liberalizing the rice purchase market can be enhanced by improving market access. Public investment in the physical infrastructure (roads and transport systems) might be a means for this. Moreover to reduce search and information costs market information availability could be improved, e.g. improve the accessibility of the information provided by the government, namely, reduce or remove the costs of the private traders for obtaining information on rice prices.

## Appendix 4A A model of protective purchasing

This appendix provides possible outcomes in detail of the model stated in Section 4.2. In this appendix, we discuss two possible situations (i) when  $\tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}}$ , and (ii) when  $\tilde{w}_{_{PT}} > \hat{w}_{_{SGTC}}$ .

(i) When  $\tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}}$ , we might have (1)  $\overline{w} \le \tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}}$ , (2)  $\tilde{w}_{_{PT}} < \overline{w} \le \hat{w}_{_{SGTC}}$ , and (3)  $\tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}} < \overline{w}$  (Figure 4A.1).

Figure 4A.1 Possible situations when  $\tilde{w}_{PT} < \hat{w}_{SGTC}$ 

					_
	$\widetilde{w}_{_{PT}}$		$\widehat{w}_{ m SGTC}$		
(1) $\overline{w} \leq \widetilde{w}_{_{PT}} < \widehat{w}_{_{SGTC}}$		(2) $\widetilde{w}_{PT} < \overline{w} \le \widehat{w}_{SGTC}$		$(3)  \widetilde{w}_{_{PT}} < \widehat{w}_{_{SGTC}} < \overline{w}$	W

(1) When  $\overline{w} \leq \widetilde{w}_{pT} < \widehat{w}_{SGTC}$ , we might have (1.1) the SGTC does not receive a subsidy (*s*) from the government and (1.2) the SGTC receives a subsidy from the government.

(1.1) When the SGTC does not receive a subsidy from the government, we might have (1.1.1) when both the SGTC and private traders choose  $\overline{w}$  as their purchase price and (1.1.2) when neither the SGTC nor private traders choose  $\overline{w}$  as their purchase price.

(1.1.1) When both the SGTC and private trader choose  $\overline{w}$  as their purchase price, the outcome of the game depends on first, to whom that farm households choose to sell the rice; second, the capacity constraint<sup>45</sup> of the private traders ( $\overline{q}_{PT}$ ). Here we assume that due to the monopsonistic history of the SGTC and the conflicts between the SGTC and the farm households such as the SGTC down-graded the rice sold by the farm households), farm households prefer to sell their rice to private traders.

(a) When total rice supplied (Q) is more than the sum of capacity constraint of private traders  $(\sum_{i=1}^{n} \overline{q}_{PT_{i}})$ , i.e.  $Q \ge \sum_{i=1}^{n} \overline{q}_{PT_{i}}$ , private traders purchase rice up to their capacity constraint ( $\overline{q}_{PT_{i}}$ ) and the SGTC takes what is left in the market ( $q_{SGTC} = Q - \sum_{i=1}^{n} \overline{q}_{PT_{i}}$ ). Therefore, the profit of private trader *i* equals  $\pi_{PT_{i}} = (\widetilde{w}_{PT} - \overline{w})\overline{q}_{PT_{i}}$  ( $\forall i = 1, ..., n$ ) and the profit of the SGTC equals  $\pi_{SGTC} = (\widehat{w}_{SGTC} - \overline{w})q_{SGTC}$ .

(b) When the total rice supplied is less than the sum of the capacity constraints of private traders, i.e.  $Q < \sum_{i=1}^{n} \overline{q}_{PT_{i}}$ , private traders purchase all the rice supplied and the quantity purchased by private trader *i* equals  $q_{PT_{i}} = \frac{Q}{n}$ , the profit of private trader *i* is  $\pi_{PT_{i}} = (\widetilde{w}_{PT} - \overline{w})q_{PT_{i}}$ . Thus, the SGTC has nothing to purchase  $(q_{SGTC} = 0)$ .

(1.1.2) When private traders and the SGTC do not stick to  $\overline{w}$ , the outcome depends on the game the private traders and the SGTC play, i.e. Cournot, Stackelberg or price leadership.

<sup>&</sup>lt;sup>45</sup> In this chapter, we only look at short-term rice trade, i.e. the period after harvesting and before plowing for the next sowing. In the short-term, private traders face capacity constraints due to their time available and the capacity of the truck.

Given that  $\overline{w}$  only by accident would give the equilibrium price there is an incentive for traders not to stick to the price set by the government.

(1.2) When the SGTC receives a subsidy (s) from the government, we have  $\overline{w} < \widetilde{w}_{pT} < \widehat{w}_{SGTC} + s$ . In this case, we might have (1.2.1) when the SGTC chooses  $\overline{w}$  as its purchase price and (1.2.2) when the SGTC does not choose  $\overline{w}$  as its purchase price.

(1.2.1) When the SGTC chooses  $\overline{w}$  as its purchase price and when the farm households choose to sell the rice to the private traders, we have:

(a) When total rice supplied (Q) is more than the sum of capacity constraint of private traders  $(\sum_{i=1}^{n} \overline{q}_{PT_{i}})$ , i.e.  $Q \ge \sum_{i=1}^{n} \overline{q}_{PT_{i}}$ , private traders purchase rice up to their capacity constraint  $(\overline{q}_{PT_{i}})$  and the SGTC takes what is left in the market  $(q_{SGTC} = Q - \sum_{i=1}^{n} \overline{q}_{PT_{i}})$ . Therefore, the profit of private trader *i* equals  $\pi_{PT_{i}} = (\widetilde{w}_{PT} - \overline{w})\overline{q}_{PT_{i}}$  and the profit of the SGTC equals  $\pi_{SGTC} = (\widehat{w}_{SGTC} + s - \overline{w})q_{SGTC}$ .

(b) When the total rice supplied is less than the sum of the capacity constraints of private traders, i.e.  $Q < \sum_{i=1}^{n} \overline{q}_{PT_{i}}$ , private traders purchase all the rice supplied and the quantity purchased by private trader *i* equals  $q_{PT_{i}} = \frac{Q}{n}$ , the profit of private trader *i* is  $\pi_{PT_{i}} = (\widetilde{w}_{PT} - \overline{w})q_{PT_{i}}$ . Thus, the SGTC has nothing to purchase  $(q_{SGTC} = 0)$ .

(2) When  $\tilde{w}_{PT} < \overline{w} \le \hat{w}_{SGTC}$ , we might have (2.1) the SGTC does not receive a subsidy (s) from the government and (2.2) the SGTC receives a subsidy from the government.

(2.1) When the SGTC does not receive a subsidy from the government, we might have (2.1.1) when the SGTC chooses  $\overline{w}$  as its purchase price and (2.1.2) when the SGTC does not choose  $\overline{w}$  as its purchase price.

(2.1.1) When the SGTC chooses  $\overline{w}$  as its purchase price, only the SGTC stays in the market and private trader *i* does not trade ( $\pi_{PT_i} = 0$ ). The SGTC purchases all the rice in the market ( $q_{SGTC} = Q$ ) and its profit equals  $\pi_{SGTC} = (\widehat{w}_{SGTC} - \overline{w})q_{SGTC}$ .

(2.1.2) When the SGTC does not choose  $\overline{w}$ , the outcome depends on the game the private traders and the SGTC play, e.g. Cournot, Stackelberg, and price leadership.

(2.2) When the SGTC receives subsidy (s) from the government, we have  $\tilde{w}_{PT} < \overline{w} < \hat{w}_{SGTC} + s$ . In this case, we might have (2.2.1) when the SGTC chooses  $\overline{w}$  as its purchase price and (2.2.2) when the SGTC does not choose  $\overline{w}$  as its purchase price.

(2.2.1) When the SGTC chooses  $\overline{w}$  as its purchase price, only the SGTC stays in the market and private trader *i* does not trade ( $\pi_{PT_i} = 0$ ). The SGTC purchases all the rice in the market ( $q_{SGTC} = Q$ ) and its profit equals  $\pi_{SGTC} = (\widehat{w}_{SGTC} + s - \overline{w})q_{SGTC}$ .

(2.2.2) When the SGTC does not choose  $\overline{w}$ , the outcome depends on the game the private traders and the SGTC play, e.g. Cournot, Stackelberg, and price leadership.

(3) When  $\tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}} < \overline{w}$ , we might have (3.1) the SGTC does not receive a subsidy (*s*) from the government and (3.2) the SGTC receives a subsidy from the government.

(3.1) When the SGTC does not receive a subsidy from the government it does not trade at  $\overline{w}$  (3.1.1). However, the SGTC and private traders could still play different games in the market and do not stick to  $\overline{w}$  (3.1.2).

(3.2) When the SGTC receives a subsidy (*s*) from the government, we might have  $\tilde{w}_{PT} < \hat{w}_{SGTC} + s < \overline{w}$  and  $\tilde{w}_{PT} < \overline{w} \le \hat{w}_{SGTC} + s$ . The first case has the same result as (3.1). The latter case has the same result as (2.2).

(ii) When  $\tilde{w}_{pT} > \hat{w}_{SGTC}$ , we might have (4)  $\overline{w} \le \hat{w}_{SGTC} < \tilde{w}_{pT}$ , (5)  $\hat{w}_{SGTC} < \overline{w} \le \tilde{w}_{pT}$ , and (6)  $\tilde{w}_{SGTC} < \tilde{w}_{pT} < \overline{w}$  (Figure 4A.2).

Figure 4A.2 Possible situations when  $\tilde{w}_{PT} > \hat{w}_{SGTC}$ 



(4) When  $\overline{w} \leq \widehat{w}_{SGTC} < \widetilde{w}_{PT}$ , we might have (4.1) the SGTC does not receive a subsidy (*s*) from the government and (4.2) the SGTC receives a subsidy from the government.

(4.1) When the SGTC does not receive a subsidy from the government and we still assume that farm households prefer to sell their rice to private traders, the result of this case is the same as (1.1).

(4.2) When the SGTC receives a subsidy (s) from the government, we have  $\overline{w} < \widehat{w}_{sGTC} + s < \widetilde{w}_{pT}$  and  $\overline{w} < \widetilde{w}_{pT} < \widehat{w}_{sGTC} + s$ . Both cases have the same results as (1.2).

(5) When  $\hat{w}_{SGTC} < \overline{w} \le \tilde{w}_{PT}$ , we might have (5.1) the SGTC does not receive a subsidy (*s*) from the government and (5.2) the SGTC receives a subsidy from the government.

(5.1) When the SGTC does not receive a subsidy from the government, we might have (5.1.1) private traders choose  $\overline{w}$  as their purchase price and (5.1.2) private traders do not stick to  $\overline{w}$ .

(5.1.1) When private traders choose  $\overline{w}$  as their purchase price and (a)  $Q \ge \sum_{i=1}^{n} \overline{q}_{PT_i}$ , private traders purchase rice up to their capacity constraint ( $\overline{q}_{PT_i}$ ). The profit of private trader *i* equals  $\pi_{PT_i} = (\widetilde{w}_{PT} - \overline{w})\overline{q}_{PT_i}$ . Whether farm households sell what is left in the market  $(Q - \sum_{i=1}^{n} \overline{q}_{PT_i})$  to the SGTC or not depends on the price offered by the SGTC. When private traders choose  $\overline{w}$  and (b)  $Q < \sum_{i=1}^{n} \overline{q}_{PT_i}$ , they purchase all the rice supplied and the quantity purchase by private trader *i* equals  $q_{PT_i} = \frac{Q}{n}$ , the profit of private trader *i* is  $\pi_{PT_i} = (\widetilde{w}_{PT} - \overline{w})q_{PT_i}$ . Thus, the SGTC has nothing to purchase ( $q_{SGTC} = 0$ ).

(5.1.2) When private traders do not stick to  $\overline{w}$ , the outcome depends on the game the private traders and the SGTC play, e.g. Cournot, Stackelberg, and price leadership.

(5.2) When the SGTC receives a subsidy (s) from the government, we might have (5.2.1)  $\widehat{w}_{SGTC} + s < \overline{w} \le \widetilde{w}_{PT}$  and (5.2.2)  $\overline{w} \le \widehat{w}_{SGTC} + s < \widetilde{w}_{PT}$  and  $\overline{w} < \widetilde{w}_{PT} < \widehat{w}_{SGTC} + s$ .

(5.2.1) When  $\hat{w}_{\text{SGTC}} + s < \overline{w} \le \widetilde{w}_{\text{PT}}$ , the outcome in this case is the same as the outcome in (5.1).

(5.2.2) When  $\overline{w} \leq \widehat{w}_{SGTC} + s < \widetilde{w}_{PT}$  and  $\overline{w} < \widetilde{w}_{PT} < \widehat{w}_{SGTC} + s$ , the outcome in this case is the same as (1.2).

(6) When  $\tilde{w}_{\text{SGTC}} < \tilde{w}_{\text{PT}} < \overline{w}$ , we might have (6.1) the SGTC does not receive a subsidy (*s*) from the government and (6.2) the SGTC receives a subsidy from the government.

(6.1) When the SGTC does not receive a subsidy from the government, the outcome in this case is the same as the outcome in (3.1).

(6.2) When the SGTC receives a subsidy (s) from the government, we might have (6.2.1)  $\hat{w}_{sGTC} + s < \tilde{w}_{PT} < \overline{w}$  and  $\tilde{w}_{PT} < \hat{w}_{sGTC} + s < \overline{w}$ , and (6.2.2)  $\tilde{w}_{PT} \le \overline{w} < \hat{w}_{sGTC} + s$ .

(6.2.1) When  $\hat{w}_{SGTC} + s < \tilde{w}_{PT} < \overline{w}$  and  $\tilde{w}_{PT} < \hat{w}_{SGTC} + s < \overline{w}$ , the outcome in this case is the same as the outcome in (3.1).

(6.2.2) When  $\tilde{w}_{PT} \leq \overline{w} < \hat{w}_{SGTC} + s$ , the outcome in this case is the same as the outcome in (2.2).

Table 4A.1 gives an overview of all possible outcomes under the protective purchasing.

		(1,1,1) -	Q	$\geq \sum_{i=1}^{n} \overline{q}_{PT_i}$	$q_{_{PTi}}$ = $\pi_{_{PTi}}$	$= \overline{q}_{p_{Ti}}$ = $(\widetilde{w}_{p'})$	$(T - \overline{w})\overline{q}$	PTi	$q_{\rm SGTC} = 0$ $\pi_{\rm SGTC} = 0$	$\begin{aligned} & Q - \sum_{i=1}^{n} \overline{q}_{PTi} \\ & (\widehat{w}_{SGTC} - \overline{w}) q_{SGTC} \end{aligned}$
	$(1.1)_{s=0}$	(1.1.1) = w	Q	$<\sum_{i=1}^{n}\overline{q}_{PTi}$	$\begin{array}{c} q_{PT_{i}} = Q / n \\ \pi_{PT_{i}} = (\widetilde{w}_{PT_{i}} - \overline{w})q_{PT_{i}} \end{array}$		pT:	$q_{\rm SGTC} = 0$ $\pi_{\rm SCTC} = 0$		
(1)		$(1.1.2) \neq \overline{w}$	Со	urnot, S	tackell	berg a	ind pri	ice leadersh	ip.	
(1) $\overline{w} \leq \widetilde{w}_{pT} < \widetilde{w}_{SGTC}$		~		(1.2.1)	$=\overline{w}$	Q≥	$\sum_{i=1}^{n} \overline{q}_{PTi}$	$\begin{aligned} q_{PTi} &= \overline{q}_{PTi} \\ \pi_{PTi} &= (\widetilde{w}_{PT}) \end{aligned}$	$-\overline{w})\overline{q}_{pTi}$	$q_{\text{SGTC}} = Q - \sum_{i=1}^{n} \overline{q}_{\text{PTi}}$ $\pi_{\text{SGTC}} = (\widehat{w}_{\text{SGTC}} + s - \overline{w})q_{\text{SGTC}}$
	(1.2) s > 0	$w < w_{pT} \le w_{SGTC}$	+ s	(1 2 2)		Q <	$\sum_{i=1}^{n} \overline{q}_{PTi}$	$q_{PT_i} = Q / n$ $\pi_{PT_i} = (\tilde{w}_{PT})$	$-\overline{w})q_{PT_i}$	$q_{\text{SGTC}} = 0$ $\pi_{\text{SGTC}} = 0$
				(1.2.2)	≠w	Cot	irnot,	Stackelberg	and pric	e leadership.
	(2.1) $s = 0$	$(2.1.1) = \overline{w}$	$q_{_{PTi}}$ $\pi_{_{PT}}$	= 0 = 0					$q_{\rm SGTC} = q$ $\pi_{\rm SGTC} = q$	$(\widehat{w}_{\text{SGTC}} - \overline{w})q_{\text{SGTC}}$
(2) $\widetilde{w}_{w} < \overline{w} \leq \widehat{w}_{w}$		$(2.1.2) \neq \overline{w}$	Co	urnot, S	tackell	berg a	ınd pri	ice leadersh	ip.	
PI SGIC	$(2.2)_{s>0}$	$\widetilde{w}_{_{PT}} < \overline{w} \leq \widehat{w}_{_{\rm SGTC}}$	+ s	(2.	2.1)=	w	$q_{PTi} =$ $\pi_{PTi} =$	0 = 0	$q_{\rm SGTC} = Q$ $\pi_{\rm SGTC} = Q$	Q $(\hat{w}_{\text{SGTC}} + s - \overline{w})q_{\text{SGTC}}$
				(2.	2.2)≠	w	Cour	not, Stacke	lberg and	l price leadership.
	$(3.1)_{s=0}$	$(3.1.1) = \overline{w}$	$q_{PTi}$ $\pi_{PT}$	= 0 = 0					$q_{SGTC} = 0$ $\pi_{SGTC} = 0$	0
		$(3.1.2) \neq \overline{w}$ Cournot, Stackelberg and price leadership.								
$(3) \tilde{w}_{_{PT}} < \hat{w}_{_{SGTC}} < \overline{w}$	(3.2) s > 0	$(3.2.1)$ $\widetilde{w}_{_{PT}} < \widehat{w}_{_{SGTC}} + s < 0$	$\begin{array}{l} (3.2.1)\\ \widetilde{w}_{_{PT}} < \widehat{w}_{_{SGTC}} + s < \overline{w} \end{array} \tag{3.1}$					-		
		$(3.2.2) \\ \widetilde{w}_{_{PT}} < \overline{w} \le \widehat{w}_{_{SGTC}} + s $ $(2.2)$								
	$(4.1) \ s = 0$	(1.1)								
$(4)\overline{w} \leq \widehat{w}_{\rm SGTC} < \widetilde{w}_{\rm PT}$	(4.2) s > 0	$\overline{w} < \widehat{w}_{\text{SGTC}} + s < \overline{w}_{\text{SGTC}}$ $\overline{w} < \widetilde{w}_{\text{PT}} < \widehat{w}_{\text{SGTC}}$	$\tilde{w}_{pT} \otimes \frac{1}{2} + s$	(1.	2)					
		(5.1.1)	Q≥	$\sum_{i=1}^{n} \overline{q}_{PTi}$	$q_{_{PTi}}$ = $\pi_{_{PTi}}$	$= \overline{q}_{PTi}$ $= (\widetilde{w}_{P}$	$_T - \overline{w})\overline{c}$	$\bar{a}_{PTi}$	It depei	nds
	(5.1) s = 0	$(5.1.1) = \overline{w}$	Q <	$Q < \sum_{i=1}^{n} \overline{q}_{PTi} \qquad \begin{array}{c} q_{PT} \\ \pi_{p} \end{array}$		$p_{Ti} = Q / n$ $p_{Ti} = (\widetilde{w}_{pT} - \overline{w})q_{pTi}$		$q_{\rm SGTC} = 0$ $\pi_{\rm SGTC} = 0$		
(5) $\widehat{w}_{SGTC} < \overline{w} \le \widetilde{w}_{PT}$		$(5.1.2) \neq \overline{w}$								
		$(5.2.1)_{\widehat{w}_{SGTC} + s}$	$< \overline{w} \le$	$\leq \tilde{w}_{_{PT}}$ (5.	1)					
	$(52) \rightarrow 0$	(5.2.2)								
	(5.2) \$ > 0	$\overline{w} \leq \widehat{w}_{_{\rm SGTC}} + s < \\ \overline{w} < \widetilde{w}_{_{PT}} < \widehat{w}_{_{\rm SGTC}}$	$\widetilde{w}_{PT} \otimes + s$	× (1.	.2)					
	$(6.1)_{s=0}$	(3.1)		ľ						
(6) $\hat{w}_{vare} < \tilde{w}_{pr} < \overline{w}$		$(6.2.1)$ $\widehat{w}_{\text{SGTC}} + s < \widetilde{w}_{pT}$	$<\overline{w}$ (	& (3.	.1)					
301C FI	$(6.2)_{s>0}$	$\widetilde{w}_{_{PT}} < \widehat{w}_{_{SGTC}} + s$	$<\overline{w}$							
		$(6.2.2)$ $\widetilde{w}_{pT} \le \overline{w} < \widehat{w}_{SGTC}$	+ s	(2.	.2)					

Table 4A.1Possible outcomes under the protective purchasing

### Appendix 4B Elasticities

Summarizing all the elasticities specified in Section 4.4, we have:

- (1) price elasticity that intermediate *i* faces in Banqiao and Shangzhu (Cournot competition):  $\varepsilon_i = \frac{\partial Q}{\partial w} \frac{w}{q_i}$ .
- (2) price elasticity that private trader *i* faces in Gangyan (Cournot competition):  $\varepsilon_{pT_i} = \frac{\partial q_{pT}}{\partial w_{pT}} \frac{w_{pT}}{q_{pT_i}}$ .
- (3) price elasticity that the SGTC faces in Gangyan (monopsony):  $\mathcal{E}_{SGTC} = \frac{\partial q_{SGTC}}{\partial w_{SGTC}} \frac{w_{SGTC}}{q_{SGTC}}$ .
- (4) cross price elasticity of rice supply to private traders in Gangyan:  $\mathcal{E}_{SGTC}^{PT} = \frac{\partial q_{PT}}{\partial w_{SGTC}} \frac{w_{SGTC}}{q_{PT}}$ .
- (5) inverse elasticity of supply to the SGTC with respect to the total marketable rice supply in Gangyan:  $\mathcal{E}_{SGTC}^{Q} = \frac{\partial Q}{\partial q_{SGTC}} \frac{q_{SGTC}}{Q}$ .
- (6) inverse elasticity of supply to the private intermediates with respect to the total marketable rice supply in Gangyan:  $\mathcal{E}_{PT}^{Q} = \frac{\partial Q}{\partial q_{PT}} \frac{q_{PT}}{Q}$ .

This appendix shows how the elasticities are derived. The equations listed above indicate that the values of  $\frac{\partial Q}{\partial w}$ ,  $\frac{\partial q_{PT}}{\partial w_{FT}}$ ,  $\frac{\partial q_{SGTC}}{\partial w_{SGTC}}$ ,  $\frac{\partial q_{PT}}{\partial w_{SGTC}}$ ,  $\frac{\partial Q}{\partial q_{SGTC}}$ , and  $\frac{\partial Q}{\partial q_{PT}}$  are needed for elasticity calculation. Hence, Section 4B.1 shows how to derive these values in theory. Following Section 4B.1, Section 4B.2 provides the empirical model. Section 4B.3 describes data used in the estimation and how the empirical model is estimated. Estimation results are listed and briefly discussed in Section 4B.4. Substituting the estimation results and other data such as trading quantity and price of the SGTC or the private trader(s) into the elasticity equations, the elasticities are calculated and presented in Section 4B.5.

#### 4B.1 Theoretical model

#### Marketable rice supply

Marketable rice supply equals actual production (plus possible stocks) minus taxes paid, and minus rice consumed (or stored). We do not model production but just the marketable supply decision. This makes the model a short-term model. Farmers face the decision whether to supply the harvested rice (plus stocks) to the market or to consume it themselves (Sicular, 1995). With higher market prices (farm price) less is consumed and more supplied (Ghatak and Seale, 2001) because opportunity costs of consumption have increased. This marketable supply will be modeled using a simple household production model (see Varian, 1992: 341). This model is discussed next.

The indirect utility function gives utility of farm household h as a function of prices of commodities and factor inputs and full income<sup>46</sup>. The indirect utility function is given by:

$$v(w.m + E, w) = \max\{U(x) : w.x = w.m + E\}$$
(4B1)

where v(.) is indirect utility function,  $U(\mathbf{x})$  is direct utility function,  $\mathbf{w}$  is vector of commodity and factor prices,  $\mathbf{m}$  is vector of endowments of commodities (e.g. rice) and factor inputs, E is external income and  $\mathbf{x}$  is vector of demanded commodities and factor inputs. Using Roy's identity, the Marshallian or uncompensated demand function of commodity or factor input j ( $\forall j = 1,...,k$ )  $x_j(Y,\mathbf{w})$  can be derived, where  $Y = \mathbf{w}.\mathbf{m} + E$  equals endowment income plus external income. Net demand (demand minus endowment) for commodity or factor input  $j(m_j(Y,\mathbf{w}))$  is given by:

$$x_i^n(\mathbf{Y}, \mathbf{w}) = x_i(\mathbf{Y}, \mathbf{w}) - m_i \tag{4B2}$$

where: Y is endowment income plus external income,  $x_j^n$  is net demand for commodity or factor input j,  $x_i$  is uncompensated demand for commodity or factor input j,  $m_j$  is endowment of commodity or factor input j.

If net demand for a commodity (e.g. rice) or factor input (e.g. labor, land and capital) is negative the household supplies the commodity or factor inputs. So equation (4B2) gives the marketable supply of rice as a function of production level (including stocks), prices and income.

## Price elasticities of Banqiao and Shangzhu

According to equation (4B2), in 2000, rice production of farm households (endowment of rice)<sup>47</sup> in Banqiao and Shangzhu was allocated between marketable rice supply to the intermediates (net demand of rice), rice consumption (uncompensated demand for rice), and agricultural tax<sup>48</sup>:

$$x = x_{c}(Y, \mathbf{w}) + x_{s}(Y, \mathbf{w}) + x_{T}$$
(4B3)

where x is rice output,  $x_c$  is rice consumption of farm household,  $x_s$  is marketable supply to intermediates, and  $x_T$  is agricultural tax. The agricultural tax accounts a fixed percentage of farm households' rice production and is paid to the SGTC in the form of rice. We assume it is constant. Since it is a short-term model, we assume rice output to be constant. w is farm price of rice. Y is income of farm households (endowment income plus external income<sup>49</sup>), which is defined as the value of rice endowment (output), the value of endowment of other products (e.g. other crops and livestock), and external income<sup>50</sup>. We assume the value

 $<sup>^{46}</sup>$  For readability and simplicity, we omit the subscription for farm households ( h ) in equations hereafter.

<sup>&</sup>lt;sup>47</sup> For simplicity, we assume rice stocks to be zero. The same holds for Gangyan.

 $<sup>^{\</sup>rm 48}$  We omit the subscript for rice hereafter to improve readability.

<sup>&</sup>lt;sup>49</sup> The external income consists of remittances, government subsidy, and village assistance (money borrowed from other households in the village).

<sup>&</sup>lt;sup>50</sup> According to Becker (1965), household full income equals the value of its time endowment, plus the value of farm profit and any other non-labor income. However, we could not obtain the shadow wage of each household. Therefore, we do not include the value of inputs in our full income equation.

of other agricultural products exogenous and external income to be exogenous. Therefore, the income of farm household can be written as:

$$Y = Y_{rice} + Y_{other} + E \tag{4B4}$$

where  $Y_{rice}$  is the value of rice endowment,  $Y_{other}$  is the value of endowment of other products, *E* is external income.

And the value of rice output can be written as:

$$Y_{rice} = w(x_{C} + x_{S} + x_{T}) = wx$$
(4B5)

where w is farm price of rice, x is rice output. From equation (4B3), we have:

$$x_{s}(Y, \mathbf{w}) = x - x_{c}(Y, \mathbf{w}) - x_{T}$$
(4B6)

Differentiating equation (4B6) with respect to farm price of rice (w), we derive:

$$\frac{\partial x_{\rm s}}{\partial w} = -\frac{\partial x_{\rm c}}{\partial w} - \frac{\partial x_{\rm c}}{\partial Y} \frac{\partial Y}{\partial w}$$
(4B7)

Differentiating equation (4B4) with respect to farm price of rice (w), we derive:

$$\frac{\partial Y}{\partial w} = \frac{\partial Y}{\partial Y_{rice}} \frac{\partial Y_{rice}}{\partial w} = x \tag{4B8}$$

Substituting equation (4B8) into equation (4B7), we get:

$$\frac{\partial x_{\rm s}}{\partial w} = -\frac{\partial x_{\rm c}}{\partial w} - \frac{\partial x_{\rm c}}{\partial Y} x \tag{4B9}$$

Equation (4B9) depicts the effects of changes in price on rice supply of a farm household. Assuming there are *m* farm households in a village, i.e.  $Q = m \cdot x_s^{51}$ , we therefore have:

$$\frac{\partial Q}{\partial w} = m \cdot \frac{\partial x_s}{\partial w} \tag{4B10}$$

where m is the number of farm households in a village.

Therefore, the price elasticity that intermediate *i* faces can be written as:

$$\mathcal{E}_{i} = \frac{\partial Q}{\partial w} \frac{w}{q_{i}} = -m \cdot \left(\frac{\partial x_{c}}{\partial w} + \frac{\partial x_{c}}{\partial Y}x\right) \cdot \frac{w}{q_{i}}$$
(4B11)

where  $q_i$  is rice demand of intermediate *i*.

#### Price elasticities of Gangyan

In 2000, rice production of farm households (endowment of rice) in Gangyan was allocated between marketable supply to the SGTC, rice consumption (uncompensated demand for rice),

<sup>&</sup>lt;sup>51</sup> In theory, Q should equal to  $\sum_{i=1}^{m} x_{i}$ . However, we assume the quantity supplied per farm household equal. So, we have  $Q = m \cdot x_s$ .

marketable supply to private traders (net demand of rice), and agricultural tax. Therefore, we have:

$$x = x_{\rm C}(Y, \mathbf{w}) + x_{\rm SGTC}(Y, \mathbf{w}) + x_{\rm PT}(Y, \mathbf{w}) + x_{\rm T}$$
(4B12)

where  $x_{SGTC}$  is marketable supply to the SGTC,  $x_{PT}$  is marketable supply to private traders. Y is income of farm households, which is defined as the value of rice, the value of other agricultural products, and external income. We assume the value of other agricultural products and external income to be exogenous. We assume that the shadow price of rice consumed by the farm household equals the farm price offered by private traders. The shadow price of rice paid as agricultural tax is assumed equal to the farm price offered by the SGTC. Thus, the income of farm households can be written as:

$$Y = Y_{rice} + Y_{other} + E \tag{4B13}$$

The value of rice output equals:

$$Y_{rice} = w_{PT} x_{C} + w_{SGTC} x_{SGTC} + w_{PT} x_{PT} + w_{SGTC} x_{T}$$
(4B14)

From equation (4B12), we get:

$$x_{\text{SGTC}}(Y, \mathbf{w}) = x - x_{\text{C}}(Y, \mathbf{w}) - x_{\text{PT}}(Y, \mathbf{w}) - x_{\text{T}}$$
(4B15)

$$x_{PT}(Y, \mathbf{w}) = x - x_{C}(Y, \mathbf{w}) - x_{SGTC}(Y, \mathbf{w}) - x_{T}$$
 (4B16)

Differentiating equation (4B15) with respect to  $w_{\text{SGTC}}$ , and equation (4B16) with respect to  $w_{\text{PT}}$  and  $w_{\text{SGTC}}$  respectively, we derive:

$$\frac{\partial x_{\text{SGTC}}}{\partial w_{\text{SGTC}}} = -\left(\frac{\partial x_{\text{C}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{C}}}{\partial Y}\frac{\partial Y}{\partial w_{\text{SGTC}}}\right) - \left(\frac{\partial x_{\text{PT}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{PT}}}{\partial Y}\frac{\partial Y}{\partial w_{\text{SGTC}}}\right)$$
(4B17)

$$\frac{\partial x_{PT}}{\partial w_{PT}} = -\left(\frac{\partial x_{C}}{\partial w_{PT}} + \frac{\partial x_{C}}{\partial Y}\frac{\partial Y}{\partial w_{PT}}\right) - \left(\frac{\partial x_{SGTC}}{\partial w_{PT}} + \frac{\partial x_{SGTC}}{\partial Y}\frac{\partial Y}{\partial w_{PT}}\right)$$
(4B18)

$$\frac{\partial x_{\rm PT}}{\partial w_{\rm SGTC}} = -\left(\frac{\partial x_{\rm C}}{\partial w_{\rm SGTC}} + \frac{\partial x_{\rm C}}{\partial Y}\frac{\partial Y}{\partial w_{\rm SGTC}}\right) - \left(\frac{\partial x_{\rm SGTC}}{\partial w_{\rm SGTC}} + \frac{\partial x_{\rm SGTC}}{\partial Y}\frac{\partial Y}{\partial w_{\rm SGTC}}\right)$$
(4B19)

Differentiating equation (4B14) with respect to  $w_{PT}$  and  $w_{SGTC}$  respectively, we have:

$$\frac{\partial Y}{\partial w_{\text{SGTC}}} = \frac{\partial Y}{\partial Y_{\text{rice}}} \frac{\partial Y_{\text{rice}}}{\partial w_{\text{SGTC}}} = x_{\text{SGTC}} + x_{\text{T}}$$
(4B20)

$$\frac{\partial Y}{\partial w_{_{PT}}} = \frac{\partial Y}{\partial Y_{_{rice}}} \frac{\partial Y_{_{rice}}}{\partial w_{_{PT}}} = x_{_{PT}} + x_{_{C}}$$
(4B21)

Substituting equation (4B20) and (4B21) into equation (4B17)-(4B19), we have:

$$\frac{\partial x_{\text{SGTC}}}{\partial w_{\text{SGTC}}} = -\left(\frac{\partial x_{\text{C}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{C}}}{\partial Y}(x_{\text{SGTC}} + x_{\text{T}})\right) - \left(\frac{\partial x_{\text{PT}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{PT}}}{\partial Y}(x_{\text{SGTC}} + x_{\text{T}})\right)$$
(4B22)

$$\frac{\partial x_{PT}}{\partial w_{PT}} = -\left(\frac{\partial x_{C}}{\partial w_{PT}} + \frac{\partial x_{C}}{\partial Y}(x_{PT} + x_{C})\right) - \left(\frac{\partial x_{SGTC}}{\partial w_{PT}} + \frac{\partial x_{SGTC}}{\partial Y}(x_{PT} + x_{C})\right)$$
(4B23)

$$\frac{\partial x_{PT}}{\partial w_{SGTC}} = -\left(\frac{\partial x_{C}}{\partial w_{SGTC}} + \frac{\partial x_{C}}{\partial Y}(x_{SGTC} + x_{T})\right) - \left(\frac{\partial x_{SGTC}}{\partial w_{SGTC}} + \frac{\partial x_{SGTC}}{\partial Y}(x_{SGTC} + x_{T})\right)$$
(4B24)

Since  $q_{\text{SGTC}} = m \cdot x_{\text{SGTC}}$ , we have:

$$\frac{\partial q_{\rm SGTC}}{\partial w_{\rm SGTC}} = m \cdot \frac{\partial x_{\rm SGTC}}{\partial w_{\rm SGTC}}$$
(4B25)

Therefore, the price elasticity that the SGTC faces can be written as:

$$\mathcal{E}_{\text{SGTC}} = \frac{\partial q_{\text{SGTC}}}{\partial w_{\text{SGTC}}} \frac{w_{\text{SGTC}}}{q_{\text{SGTC}}} = m \cdot \frac{\partial x_{\text{SGTC}}}{\partial w_{\text{SGTC}}} \frac{w_{\text{SGTC}}}{m \cdot x_{\text{SGTC}}}$$

$$= \left(-\left(\frac{\partial x_{\text{C}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{PT}}}{\partial w_{\text{SGTC}}}\right) - \left(x_{\text{SGTC}} + x_{\text{T}}\right)\left(\frac{\partial x_{\text{C}}}{\partial Y} + \frac{\partial x_{\text{PT}}}{\partial Y}\right)\right) \frac{w_{\text{SGTC}}}{x_{\text{SGTC}}}$$
(4B26)

Since  $q_{PT} = m \cdot x_{PT}$ , we have:

$$\frac{\partial q_{PT}}{\partial w_{PT}} = \frac{\partial m \cdot x_{PT}}{\partial w_{PT}} = m \cdot \frac{\partial x_{PT}}{\partial w_{PT}}$$
(4B27)

$$\frac{\partial q_{PT}}{\partial w_{SGTC}} = \frac{\partial m \cdot x_{PT}}{\partial w_{SGTC}} = m \cdot \frac{\partial x_{PT}}{\partial w_{SGTC}}$$
(4B28)

The price elasticity of supply to private traders can be written as:

$$\mathcal{E}_{PT_{i}} = \frac{\partial q_{PT}}{\partial w_{PT}} \frac{w_{PT}}{q_{PT_{i}}} = m \cdot \frac{\partial x_{PT}}{\partial w_{PT}} \frac{w_{PT}}{q_{PT_{i}}}$$

$$= \left(-\left(\frac{\partial x_{C}}{\partial w_{PT}} + \frac{\partial x_{SGTC}}{\partial w_{PT}}\right) - \left(x_{PT} + x_{C}\right)\left(\frac{\partial x_{C}}{\partial Y} + \frac{\partial x_{SGTC}}{\partial Y}\right)\right) \cdot m \cdot \frac{w_{PT}}{q_{PT_{i}}}$$
(4B29)

where  $q_{PTi}$  is rice demand of private trader *i*.

The cross price elasticity of supply to private traders can be written as:

$$\mathcal{E}_{\text{SGTC}}^{PT} = \frac{\partial q_{\text{PT}}}{\partial w_{\text{SGTC}}} \frac{w_{\text{SGTC}}}{q_{\text{PT}}} = m \cdot \frac{\partial x_{\text{PT}}}{\partial w_{\text{SGTC}}} \frac{w_{\text{SGTC}}}{m \cdot x_{\text{PT}}}$$

$$= (-(\frac{\partial x_{\text{C}}}{\partial w_{\text{SGTC}}} + \frac{\partial x_{\text{SGTC}}}{\partial w_{\text{SGTC}}}) - (x_{\text{SGTC}} + x_{\text{T}})(\frac{\partial x_{\text{C}}}{\partial Y} + \frac{\partial x_{\text{SGTC}}}{\partial Y})) \frac{w_{\text{SGTC}}}{x_{\text{PT}}}$$
(4B30)

#### Other elasticities of supply in Gangyan

Since farm households make decisions between rice consumption and rice supply, we assume total rice supply of farm household *h* is a function of its rice consumption and rice supplied to the SGTC, i.e.  $x_s = x_s(x_c, x_{sGTC})$ ; and a function of its rice consumption and rice supplied to private traders, i.e.  $x_s = x_s(x_c, x_{PT})$ . Therefore, the elasticities of supply to the intermediates with respect to the total marketable rice supply can be written as:

$$\varepsilon_{Q}^{SGTC} = \frac{\partial q_{SGTC}}{\partial Q} \frac{Q}{q_{SGTC}} = 1 / (\frac{\partial x_{s}}{\partial x_{SGTC}} \frac{x_{SGTC}}{x_{s}})$$
(4B31)

$$\mathcal{E}_{PT}^{Q} = \frac{\partial q_{PT}}{\partial Q} \frac{Q}{q_{PT}} = 1 / (\frac{\partial x_{s}}{\partial x_{PT}} \frac{x_{PT}}{x_{s}})$$
(4B32)

#### 4B.2 Empirical model

#### Banqiao and Shangzhu

In order to derive the price elasticity of supply, we need to estimate the equation of rice consumption of farm households. We assume a linear expression for this rice consumption equation. The econometric specification of rice consumption equation is as follows:

$$x_{\rm c} = \alpha_{11} + \alpha_{12}w + \alpha_{13}Y + \alpha_{14}N + \alpha_{15}A + e_{11}$$
(4B33)

where w is farm price of rice, Y is income of farm households, N is the number of family members, A is planted area of rice. We include the size of farm household (N) since a farm household with more members consumes more rice. The planted area of rice (A) is assumed to have a positive correlation with rice consumption of farm household, e.g. when a farm household has larger planted area of rice, it consumes more rice.  $e_{11}$  is error term.

Gangyan

In order to derive the price elasticity of supply with respect to the SGTC and private traders, we need to estimate the equations of rice consumption, rice sold to the SGTCs, and rice sold to private traders. We assume linear expressions for equations of rice consumption, rice sold to the SGTCs, and rice sold to private traders. The econometric specifications of three equations are as follows:

$$x_{\rm C} = \alpha_{21} + \alpha_{22} w_{\rm SGTC} + \alpha_{23} w_{\rm PT} + \alpha_{24} Y + \alpha_{25} N + \alpha_{26} A + e_{21}$$
(4B34)

$$x_{\rm SGTC} = \alpha_{31} + \alpha_{32} w_{\rm SGTC} + \alpha_{33} w_{\rm PT} + \alpha_{34} Y + e_{31}$$
(4B35)

$$x_{\rm PT} = \alpha_{41} + \alpha_{42} w_{\rm SGTC} + \alpha_{43} w_{\rm PT} + \alpha_{44} Y + e_{41}$$
(4B36)

where  $e_{21}$ ,  $e_{31}$ , and  $e_{41}$  are error terms.

As mentioned in Section 4.3.2, we need to estimate relations between total rice supplied and rice supplied to the SGTC and private traders, respectively. We assume linear expressions for these two equations:

$$x_{\rm s} = \beta_{11} + \beta_{12} x_{\rm c} + \beta_{13} x_{\rm SGTC} + e_{51}$$
(4B37)

$$x_{\rm s} = \beta_{21} + \beta_{22} x_{\rm C} + \beta_{23} x_{\rm PT} + e_{61} \tag{4B38}$$

where  $e_{51}$  and  $e_{61}$  are error terms.

#### 4B.3 Data and Estimation

The model is estimated using data from SERENA project (Kuiper et. al., 2001). Surveys at household level were conducted in three villages in Jiangxi Province. Questionnaires were focused on demographic characteristics, land structure, production and consumption activities, and off-farm employment of farm households. Three hundred and thirty-two households were selected randomly in the survey, among which 56 households in Banqiao, 107 households in Shangzhu, and 168 households in Gangyan. They account for 20% of all households residing in the three villages. The data cover the year of 2000.

Three types of rice are cultivated in the study area, namely early rice, late rice, and oneseason rice. Since we assume that rice is a homogeneous product in our theoretical model, we use weighted average prices. The full income of farm households is the sum of the value of rice production, the value of other agricultural products (e.g. vegetables, cattle, and pig), and external income (e.g. remittances, government subsidies, and village assistance from outside the villages with no interest or other obligations attached). The number of family members is defined as the members who stay at home most time of the year. The planted area of rice is defined as the actual sown area of rice.

Equations (4B33)-(4B36) should be homogeneous of degree zero. This can be derived by normalization of farm prices of rice (w,  $w_{SGTC}$ , and  $w_{PT}$ ) and prices of other goods produced and consumed. However we lack good deflators. Choosing one deflator does not affect relative prices. We therefore leave all the prices as they are. The variables of prices (w,  $w_{SGTC}$ , and  $w_{PT}$ ) and income (Y) are scaled down by 1000 to simplify estimation and simulations.

Equation (4B33), (4B37) and (4B38) are estimated using Ordinary Least Square. According to equation (4B14), the value of rice output is endogenous due to endogenous variables  $x_{SGTC}$  and  $x_{PT}$ . Therefore, the income of farm households in Gangyan is also endogenous. Hence, we estimate equations (4B34)-(4B36) in two steps. First we regress income on a series of independent variables. The reduced form looks like:

$$Y = \lambda_{11} + \lambda_{12}w_{SGTC} + \lambda_{13}w_{PT} + \lambda_{14}Y_{other} + \lambda_{15}E + \lambda_{16}A + e_{71}$$
(4B39)

where  $e_{71}$  is error term. Then we substitute the predicted value of full income ( $\hat{Y}$ ) for the endogenous variable (Y) in equations (4B34)-(4B36). We assume that the error terms of equations (4B34), (4B35), and (4B36) are correlated and therefore apply Seemingly Unrelated Regressions (SUR).

#### 4B.4 Estimation results

Table 4B.1 presents the estimated coefficients of equations (4B33)-(4B36). We see that in Banqiao and Shangzhu, farm price has a significant negative effect on rice consumption of farm households. Income has a significant positive effect on rice consumption only for farm households in Shangzhu. This might be caused by the relative large proportion of value of rice output to the full income. Results show that farm households with larger rice planting area

consume more rice. Family size of farm households has a significant positive effect on rice consumption in Banqiao.

In Gangyan, we see that farm prices offered by the SGTC and private traders both have a significant negative effect on rice consumption. The farm price offered by the SGTC has significant positive effect on rice supplied to the SGTC. The farm price offered by private traders has a significant positive effect on rice supplied to private traders. Income has a significant positive effect on rice consumption and rice supplied to the intermediates.

	constant	w	w <sub>SGTC</sub>	w <sub>PT</sub>	Y	N	А	$DF^a$	$R^2$
Rice consumption Banqiao (OLS)	0.919* (0.401) <sup>b</sup>	-0.812* (0.439)			0.032 (0.034)	0.154* (0.087)	1.219* (0.471)	56	0.387
Rice consumption Shangzhu (OLS)	0.258* (0.132)	-0.269* (0.084)			0.023* (0.012)	-0.027 (0.028)	3.018* (0.219)	102	0.715
Rice consumption Gangyan (SUR)	0.750* (0.242)		-0.276* (0.149)	-0.421* (0.162)	0.027* (0.014)	0.072 (0.048)	2.286* (0.154)	166	0.469
Rice supply to SGTC Gangyan (SUR)	-0.083 (0.071)		0.740* (0.063)	-0.010 (0.063)	0.009* (0.005)			166	0.471
Rice supply to Private Trader Gangyan (SUR)	-0.563* (0.259)		-0.193 (0.227)	1.490* (0.227)	0.076* (0.019)			166	0.299

Table 4B.1 Estimated coefficients of equations (4B33)-(4B36)

*a* DF: degrees of freedom.

*b* Standard errors in parentheses.

\* Significant at 10% level.

Note: For readability, price and income variables are scaled down by 1000.

Table 4B.2 presents the estimated coefficients of equation (4B37) and (4B38). We see that both rice supply to the SGTC ( $x_{SGTC}$ ) and rice supply to private traders have significant positive effects on total rice supplied in Gangyan. Notice that rice consumption has a significant positive effect only in equation (4B37), which indicates a stronger correlation between rice supply to private traders ( $x_{PT}$ ) and total rice supply ( $x_s$ ).

	constant	x <sub>C</sub>	x <sub>SGTC</sub>	x <sub>PT</sub>	$DF^{lpha}$	$R^2$
Total rice supply	-0.103 (0.267) <sup>b</sup>	0.485* (0.093)	1.187* (0.228)		161	0.256
Total rice supply	-0.095 (0.065)	0.015 (0.023)		1.040* (0.018)	159	0.960

Table 4B.2 Estimated coefficients of equations (4B37) and (4B38)

*a* DF: degrees of freedom.

*b* Standard errors in parentheses.

\* Significant at 10% level.

### 4B.5 Elasticities

We substitute the correspondent coefficients in Table 4B.1 and Table 4B.2 into equations (4B11), (4B26), (4B29), and (4B30), using data presented in Tables 4B.3 and 4B.4, the elasticities in Banqiao, Shangzhu and Gangyan can be derived.

Table 4B.3 Weighted average per farm household of the rice quantities supplied and demanded, prices, and income (quantities in tons, prices in Yuan/ton and income in Yuan)

Variables	Banqiao	Shangzhu	Variables	Gangyan	
x	6.60	2.84	x	8.79	
$x_{\mathrm{S}}$	3.32	0.78	x <sub>SGTC</sub>	1.45	
			$x_{PT}$	3.60	
$x_{ m C}$	2.94	1.89	$x_{ m C}$	3.20	
$x_T$	0.34	0.17	$x_T$	0.54	
w	1072.93	977.06	WSGTC	1068.43	
			$w_{PT}$	1024.43	
Y	11307.09	6504.16	Y	13837.04	

Table 4B.4 Number of farm households and rice demand of private trader i in the three villages (Unit: ton)

	Banqiao	Shangzhu	Gangyan
m	257	529	721
$q_i$	4.64	3.13	8.42

Table 4B.5 Calculated elasticities
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Banqiao S	Shangzhu	Gangyan					
$\mathcal{E}_{i}$	${\cal E}_i$	$\varepsilon_{PTi}$	$\varepsilon_{_{ m SGTC}}$	$arepsilon_{ m SGTC}^{ m PT}$	$\varepsilon_{\rm Q}^{\rm SGTC}$	$arepsilon_{ m Q}^{ m PT}$	
38.666	33.764	34.148	0.275	-0.127	2.941	1.348	

As assumed in Section 4.3.2, the cross price elasticity of rice supply to private traders  $(\varepsilon_{\text{SGTC}}^{pT})$  has a negative sign.  $\varepsilon_{Q}^{\text{SGTC}}$  is more than  $\varepsilon_{Q}^{pT}$  indicates rice supplied to the SGTC is more responsive than rice supplied to private traders to total rice supply. In Table 4B.5, the intermediates in Banqiao face a higher price elasticity than the intermediates in Shangzhu, which indicates that the intermediates in Banqiao possess less market power. According to equations (4B26), (4B29), and (4B30), the large difference between the price elasticity an individual private trader faces and the price elasticity the SGTC faces is due to the number of the households in Gangyan, i.e. *m*. Intuitively, the SGTC is supposed to possess large market power in the temporary monopsony period. However, this market power is counter-balanced by the negative effects of the entrance of the private trades in the following period on the rice supplied to the SGTC from the farm households (see equation 4.14). The large price elasticity a private trader faces implies limited market power due to Cournot competition in the second stage.

# 5 QUANTITY LEADERSHIP AND PRICE LEADERSHIP COMPETITION

#### 5.1 Introduction

In Chapter 4, a model of protective purchasing in 2000-03 was developed. The actual situation of the rice purchase market in the three villages described in Chapter 3 (i.e. price fixed by the government  $\overline{w}$  was higher than  $\hat{w}_{sGTC}$  and  $\tilde{w}_{PT}$ , the SGTCs receive no subsidy, and neither SGTCs nor private traders choose  $\overline{w}$  as their purchase price) narrowed us down to outcomes of imperfect competition (case 3.1.2). Possible outcomes of case 3.1.2 were that neither the SGTCs nor the private traders applied the price fixed by the government and they may play Cournot, price leadership or quantity leadership competition. Chapter 4 modeled three types of competition, i.e. a short period of state monopsony after rice harvest, oligopsony (the most likely situation in the period after 2000), and perfect competition (from 2003 on). In the case of oligopsony, we modeled Cournot competition, in which the SGTC and private traders determine simultaneously the quantity they want to purchase. This chapter is a continuation of the analysis in Chapter 4. As mentioned in Chapter 3 the SGTCs have better market information because they have access to the marketing information system provided by the government. However, private traders could only access the marketing information system after paying a relatively high fee. The advantage on marketing information had made it possible for the SGTCs to act as a leader in the market. Therefore, this chapter analyzes other possible competitions that the SGTCs and the private traders might play, i.e. quantity leadership and price leadership competition.

As the continuation of the previous chapter, the aim of this chapter is identical to the second aim of Chapter 4, i.e. to analyze the effects of market deregulation and liberalization on farm households under a system of protective purchasing.

Being possible outcomes, the theoretical models of quantity leadership, price leadership, and perfect competition are discussed in Section 5.2. Section 5.3 describes the empirical model and data, simulation results are discussed in Section 5.4. Section 5.5 provides a general discussion and conclusions.

#### 5.2 Theoretical model

This section presents some of the alternative competitions between the SGTC and private traders in the rice purchase market (see case 3.1.2). In Chapter 4 we assumed Cournot competition in Banqiao and Shangzhu and a two-stage (monopsony and Cournot) competition in Gangyan. Cournot competition is a simultaneous game. We assumed that both the SGTC

and private traders choose the quantities they want to purchase at the same time given each other's choice. In this chapter, we look at sequential games where players move one after another (Tirole, 1988; Varian, 1992; Deneckere and Kovenock, 1992), i.e. quantity leadership competition (Stackelberg) and price leadership competition (a dominant-firm model). For simplicity, we do not assume the short period monopsony of the SGTC in Gangyan.

## 5.2.1 Oligopsony in 2000

In Chapter 4 it has been discussed that China's grain market liberalization led to the participation of private traders in the grain purchase market. In 2000 the number of private traders is limited due to the size of the market, the degree of market access and possible entry barriers such as search and information costs, networking costs (for private traders) and overhead costs (for the SGTC). Therefore, we assume that there are n private traders in the market. Since we assumed that private traders and the SGTC have the same marginal other costs in Chapter 4, for consistency the same assumptions also applies in this Chapter, i.e.

 $c_{PTi} = c_{SGTC}$ .

# Quantity leadership (Stackelberg model)

The quantity leadership model is a sequential game. With Stackelberg competition, the leader knows how the follower will react if he sets a quantity and his decision is irreversible – he cannot undo his commitment (Tirole, 1988: 315). Being the first mover, the leader takes advantage of choosing the 'optimal' point on the follower's reaction curve (Varian, 1992: 297). Therefore, in Stackelberg competition, leadership is preferred. According to Fjell and Heywood (2004), the incumbent monopoly of the industry is likely to retain leadership after market liberalization and the private firms as newly entrants are likely to be the followers. Therefore, we assume that the SGTC is the leader and the private traders are the followers.

The quantity of rice purchased by the SGTC is  $q_{SGTC}$ . We assume there are *n* private traders and each private trader purchases quantity  $q_{PTi}$  ( $\forall i = 1,...,n$ ). So the total quantity purchased by private traders ( $q_{PT}$ ) equals  $\sum_{i=1}^{n} q_{PTi}$ . Therefore, the total quantity demanded ( $Q^d$ ) equals  $q_{SGTC} + \sum_{i=1}^{n} q_{PTi}$ , i.e.  $Q^d = q_{SGTC} + \sum_{i=1}^{n} q_{PTi}$ . The aggregate marketable supply of individual farm households equals village marketable rice supply ( $Q^s$ ), which equals total demand of the intermediates ( $Q^d$ ), i.e.  $Q^d = Q^s = Q$ .

We assume that private traders are not subsidized by the government (s = 0). As a follower, given the purchase quantity of the SGTC, private trader *i* maximizes its profit.

$$\pi_{PT_i} = (p - c_{PT_i} - w)q_{PT_i} - f_{PT_i}$$
(5.1)

where:  $\pi_{PTi}$  is profit of private trader *i*,  $c_{PTi}$  is marginal other costs of private trader *i*, i.e. transport costs, search and information costs, i.e. visiting farm households and making phone

calls, and networking costs such as cigarettes, drinks, and meals, p is consumer price of rice (selling price of private traders), w is farm price of rice,  $f_{PTi}$  is fixed costs of private trader *i* (e.g. the costs of cell phones).

The first-order condition of private trader *i* is given by:

$$\frac{\partial \pi_{PT_i}}{\partial q_{PT_i}} = p - c_{PT_i} - w - \frac{\partial w}{\partial Q} \frac{\partial Q}{\partial q_{PT_i}} q_{PT_i} = 0$$
(5.2)

where  $\frac{\partial Q}{\partial q_{PT_i}}$  is private trader *i*'s beliefs about how total demand would change when its

own demand changes. Here, it is assumed it equals 1, which indicates private traders play Cournot. Therefore equation (5.2) can be written as:

$$\frac{\partial \pi_{PT_i}}{\partial q_{PT_i}} = p - c_{PT_i} - w - w \frac{\partial w}{\partial Q} \frac{q_{PT_i}}{w} = 0$$
(5.3)

Or:

$$p = c_{PTi} + w + \frac{w}{\varepsilon_{PTi}}$$
(5.4)

where  $\varepsilon_{PT_i}$  is the price elasticity that private trader *i* faces ( $\varepsilon_{PT_i} = \frac{\partial Q}{\partial w} \frac{w}{q_{PT_i}}$ ). In other words,

it shows the percentage change in demand of private trader *i* when the farm price changes 1%.

Equation (5.4) shows that under Cournot competition, private trader *i* receives a mark-up (extra profit above marginal costs of production) that depends on the price he pays to farm households (farm price) and the price elasticity he faces. The larger  $\varepsilon_{p_{T_i}}$  becomes the more competitive the market becomes. An infinite  $\varepsilon_{p_{T_i}}$  indicates a perfectly competitive market. This mark-up leads to imperfect price transmission between consumer and farm prices if the price elasticity it faces is not a constant. The percentage price changes at the level of the consumer and farm gate always will differ.

Now, let us look at the leader. The SGTC wants to choose its profit-maximizing level of purchase quantity. The SGTC maximizes its profit.

$$\pi_{\rm SGTC} = (p - c_{\rm SGTC} - w)q_{\rm SGTC} - f_{\rm SGTC}$$
(5.5)

Or:

$$\pi_{\rm sGTC} = (p - c_{\rm sGTC} - w(Q))q_{\rm sGTC} - f_{\rm sGTC}$$
(5.6)

where:  $\pi_{\text{SGTC}}$  is profit of the SGTC,  $c_{\text{SGTC}}$  is marginal other costs of the SGTC, such as transport costs, the costs it pays its employees to purchase rice in the village, and storage costs,  $f_{\text{SGTC}}$  is fixed costs of the SGTC (e.g. overhead costs such as salaries to its employees).

With Stackelberg we assume that the leader knows the reaction curves of the followers and takes them into account when maximizing profit. The reaction curve of each private trader  $(R_{PT_i}(q_1))$  shows how private trader *i* reacts given various beliefs it might have about the

amount of rice that the SGTC decides to purchase. We therefore have total rice demand as  $Q = q_{\text{SGTC}} + \sum_{1}^{n} R_{\text{PT}i}(q_{\text{SGTC}})$ . Substituting the total rice demand into equation (5.6), we get:

$$\pi_{\rm SGTC} = (p - c_{\rm SGTC} - w(q_{\rm SGTC} + \sum_{1}^{n} R_{\rm PTi}(q_{\rm SGTC})))q_{\rm SGTC} - f_{\rm SGTC}$$
(5.7)

The first-order condition of the SGTC is given by:

$$\frac{\partial \pi_{\rm SGTC}}{\partial q_{\rm SGTC}} = p - c_{\rm SGTC} - w - \frac{\partial w (q_{\rm SGTC} + \sum_{1}^{L} R_{\rm PTi} (q_{\rm SGTC}))}{\partial q_{\rm SGTC}} q_{\rm SGTC} = 0$$
(5.8)

$$\frac{\partial \pi_{\rm SGTC}}{\partial q_{\rm SGTC}} = p - c_{\rm SGTC} - w - w \frac{\partial w}{\partial Q} \frac{\partial (q_{\rm SGTC} + \sum_{1}^{c} R_{\rm PTi}(q_{\rm SGTC}))}{\partial q_{\rm SGTC}} \frac{q_{\rm SGTC}}{w} = 0$$
(5.9)

Equation (5.9) can be rewritten as:

$$p = c_{\text{SGTC}} + w + w \frac{\partial w}{\partial Q} \frac{q_{\text{SGTC}}}{w} (1 + \sum_{1}^{n} R_{\text{PTi}}^{'}(q_{\text{SGTC}}))$$
(5.10)

$$p = c_{\text{SGTC}} + w + \frac{w}{\varepsilon_{\text{SGTC}}} (1 + \sum_{1}^{n} R'_{\text{PTi}}(q_{\text{SGTC}}))$$
(5.11)

where  $\varepsilon_{\text{SGTC}}$  is price elasticity that the SGTC ( $\varepsilon_{\text{SGTC}} = \frac{\partial Q}{\partial w} \frac{w}{q_{\text{SGTC}}}$ ). In other words, it shows

the percentage change in demand of the SGTC when the farm price changes 1%.

Equation (5.11) shows that the mark-up received by the SGTC depends on the price it pays to farm households, the price elasticity it faces, and also the slope of the reaction curve of private trader *i* ( $R'_{PTi}(q_{SGTC})$ ) (See Appendix 5A for the specification of  $R'_{PTi}(q_{SGTC})$ ).

#### Price leadership (Dominant-firm model)

A price leadership model describes that the leader sets a price and the followers take the price as given. With the followers acting as price takers, the dominant firm is left as the only buyer to set the price so as to maximize its profit subject to the residual supply (Varian, 1992: 298-99). When both the leader and the followers have the same constant marginal costs, the result of a price leadership model is identical with the result of Bertrand competition, i.e. the market price equals marginal cost and the leader and the followers have zero profits (Tirole, 1988:210). Because this result does not reflect the situation of 2000 in the three villages, we apply the price leadership model described by Deneckere and Kovenock (1992) instead.

#### The model of Deneckere and Kovenock

In their duopoly model, Deneckere and Kovenock (1992) do not assume price-taking behavior by the follower. They assume that both the leader and the follower face capacity constraints, i.e. none of them is able to satisfy the whole market. The leader sets the price knowing the capacity constraints of the follower. In their paper, Deneckere and Kovenock (1992) discuss extensively the formation of equilibria under different assumptions. Suppose two firms in a price-setting
game face capacity constraints. Firm 2 (with capacity  $k_2$ ) is exogenously determined as the price leader and firm 1 (with capacity  $k_1$ ) is exogenously determined as the follower. For each pair ( $k_1$ ,  $k_2$ ) with  $k_2 \ge k_1$ , firm 2 faces the following equilibria:

- (a) If both firms have large enough capacities to serve the entire market the leader sets the price equal to the marginal cost and both firms have zero profit (Bertrand outcome).
- (b) If the capacities of both firms are such that the Cournot outcome satisfies the capacities the leader-follower equilibrium coincides with the Cournot equilibrium.
- (c) If the follower has a capacity that is larger than the Cournot outcome, the leader sets a (capacity-constrained monopoly) price p facing the residual demand and the follower matches that price and sells its capacity  $k_1$ .

(Adapted from Deneckere and Kovenock, 1992.)

Case (c) can be interpreted as that when the large firm (firm 2) is a leader it provides a price umbrella for the small firm (firm 1), allowing it to match its price and sell all of its capacity. Case (c) also shows that the outcome of this game is more collusive and therefore more stable than the outcome under Bertrand competition. Although Deneckere and Kovenock (1992) presented a duopoly model, its outcome can be generalized to the case of n firms in the market.

#### Our model

We assume the SGTC being the leader and the private traders being the followers according to Fjell and Heywood (2004). The monopsonistic history of the SGTC indicates that the SGTC is able to satisfy the entire rice purchase market in a village, which leads to outcomes described in case (a), i.e. the farm price is set equal to the marginal costs and both the SGTC and the private traders earn zero profit. This leads us back to the discussion presented before, namely, the outcomes in case (a) do not reveal the actual situation of 2000 in the three villages; we therefore do not consider the case (a) in this chapter.

According to Tirole (1988: 231-32), when firms play a price-setting game facing capacity constraints, their profit functions are identical to Cournot profit functions. Hence their output levels are Cournot outputs. We therefore assume that the capacity constraint of the private traders equals the Cournot outcome in Chapter 4, i.e.  $\bar{q}_{PTi} = q_{PTi}^{cournot}$ . The application of this assumption thus leads us to the outcomes of case (b), i.e. the Cournot outcome.

Here we present the theoretical model of the price leadership competition. Knowing the capacity constraints of the private traders, the SGTC sets the farm price of rice and private traders accept this price instead of trying to set a higher price. The private traders then purchase rice at their capacity, leaving the SGTC with the residual supply. We first look at the followers.

As the follower, accepting the farm price w set by the SGTC, the private traders fulfill their capacities. Private trader i's profit is:

$$\pi_{PT_{i}} = (p - c_{PT_{i}} - w)\overline{q}_{PT_{i}} - f_{PT_{i}}$$
(5.12)

Therefore, the total amount of rice bought by the private traders equals  $q_{PT} = \sum_{i=1}^{n} \overline{q}_{PT_i}$ .

The residual supply curve the SGTC faces is thus:

$$r(w) = q_{\rm SGTC} = Q(w) - q_{\rm PT}$$
 (5.13)

The SGTC now has to choose w so as to maximize its profit function:

$$\pi_{\rm SGTC} = (p - c_{\rm SGTC} - w)q_{\rm SGTC} - f_{\rm SGTC}$$
(5.14)

This is just the problem of a monopsonist facing the residual supply curve. The first-order condition is:

$$\frac{\partial \pi_{\rm SGTC}}{\partial q_{\rm SGTC}} = p - c_{\rm SGTC} - w - \frac{\partial w}{\partial Q} \frac{\partial Q}{\partial q_{\rm SGTC}} q_{\rm SGTC} = 0$$
(5.15)

This can be rewritten as:

$$\frac{\partial \pi_{\rm SGTC}}{\partial q_{\rm SGTC}} = p - c_{\rm SGTC} - w - w \frac{\partial w}{\partial Q} \frac{\partial Q}{\partial q_{\rm SGTC}} \frac{q_{\rm SGTC}}{w} = 0$$
(5.16)

Since the SGTC takes the fixed capacity constraint of the private traders as given,  $\frac{\partial Q}{\partial q_{SGTC}} = 1$  that implies changes in rice demand of the SGTC leads to the same changes in the total rice demand. Therefore, equation (5.16) can be written as:

$$\partial w q_{\rm NGTC}$$

$$p = c_{\text{SGTC}} + w + w \cdot \frac{\partial w}{\partial Q} \frac{q_{\text{SGTC}}}{w}$$
(5.17)

Or:

$$p = c_{\rm SGTC} + w + \frac{w}{\mathcal{E}_{\rm SGTC}}$$
(5.18)

where  $\varepsilon_{\text{SGTC}}$  is the price elasticity the SGTC faces ( $\varepsilon_{\text{SGTC}} = \frac{\partial Q}{\partial w} \frac{w}{q_{\text{SGTC}}}$ ). In other words, it

shows the percentage change in demand of the SGTC when the farm price changes 1%.

Equation (5.18) shows that the mark-up of the SGTC depends on the price it pays to farm households and the price elasticity it faces. The smaller  $\varepsilon_{\text{SGTC}}$  becomes the larger the mark-up of the SGTC<sup>52</sup>.

## 5.2.2 Perfect competition in 2003

As been discussed in Chapter 4 (Section 4.3.3), rice purchase markets in all the villages are assumed to be perfectly competitive in 2003. The perfect competition model in this chapter is identical to that of the previous chapter. It is therefore skipped to avoid repetition. For details, please see Section 4.3.3.

## 5.3 Empirical model and data

<sup>&</sup>lt;sup>52</sup> Note that the price elasticity that a monopsonist faces should be larger than -1 to give a realistic outcome.

The theoretical model presented in Section 5.2 consists of the first-order conditions of quantity leadership competition (eq. 5.4 and eq. 5.11) and the first-order condition of price leadership competition (eq. 5.18). The consumer price is exogenous. Values of price elasticities that private trader i and the SGTC face are presented in Table 5C.3 (see Appendix 5C for the calculation).

In Chapter 4, for simplicity, we assume the SGTC and private traders in Banqiao and Shangzhu have the same marginal other costs while in Gangyan, due to the temporary monopsony of the SGTC, the marginal other costs of the SGTC are higher than that of private traders. In this chapter, we removed this assumption for Gangyan in our theoretical model (Section 5.2). Therefore the SGTC and private traders have the same marginal other costs for all the three villages. The marginal other costs of the SGTC consist of transport costs, storage costs, and the costs the SGTC pays its employees to go to the villages to purchase rice. The marginal other costs of private trader *i* consist of transport costs, search and information costs such as visiting farm households and making phone calls, and networking costs such as cigarettes, drinks, and meals. Since we could not obtain data on storage costs of the SGTC, search and information costs of the private traders, we do not specify these costs. We only provide the marginal other costs of intermediates as a whole. Moreover we assume that due to the development in road construction and in telecommunication, the marginal other costs of the intermediates decrease from 2000 to 2003 (see Table 4.1). Other data such as consumer and farm prices, marketable rice supply and numbers of intermediates is the same as listed in Chapter 4 (see Table 4.2).

## 5.4 Scenarios and Results

#### 5.4.1 Scenarios

In Chapter 4, we compared the situation in 2000, i.e. monopsony and Cournot competition, with the situation in 2003, i.e. perfect competition, assuming (1) a constant consumer price; (2) a 10% decrease in consumer price; (3) a 10% increase in consumer price. In this Chapter we compare (1) quantity leadership and (2) price leadership in 2000 with perfect competition in 2003. Applying the same assumptions on the consumer price in this chapter would lead to six scenarios. To reduce the number of scenarios, we only take the situation with a constant consumer price and a 10% increase in consumer price into account.

(1) Comparison between quantity leadership competition and perfect competition. In the case of quantity leadership, the SGTCs receive mark-up  $\frac{w}{\varepsilon_{\text{SGTC}}}(1 + \sum_{1}^{n} R'_{\text{PT}_{i}}(q_{\text{SGTC}}))$  and the private

traders  $\frac{w}{\varepsilon_{PTi}}$ . While under perfect competition mark-ups are zero for all intermediates. This implies that a transition from quantity leadership competition to perfect competition leads to an increase in farm prices and marketable rice supply. Therefore, the profit of farm households increases. The profit of intermediates decreases under quantity leadership competition compared to perfect competition. The final increase in farm prices, marketable rice supply, and

profit of farm households depends on the specific situation of each village. We also compare the quantity of rice purchased, mark-up, and profits of the SGTC (leader) and private traders (followers) under quantity leadership competition.

(2) Comparison between quantity leadership competition and perfect competition with a 10% increase in consumer prices. This scenario is to examine how the degree of price transmission from consumer to farm households is influenced by the market power possessed by the intermediates. We expect similar results as scenario 1 but with larger increases and/or smaller decreases.

(3) Comparison between price leadership competition and perfect competition. As mentioned in Section 5.2.1, price leadership competition under a capacity constraint gives the same outcome as Cournot competition. Therefore comparison between price leadership and perfect competition is identical to a comparison between Cournot and perfect competition. The markup of private trader i therefore equals the markup under Cournot competition, i.e.

 $\frac{w}{\varepsilon_{\rm PTi}}$  . The SGTC is a monopsonist for residual supply, i.e. total rice supply minus rice

purchased by private traders  $(Q - \sum_{i=1}^{n} \overline{q}_{PT_i})$ . So the SGTC receives a mark-up that equals  $\frac{w}{\varepsilon_{SGTC}}$ .

Both the SGTC and private traders receive a zero mark-up under perfect competition. Therefore, going from price leadership competition to perfect competition, we expect an increase in farm prices, marketable rice supply, and farm profits. Profits of the SGTC and private traders decrease. The final outcomes of price leadership competition depend on the specific situation of each village.

(4) Comparison between price leadership and perfect competition with a 10% increase in consumer prices. We expect similar results as scenario 3 but with larger increases and/or smaller decreases.

## 5.4.2 Results

The first three columns of Table 5.1 show the results of the comparison of quantity leadership competition with perfect competition for the three villages when the consumer price remains constant (scenario 1). We see that under quantity leadership competition, all the intermediates receive a mark-up while they receive a zero mark-up under perfect competition. As a result, the profit of all intermediates decreases in all the villages. In Section 5.3, we assume that the SGTC and the private traders have the same marginal other costs. Since they also face the same consumer price and farm price they therefore have the same markup. Hence, the profit of the intermediates decreases with 27.1 Yuan/ton in Banqiao, 29.9 Yuan/ton in Shangzhu, and 29.6 Yuan/ton in Gangyan. The slightly higher markup of the intermediates in Shangzhu than in Banqiao and Gangyan indicates more market power of the intermediates in Shangzhu. Since we use the same data as in the previous chapter, the markup loss of the intermediates is identical with the simulation results in Table 4.2. Since the condition of zero profit in the case of perfect

competition indicates the loss of the intermediate's markup, we expect the loss of the intermediate's markup is identical among all the scenarios.

The loss of the intermediate's markup leads to an increase in farm price. As a result, the farm price in the three villages increases with 3.3% in Banqiao, 3.9% in Shangzhu, and 3.7% in Gangyan. The relative large increase in Shangzhu is due to the relative large markup of the intermediates. The increase in the farm price leads to an increase in total marketable rice supply of the farm households by 0.6% in Banqiao, 1.0% in Shangzhu, and 0.2% in Gangyan. The largest increase in total rice supply in Shangzhu corresponds with its largest increase in farm price, given the linear rice demand function.

The loss of the markup leads to a decrease in the trading quantity of the intermediates. The decrease is larger for the SGTC than for an individual private trader. Appendix 5B shows us that under the assumption of the linear demand function, trading quantity of the leader is twice as many as that of the followers. We know that under perfect competition all the intermediates have the same trading quantity. This leads to a larger decrease in trading quantity for the SGTC. The increase in total rice demand (supply) for all the villages is due to the assumption that more traders enter the rice purchase market in the case of perfect competition. Zero profit under perfect competition leads to profit loss of the intermediates. Given the identical markup and total rice supply in the initial situation, we expect an identical profit loss for all the intermediates among all the scenarios. The relative large profit loss of the intermediates in Gangyan is due to its relative large trading quantity.

The increase in the marketable rice supply and the farm price leads to an increase in farm profit. In all the villages the increase in farm profit is larger than the decrease in intermediate profit; overall social welfare thus increases.

The next three columns of Table 5.1 show the results of the comparison between quantity leadership and perfect competition when the consumer price increases with 10% for all the villages (scenario 2). As expected the decrease in the markup remains the same as scenario 1. The decrease in the intermediate markup leads to an increase in farm price. The larger increase in farm price than in scenario 1 is due to the 10% increase in the consumer price. The farm price increases with 13.7% in Banqiao, 14.5% in Shangzhu, and 14.2% in Gangyan. This indicates that the increase of the consumer price (10%) is more than fully transmitted to farm households. The increase in the farm price leads to an increase in marketable rice supply of the farm households by 2.6% in Banqiao, 3.8% in Shangzhu, and 0.8% in Gangyan.

As expected, the decrease in the trading quantity of an individual intermediate is less than scenario 1 due to a 10% increase in consumer price. As expected, the decrease in the intermediate profit remains the same as in scenario 1.

The increase in the marketable rice supply and the farm price leads to an increase in farm profit. As expected, it increases more than that of scenario 1. In this scenario, the increase in the farm profit is much larger than the decrease in the intermediate profit due to the 10% increase in the consumer price. As a result, the overall profit increase is much larger for all the villages. The small gain of Shangzhu is due to its relative small trading quantity.

The following three columns of Table 5.1 show the results of the comparison of price leadership competition with perfect competition for all the villages when the consumer price remains constant (scenario 3). The results are the same as the results of the first scenario in Chapter 4 (comparison between Cournot and perfect competition with a constant consumer price)<sup>53</sup>. This confirms that price leadership competition under a capacity constraint at the level of the Cournot output leads to the Cournot outcome. As mentioned before the decrease in the intermediate markup is the same as in scenario 1 and 2.

The decrease in the markup leads to the increase in the farm price. The increase in the farm price is the same as scenario 1. This is because the intermediates face an identical consumer price, marginal other costs, and markup. Losing the markup under perfect competition leads to an identical increase in the farm price in scenario 1 and 3. As a result, the increase in total rice supply is the same with scenario 1 given the linear demand function.

The loss of the markup leads to a decrease in the trading quantity of the intermediates. The decrease in trading quantity is identical among all the intermediates given the Cournot outcomes (i.e. 20.1% in Banqiao, 27.1% for Shangzhu, and 7.3% for Gangyan). The increase in total rice demand (supply) is due to the assumption that more private traders enter the rice purchase market in 2003. As expected, the decrease in the intermediate profit remains the same as in scenario 1 and 2.

The identical increase in the farm price and rice supply leads to the same increase in farm profit as in scenario 1. Given the identical profit loss of the intermediates, the overall increase in the social welfare is the same as in scenario 1.

The last three columns of Table 5.1 show the results of the comparison between price leadership and perfect competition when the consumer price increases with 10% (scenario 4). As expected, the markup loss of the intermediates is identical the loss in other scenarios.

The loss of the intermediate's markup leads to an increase in farm price. The larger increase in the farm price than scenario 3 is due to the 10% increase in the consumer price. It is identical with that of scenario 2. This is because of the identical loss of intermediate's markup and a 10% increase in the consumer price. As a result, the increase in the total marketable rice supply is identical with that of scenario 2. It is larger than scenario 3 due to the 10% increase in the farm price. Since the increase in the farm price and rice supply is identical with that of scenario 2, the increase in the farm profit is also identical with that of scenario 2.

The loss of intermediate markup leads to a decrease in the trading quantity of the intermediates. The Cournot outcome leads to a decrease in the trading quantity of the SGTC and the private traders (i.e. 18.6% in Banqiao, 25.1% in Shangzhu, and 6.7% in Gangyan). The decrease is less than scenario 3 due to the 10% increase in the consumer price. The total rice demand increases because more private traders enter the market in perfect competition. As expected the profit loss of the intermediates is identical with other scenarios.

<sup>&</sup>lt;sup>53</sup> The results are the same only for Banqiao and Shangzhu since we assumed monopsony and Cournot competition for Gangyan in Chapter 4.

	Quantity leadership					Price leadership						
	(consumer price constant)			(consumer price +10%)		(consumer price constant)		(consumer price +10%)				
	BQ	SZ	GY	BQ	SZ	GY	BQ	SZ	GY	BQ	SZ	GY
Change i	n trade (%)											
$\Delta q_{ m SGTC}$	-59.9	-63.3	-53.6	-59.1	-62.3	-53.3	-20.1	-27.1	-7.3	-18.6	-25.1	-6.7
$\Delta q_{PTi}$	-19.8	-26.7	-7.1	-18.2	-24.6	-6.6	-20.1	-27.1	-7.3	-18.6	-25.1	-6.7
ΔQ	0.6	1.0	0.2	2.6	3.8	0.8	0.6	1.0	0.2	2.6	3.8	0.8
Change in price (%)												
$\Delta p$	0	0	0	10	10	10	0	0	0	10	10	10
$\Delta w$	3.3	3.9	3.7	13.7	14.5	14.2	3.3	3.9	3.7	13.7	14.5	14.2
Change i	Change in markup per unit (Yuan)											
∆mk <sub>SGTC</sub> ∆mk <sub>PTi</sub>	-27.1	-29.9	-29.6	-27.1	-29.9	-29.6	-27.1	-29.9	-29.6	-27.1	-29.9	-29.6
Total profit change (1,000 Yuan)												
$\Delta \pi_{ m SGTC}$ + $\Delta \pi_{ m PT}$	-23.7	-11.9	-111.1	-23.7	-11.9	-111.1	-23.7	-11.9	-111.1	-23.7	-11.9	-111.1
$\Delta\pi_{\scriptscriptstyle farm}$	28.7	14.5	141.7	121.5	54.7	544.2	28.7	14.5	141.7	121.5	54.7	544.2
$\Delta \pi_{ m SGTC}$ + $\Delta \pi_{ m PT}$ + $\Delta \pi_{ m farm}$	5.0	2.6	30.6	97.8	42.8	433.1	5.0	2.6	30.6	97.8	42.8	433.1

 Table 5.1
 Simulation results, comparison with perfect competition

Note: BQ = Banqiao, SZ = Shangzhu, GY = Gangyan.

Given that the increase in farm profit and the decrease of the profits of the intermediates is the same as in scenario 2, the overall increase in the social welfare is also identical with that of scenario 2. It is much higher than that of scenario 3 due to the 10% increase in the consumer price.

## 5.5 Conclusions

The aim of this chapter is to analyze the effects of market deregulation and liberalization on farm households. Given that Cournot competition has been examined in the previous chapter, our analysis mainly focuses on quantity and price leadership competition in the rice purchase market in 2000. The results are compared with perfect competition in 2003. We find that market deregulation increases the degree of competition in the rice purchase market. The increase in farm profit indicates that farm households benefit from market deregulation. To what extent they benefit depends on the market access of their villages and the amount of rice supplied. First, the intermediates possess most market power in the village with limited market access. Therefore, farms households in the most remote village benefit most from market

deregulation. Second, the benefit is limited by the relatively small rice supply of the most remote village. The sum of both effects is that farm households in the most remote village benefit less than those in the villages with better market access and larger rice supply. Comparing results of Banqiao and Shangzhu in Table 4.3 and Table 5.1<sup>54</sup>, we see that changes in farm price are the same with different types of competition. This is due to the assumptions of the linear rice supply function, constant marginal costs, and the number of intermediates made in this thesis so that the differences are not obvious using one digit after decimal. With respect to changes in social welfare (i.e. overall changes in profits of the intermediates and the farm households), it is clear that in this thesis, with the starting position of quantity leadership and price leadership competition the gain in social welfare is higher than with Cournot competition.

The outcomes of the model show that China's government made the right decision to abolish the system in early 2004. Results also show that improving market access of remote villages (e.g. by road construction and telecommunication improvement) would be welfare improving for farm households.

The models used in this chapter are subject to the same caveats of the model used in the previous chapter, i.e. the effect of changes in farm price on rice production is not taken into account, the profit of the farm households is different from the utility of the farm households, etc. The next chapter takes these caveats into account by using a village Computable General Equilibrium model.

 $<sup>^{54}</sup>$  Since Chapter 4 and 5 developed different models for Gangyan, model results of Gangyan in the two tables are not comparable given the different assumptions made.

## Appendix 5A The derivation of the slope of the reaction curve of private trader i $(\forall i = 1,..., n)$

The reaction curve of each private trader ( $R_{PTi}(q_{SGTC})$ ) shows how private trader *i* reacts given various beliefs it has about the SGTC's choice. According to Varian (1992: 286), the slope of the reaction curve of private trader *i* that is also called conjectural variation can be derived as such that:

$$R'_{PTi}(q_{SGTC}) = \frac{\partial R_{PTi}(q_{SGTC})}{\partial q_{SGTC}} = -\frac{\frac{\partial \pi_{PTi}/\partial q_{PTi}}{\partial q_{SGTC}}}{\frac{\partial \pi_{PTi}/\partial q_{PTi}}{\partial q_{PTi}}} = -\frac{\partial \pi_{PTi}^2/\partial q_{PTi}q_{SGTC}}{\partial \pi_{PTi}^2/\partial q_{PTi}^2}$$
(5A1)

First, we derive:

$$\frac{\partial \pi_{_{PT_i}}/\partial q_{_{PT_i}}}{\partial q_{_{SGTC}}} = \frac{\partial}{\partial q_{_{SGTC}}} (p - c_{_{PT_i}} - w(Q) - \frac{\partial w(Q)}{\partial q_{_{PT_i}}} q_{_{PT_i}}) = -\frac{\partial w(Q)}{\partial q_{_{SGTC}}} - \frac{\partial w^2(Q)}{\partial q_{_{PT_i}}\partial q_{_{SGTC}}} q_{_{PT_i}}$$
(5A2)

$$\frac{\partial \pi_{_{PT_i}}/\partial q_{_{PT_i}}}{\partial q_{_{PT_i}}} = \frac{\partial}{\partial q_{_{PT_i}}} \left( p - c_{_{PT_i}} - w(Q) - \frac{\partial w(Q)}{\partial q_{_{PT_i}}} q_{_{PT_i}} \right) = -2 \frac{\partial w(Q)}{\partial q_{_{PT_i}}} - \frac{\partial w^2(Q)}{\partial^2 q_{_{PT_i}}} q_{_{PT_i}}$$
(5A3)

According to equation (4B6) (Appendix 4B), the functional form of the aggregate marketable rice supply is:

$$Q = TQ - Q_c - Q_t \tag{5A4}$$

where: Q aggregate marketable rice supply, TQ total aggregate rice output,  $Q_c$  aggregate rice consumption,  $Q_t$  aggregate agricultural tax.

According to equation (4B33), the functional form of  $Q_c$  is:

$$Q_{c} = \alpha_{11} + \alpha_{12}w + \alpha_{13}Y + \alpha_{14}N + \alpha_{15}A + e_{11}$$
(5A5)

Substituting equation (5A5) into equation (5A4), we have:

$$Q = TQ - (\alpha_{11} + \alpha_{12}w + \alpha_{13}Y + \alpha_{14}N + \alpha_{15}A + e_{11}) - Q_{t}$$
(5A6)

We know that  $Q = q_{SGTC} + \sum_{i=1}^{n} q_{PTi}$ , therefore

$$q_{\rm SGTC} + \sum_{1}^{n} q_{\rm PTi} = TQ - (\alpha_{11} + \alpha_{12}w + \alpha_{13}Y + \alpha_{14}N + \alpha_{15}A + e_{11}) - Q_{\rm t}$$
(5A7)

So we have:

$$\frac{\partial w}{\partial q_{\rm PTi}} = -\frac{1}{\alpha_{12}} \tag{5A8}$$

$$\frac{\partial w}{\partial q_{\rm SGTC}} = -\frac{1}{\alpha_{12}} \tag{5A9}$$

$$\frac{\partial^2 w}{\partial q_{PTi} \partial q_{SGTC}} = 0$$
(5A10)

$$\frac{\partial^2 w}{\partial^2 q_{\text{PTi}}} = 0 \tag{5A11}$$

Substituting equation (5A8)-(5A11) into equation (5A2) and (5A3), we have:

$$\frac{\partial \pi_{\rm PTi} / \partial q_{\rm PTi}}{\partial q_{\rm SGTC}} = \frac{1}{\alpha_{\rm 12}}$$
(5A12)

$$\frac{\partial \pi_{\text{PT}} / \partial q_{\text{PT}}}{\partial q_{\text{PT}}} = \frac{2}{\alpha_{12}}$$
(5A13)

Substituting equation (5A12) and (5A13) into equation (5A1), we get:

$$R'_{PTi}(q_{1}) = -\frac{\frac{\partial \pi_{PTi}/\partial q_{PTi}}{\partial q_{SGTC}}}{\frac{\partial \pi_{PTi}/\partial q_{PTi}}{\partial q_{PTi}}} = -\frac{\frac{1}{\alpha_{12}}}{\frac{2}{\alpha_{12}}} = -\frac{1}{2}$$
(5A14)

Bringing equation (5A14) into equation (5.11), we get:

$$p = c_{\rm SGTC} + w + \frac{w}{2 \cdot \varepsilon_{\rm SGTC}} \tag{5A15}$$

# Appendix 5B The trading quantity of the leader and the follower in quantity leadership competition

According to equation (5.4), we have:

$$p = c_{PT_i} + w + \frac{w}{\varepsilon_{PT_i}}$$
(5B1)

According to equation (5A15), we have:

$$p = c_{\rm SGTC} + w + \frac{w}{2 \cdot \varepsilon_{\rm SGTC}}$$
(5B2)

Since we assume that the SGTC and the private traders have the same marginal other costs, this indicates  $c_{PTi} = c_{SGTC}$ . Facing the same consumer price and the farm price, the SGTC and the private traders have the same markup. Hence we have:

$$\frac{w}{\varepsilon_{\rm PTi}} = \frac{w}{2 \cdot \varepsilon_{\rm SGTC}} \tag{5B3}$$

Equation (5B3) can be rewritten as:

$$\varepsilon_{\rm PTi} = 2 \cdot \varepsilon_{\rm SGTC} \tag{5B4}$$

Since we have  $\mathcal{E}_{PT_i} = \frac{\partial Q}{\partial w} \frac{w}{q_{PT_i}}$  and  $\mathcal{E}_{SGTC} = \frac{\partial Q}{\partial w} \frac{w}{q_{SGTC}}$ , equation (5B4) can be written as:

$$\frac{\partial Q}{\partial w} \frac{w}{q_{\rm PTi}} = 2 \cdot \frac{\partial Q}{\partial w} \frac{w}{q_{\rm SGTC}}$$
(5B5)

Simplifying equation (5B5), we get:

$$q_{\rm SGTC} = 2 \cdot q_{\rm PTi} \tag{5B6}$$

From equation (5B6), we see that the trading quantity of the SGTC as a leader ( $q_{SGTC}$ ) is twice as many as the trading quantity of the private trader *i* as a follower ( $q_{PTi}$ ) in the case of a linear demand function. Given the same markup of the SGTC and the private traders, the profit of the SGTC as a leader ( $\pi_{SGTC}$ ) in quantity leadership competition is twice as much as that of the private trader *i* as a follower ( $\pi_{PTi}$ ). We can therefore conclude that an intermediate prefers to be a leader in quantity leadership competition.

#### Appendix 5C Estimation of the elasticities

Summarizing all the elasticities specified in Section 5.2, we have:

- (1) price elasticity that private trader *i* (the follower) faces in quantity leadership competition for all the villages:  $\varepsilon_{p_{Ti}} = \frac{\partial Q}{\partial w} \frac{w}{q_{p_{Ti}}}$ .
- (2) price elasticity that the SGTC (the leader) faces in quantity leadership competition for all the villages:  $\varepsilon_{\text{SGTC}} = \frac{\partial Q}{\partial w} \frac{w}{q_{\text{SGTC}}}$ .
- (3) price elasticity that the SGTC (the leader) faces in price leadership competition for all the villages:  $\varepsilon_{\text{SGTC}} = \frac{\partial Q}{\partial w} \frac{w}{q_{\text{SGTC}}}$ .

Following Appendix 4B in the previous chapter, this appendix provides the derivation of the price elasticities that an individual intermediate (the leader and the follower) face in quantity and price leadership competition.

In this appendix, we first present the theoretical model of the derivation of the price elasticity that an individual intermediate faces. Second, since the empirical model and the estimation results of Banqiao and Shangzhu were already carried out in Appendix 4B of the previous chapter we only present the results for Gangyan in this appendix. This is because in chapter 4 we assume a temporary monopsony of the SGTC in Gangyan while in the chapter this assumption does not apply.

#### 5C.1 Theoretical model

#### Price elasticities of quantity leadership competition

According to equation (4B6) in the previous chapter, we have:

$$x_{s}(\mathbf{Y}, \mathbf{w}) = x - x_{c}(\mathbf{Y}, \mathbf{w}) - x_{T}$$
(5C1)

According to equation (4B9), we have:

$$\frac{\partial x_{\rm s}}{\partial w} = -\frac{\partial x_{\rm c}}{\partial w} - \frac{\partial x_{\rm c}}{\partial Y} x \tag{5C2}$$

According to equation (4B10), we have:

$$\frac{\partial Q}{\partial w} = m \cdot \frac{\partial x_s}{\partial w}$$
(5C3)

The price elasticity that private trader *i* (the follower) faces is:

$$\mathcal{E}_{PT_i} = \frac{\partial Q}{\partial w} \frac{w}{q_{PT_i}}$$
(5C4)

Substituting equations (5C2) and (5C3) into equation (5C4), we have:

$$\mathcal{E}_{PT_{i}} = \frac{\partial Q}{\partial w} \frac{w}{q_{PT_{i}}} = m \cdot \frac{\partial x_{s}}{\partial w} \frac{w}{q_{PT_{i}}} = m \cdot \left(-\frac{\partial x_{c}}{\partial w} - \frac{\partial x_{c}}{\partial Y}x\right) \cdot \frac{w}{q_{PT_{i}}}$$
(5C5)

The price elasticity that the SGTC (the leader) faces is:

$$\varepsilon_{\rm SGTC} = \frac{\partial Q}{\partial w} \frac{w}{q_{\rm SGTC}}$$
(5C6)

Substituting equations (5C2) and (5C3) into equation (5C6), we have:

$$\mathcal{E}_{\text{SGTC}} = \frac{\partial Q}{\partial w} \frac{w}{q_{\text{SGTC}}} = m \cdot \frac{\partial x_{\text{s}}}{\partial w} \frac{w}{q_{\text{SGTC}}} = m \cdot \left(-\frac{\partial x_{\text{c}}}{\partial w} - \frac{\partial x_{\text{c}}}{\partial Y}x\right) \cdot \frac{w}{q_{\text{SGTC}}}$$
(5C7)

#### Price elasticities of price leadership competition

Since the private traders accept the price set by the leader and fulfill their capacity constraints, they face a perfectly elastic demand. In other words, a change in the farm price has no effects on their trading quantity given their fixed capacity constraints.

The price elasticity that the SGTC (the leader) faces is:

$$\mathcal{E}_{\rm SGTC} = \frac{\partial Q}{\partial w} \frac{w}{q_{\rm SGTC}} \tag{5C8}$$

Substituting equations (5C2) and (5C3) into equation (5C8), we have:

$$\varepsilon_{\rm SGTC} = \frac{\partial Q}{\partial w} \frac{w}{q_{\rm SGTC}} = m \cdot \frac{\partial x_{\rm s}}{\partial w} \frac{w}{q_{\rm SGTC}} = m \cdot \left(-\frac{\partial x_{\rm c}}{\partial w} - \frac{\partial x_{\rm c}}{\partial Y}x\right) \cdot \frac{w}{q_{\rm SGTC}}$$
(5C9)

#### 5C.2 Estimation results of Gangyan

To determine the price elasticity of rice supply in Gangyan, we apply the same empirical model used for Banqiao and Shangzhu in Appendix 4B of Chapter 4. The estimation results are presented in Table 5C.1.

Table 5C.1 Estimated coefficients of equation (4B33) for all the villages

x <sub>C</sub>	constant	w	Y	Ν	А	$DF^{a}$	$\mathbb{R}^2$
Rice consumption Gangyan	0.747* (0.228)	-0.250* (0.141)	0.0003 (0.024)	0.051 (0.042)	1.921* (0.259)	164	0.565

*a* DF: degrees of freedom.

*b* Standard errors in parenthesis.

\* Significant at 10% level.

Note: For readability, price and income variables are scaled down by 1000.

We see that the farm price (*w*) has a negative effect on rice consumption ( $x_c$ ) in all the villages. Full income (Y) has a positive significant effect on rice consumption ( $x_c$ ) in Shangzhu. The size of the household (N) has a positive significant effect on rice consumption ( $x_c$ ) in Banqiao. The planted area of rice (A) has a positive significant effect on rice consumption ( $x_c$ ) in all the villages.

#### 5C.3 Calculation of the price elasticities

Table 5C.2 lists the rice demand of an intermediate in quantity and price leadership competition of all the villages. Substituting the correspondent coefficients in Table 5C.1 and

the data in Table  $4B.3^{55}$  into equations (5C5), (5C7), and (5C9), the price elasticities that an individual intermediate faces can be calculated (see Table 5C.3).

	0 1		
	Banqiao	Shangzhu	Gangyan
Quantity leadership			
<b>9</b> SGTC	2.02	1.26	2.88
<b>Д</b> РТі	1.01	0.63	1.44
Price leadership			
<b>9</b> SGTC	1.01	0.63	1.44
$q_{PTi}$	1.01	0.63	1.44

Table 5C.2 Rice demand of an intermediate in quantity and price leadership competition in the three villages (quantities in tons)

## Table 5C.3 Calculated elasticities

	Banqiao	Shangzhu	Gangyan
Quantity leadership			
$\mathcal{E}_{\mathrm{SGTC}}$	19.333	16.882	16.768
${\cal E}_{PTi}$	38.666	33.764	33.536
Price leadership			
$\mathcal{E}_{\mathrm{SGTC}}$	38.666	33.764	33.536
$\varepsilon_{_{PTi}}$	38.666	33.764	33.536

Table 5C.2 shows that the trading quantity of the SGTC is twice as much as that of a private trader. The relatively small trading quantity of the intermediates in Shangzhu is due to the relatively small marketable rice supply of the farm households in Shangzhu. Table 5C.3 shows that the price elasticity that the follower faces in quantity leadership competition is twice as much as that of the leader. Following equations (5C5) and (5C7), we see that the difference between the two equations lays in the trading quantity of the SGTC and private trader *i*. Since we know that the trading quantity of the SGTC is twice as much as that of a private trader, it is therefore clear that the price elasticity that the leader faces is half of that of the follower. As described in the main text of this chapter, the price elasticity that an intermediate faces shows that the percentage change in the trading quantity of the intermediate when the farm price changes 1%. A small elasticity shows that the trading quantity of an intermediate. Hence, the leader possesses more market power than the followers in quantity leadership competition. Comparing the price elasticities between the villages, the highest price elasticity that an intermediate faces in Banqiao indicates the lowest market power they possess.

<sup>&</sup>lt;sup>55</sup> With respect to the farm price in Gangyan, we use the farm price offered by the private traders.

## 6 A NONSEPARABLE HOUSEHOLD CGE MODEL

## 6.1 Introduction

Chapters 4 and 5 have analyzed the impacts of market deregulation and liberalization on farm households. However the marketing channel model used in these two chapters was subject to some caveats with respect to the supply behavior of the farm households, e.g. we only modeled the marketable supply of rice taken rice production as given, we considered farm profits instead of utility, effects on the supply and consumption of other goods were not taken into account and the role of off-farm employment was not included in the analysis. Using a nonseparable household in a computable general equilibrium (CGE) framework enables to avoid these caveats. The nonseparable household CGE model used in this chapter is at the village level. A CGE model is a framework that analyses links between different markets and therefore interactions between production activities, consumption, factor resources, and institutions (Vargas et al., 1999). The model developed is for Gangyan. Data are coming from a SAM constructed by Kuiper (2005)<sup>56</sup>. In this research we use a higher level of aggregation (e.g. only one representative household) and construct a (completely) different model than Kuiper. In order to analyze the effects of rice market deregulation and liberalization, we assume imperfect competition in the village rice export market. The supply of rice depends on both factors outside the village (e.g. consumer price and market imperfections in the marketing channel) and village factors (e.g. household behavior, factor resources, off-farm employment).

The aim of this chapter is to analyze the effects of rice market deregulation and liberalization for Gangyan using a nonseparable household CGE model.

Section 6.2 discusses the nonseparable household CGE model. Section 6.3 describes the modeling of imperfect competition in the rice export market. A description of the Social Accounting Matrix (SAM) of Gangyan is given in Section 6.4. Section 6.5 discusses the simulation results. Concluding remarks are made in Section 6.6.

#### 6.2 Model

In the nonseparable household CGE model developed in this chapter the representative farm household's demand for commodities and supply of factors result from utility maximization subject to the household budget constraint. Output supply and input demand result from profit maximization of the production activities. The model is homogeneous of degree zero in

<sup>&</sup>lt;sup>56</sup> We would like to thank Marijke Kuiper for making this SAM available for this research.

prices and income. At equilibrium, the model solution provides a set of prices that clears commodity and factor markets. This section provides a brief discussion of the nonseparable household CGE model developed. A full description of the CGE model is provided in Appendix 6A.

## Production and output distribution

A nested production structure using Constant Elasticity of Substitution (CES) production functions is applied for the production activities in this model (see Figure 6.1). At the top of the nest, an output is produced using an aggregate variable input and an aggregate factor input as inputs. Cost minimization subject to the relevant CES production function yields demand for the aggregate variable input and aggregate factor input. At the bottom of the nest, the aggregate variable input is produced by variable inputs consisting of intermediate inputs (on-farm produced inputs) and imported or external inputs. The aggregate factor input is produced by labor, land, and tractor (capital). Cost minimization subject to the relevant CES production function yields the demand functions of the variable and factor inputs. Total endowments of labor, land, and tractor are fixed. Prices of imported inputs are exogenous, prices of intermediate inputs and factor inputs are endogenous. Zero profit conditions result from the constant-returns-to-scale technology, so total value of the aggregate output equals total value of aggregate inputs, total value of the aggregate variable input equals total value of the variable inputs and the total value of the aggregate factor input equals total value of the variable inputs and the total value of the aggregate factor input equals total value of the factor inputs.

Figure 6.1 Production technology



The aggregate output produced by the farm is assumed to be transformed into three outputs: an intermediate input, consumer good and export commodity. The three outputs are

assumed to be imperfect substitutes. Depending on the relative prices of the three outputs more or less will be produced of one of the outputs. Aggregate output is transformed in the three outputs using a Constant Elasticity of Transformation (CET) function. Revenue maximization subject to the CET transformation function yields the supply functions of the three outputs. A zero profit condition equalizes the value of the aggregate output to the value of the outputs.

Output prices of intermediate inputs and consumer goods are endogenous. Export prices are exogenous except for one season rice and two season rice. We assume imperfect competition (Cournot) among intermediates in the rice export market in the initial equilibrium (see Section 6.3). The incorporation of imperfect competition implies export prices of rice are endogenous.

## Consumption

Full income of the representative farm household comes from the return on the factor inputs (labor, land and tractor) and transfers from the rest of the world (e.g. remittances). After the deduction of taxes the full income is spend on goods produced on-farm, purchased (imported) goods and leisure. The representative farm household maximizes utility subject to a full income constraint resulting in an expenditure function. We assume a Gorman polar expenditure function consisting of the expenditure on subsistence and supernumerary demand. For the latter a CES expenditure function is assumed (see Peerlings, 1993). Using Roy's identity, Marshallian demand functions are derived. Prices of purchased goods are exogenous. Prices of on-farm produced goods and leisure are endogenous.

## Labor

Total labor availability (labor endowment) is assumed fixed. The representative farm household supplies its labor to farm activities, leisure, and off-farm employment. These different types of labor are assumed to be imperfect substitutes. Prices equilibrate labor demand and supply for each individual type of labor. The price of on-farm labor supply and the price of leisure are endogenous. The off-farm wage is exogenous. Revenue maximization subject to a CET transformation function yields the CET labor supply functions.

## Equilibrium conditions and price equations

Equilibrium conditions include equilibrium on the markets for the factors, intermediate inputs, on-farm produced consumption goods and leisure. Moreover, the net value of the transactions with the rest of the world is zero. It is assumed that there are no commodity taxes. This implies there are no price wedges between supply and demand prices.

## Welfare

In the CGE model the equivalent variation (EV) is used as a welfare measure. The EV measures the willingness of the representative farm household to accept a change. In other words, the EV measures how much money is needed to reach a new utility level facing the prices of the initial

equilibrium. Therefore, including outcomes on the EV allows us to compare welfare implications of different scenarios.

## 6.3 Rice export market

In the rice export market the farm price for rice is determined jointly by rice supply and rice demand. Rice supply of the village is derived from revenue maximization given the CET transformation function of rice output distribution. Rice demand is determined by the profit maximizing behavior of the rice intermediates under imperfect competition.

## Rice supply

Two types of rice are produced on the farm, i.e. one season rice and two season rice. The farm household has to pay a fixed share of rice production as agricultural tax. After the agricultural tax is deducted, the rest of rice output is distributed over different outputs (intermediate input, consumer good, and export). It is assumed that supply follows from revenue maximization given the CET transformation function of rice output distribution.

$$QOUZ_{g} = (1 - rtxr_{g}) \times QOU_{g} \qquad \forall g \in G \qquad (6.1)$$

$$\max_{QO_{gm}} \left( \sum_{m \in M} PO_{gm} \times QO_{gm} \right) \qquad \forall g \in G$$
(6.2)

s.t. 
$$QOUZ_g = CET(QO_g)$$
  $\forall g \in G$  (6.3)

where:  $QOU_g$  is quantity of aggregate rice produced by activity g,  $QOUZ_g$  is quantity of aggregate rice produced by activity g excluding the agricultural tax,  $rtxr_g$  is tax rate for aggregate rice produced by activity g,  $QO_{gm}$  is quantity of output m produced by activity g,  $PO_{gm}$  is price of output m produced by activity g,  $QO_g$  is vector of quantities of rice produced by activity g,  $CET(\cdot)$  is CET transformation function for output distribution, g is the index for rice (g = 1 one season rice, g = 2 two season rice), m is different outputs (m = 1 feed, m = 2 oxen, m = 3 consumer good, m = 4 export commodity).

The supply functions of rice output going to intermediate input demand, the household, and the rest of the world (export commodity) are:

$$QO_{gm} = CET(QOUZ_{g}, PO_{g}) \qquad \forall g \in G, m \in M$$
(6.4)

where:  $PO_g$  is vector of prices of rice produced by activity g,  $CET(\cdot)$  is CET output supply functions.

For simplicity, we omit subscript g for rice produced by activity g and m=4 for export. The supply function of rice supplied to the rest of the world can be written as:

$$q^s = \operatorname{CET}(Q', \mathbf{w}) \tag{6.5}$$

where:  $q^s$  is rice exported, **w** is vector of prices of rice produced supplied to the different demand categories.

#### Rice demand

In the export market, the amount of rice demanded by rice intermediates equals the amount of rice supplied by farm households, i.e.  $q^s = q^d$  where  $q^d$  is rice demand. The demand is determined by the type of competition played between intermediates and the export price of rice. Here we assume that intermediates play Cournot competition.

The farm price of rice is derived from profit maximization of the individual intermediates. Assume there are *n* intermediates in the market. The profit of intermediate *i* (i = 1,...,n) equals:

$$\pi_{i} = (p - c_{i} - w)q_{i} - f_{i} \qquad (6.6)$$

where:  $\pi_i$  is profit of intermediate *i*, *p* is price of rice that intermediates receive,  $c_i$  is marginal other costs of intermediate *i* (e.g. transportation costs, etc.), *w* is farm price of rice (the price the farm household receives or the export price of rice),  $q_i$  is quantity of rice purchased by intermediate *i*,  $f_i$  is fixed costs of intermediate *i* (i.e. networking costs). We have

$$q^d = \sum_{i=1}^n q_i = q^s \,.$$

Differentiating equation (6.6) with respect to  $q_i$  and after rearranging, the first order condition of intermediate *i* can be written as:

$$p = c_i + w + \frac{w}{\varepsilon_i} \qquad \qquad \forall i = 1, ..., n \qquad (6.7)$$

where:  $\varepsilon_i$  is price elasticity that individual intermediate *i* faces ( $\varepsilon_i = \frac{\partial q^s}{\partial w} \frac{w}{q_i}$ ).

## Market equilibrium

The export prices of rice clear the export markets. In the nonseparable household CGE model rice supply and demand not only depend on the price of rice but indirectly also on all other variables in the model (e.g. off-farm wage).

## 6.4 Social Accounting Matrix and calibration

The SAM of Gangyan is presented in Table 6E.1 (Appendix 6E). In the rows the revenues of activities are presented, in the columns the costs of activities are given. Row and column totals equal.

## Farm activities

Farm activities consist of crop production and livestock production. Crop production is divided into one-season rice, two-season rice, and other crops production. Two-season rice is an aggregate of early rice and late rice production. Livestock production is divided into cattle, pigs, and other livestock production.

Inputs of crop production are divided into intermediate inputs, external inputs, and factor inputs. Intermediate inputs are produced within the farm. They include feed, manure, and draught service provided by oxen<sup>57</sup>. External inputs are fertilizer, herbicide, pesticide, purchased seed, and other external inputs and are bought outside the village. Factor inputs consist of labor, land (both irrigated and non-irrigated), and draught service provided by tractors (capital). Inputs of livestock production include intermediate inputs (only feed such as crop residues), external inputs (purchased feed and other external inputs), and factor inputs (labor).

Output of crop production is allocated between household's own consumption, exported, agricultural tax, and animal feed (crop residue) as an intermediate input. Output of livestock production is allocated between household's own consumption (pork consumption from pig), exported (pig and other livestock output), and intermediate inputs (manure and draught service provided by oxen).

## Household income

Household income is received via factor payments (labor, land, and draught service provided by tractor) and transfers (remittances). Part of the labor income is coming from off-farm employment<sup>58</sup>.

## Household expenditure

The household allocates its income among food consumption, non-food consumption, durables, other expenses, leisure, and taxes paid to the government (see Kuiper, 2005). Food consumption of the household is an aggregate of consumption of own farm products (crop and livestock) and food such as vegetables, fruits, and noodles that are purchased from local markets. Non-food is an aggregate of e.g. cleaning products and cigarettes. Durables include furniture and clothing. Other expenses are on education, social events such as weddings, funerals, Spring Festival, and transport. Transport expenses consist of cash payments and time spend on transport. Consumption of labor is leisure, which includes the time spent on taking care of the household such as collecting fuelwood, house cleaning etc. and social activities. Taxes paid to

<sup>&</sup>lt;sup>57</sup> Draught services in the village are provided by both oxen and tractors. The first is considered to be an intermediate input the latter is considered to be a factor input (capital).

<sup>&</sup>lt;sup>58</sup> Although rice trade is an off-farm activity of the farm households, it was not included in the SAM. Moreover, there were in total 5 farm households in Gangyan that conducted rice trade in 2000. Given the number of sample farm households in Gangyan (168), the off-farm income from rice trade of these 5 farm households is negligible comparing to off-farm income of the whole village.

the government include an agricultural tax that is paid in the form of rice produced, and other taxes such as tax on water used for agricultural production etc.

## Calibration

Model calibration is the process of parameter selection. In this process, parameters are chosen such that the model outcomes replicate the original SAM (see Table 6E.2). When dealing with CES or CET functions, choosing exogenous substitution and transformation elasticities is necessary. Moreover, the expenditure function chosen requires the exogenous specification of budget shares of subsistence demand. In this chapter, substitution elasticities of pig and other livestock production and income elasticities of consumption are taken from Kuiper (2005) (see Table 6F.1). Other substitution and transformation elasticities are arbitrarily chosen. Tables 6F.2-3 give an overview of substitution and transformation elasticities used in the model.

In CGE analysis, only relative prices matter, all prices are set equal to one in the initial equilibrium (benchmark). By doing this all the flow values in the SAM can be interpreted as quantities. Once all parameters are specified, the model is solved to reproduce the benchmark. The solution obtained should be identical to the original SAM that is assumed to be an equilibrium outcome. Counterfactual equilibria can be calculated by introducing shocks to exogenous variables, e.g. taxes and off-farm wage, and changes in market conditions in the rice purchase market (market structure).

## 6.5 Scenarios and results

## 6.5.1 Scenarios

In Section 6.3, we discussed Cournot competition among the rice intermediates in the village rice export market. The simulations in this section are made using the CGE model including Cournot competition in the village rice export market. First scenarios are described. Second the simulation results are discussed.

As discussed in Chapter 2, there was still imperfect competition in the rice export market of Gangyan in 2000. In Chapter 4 we analyzed monopsony and Cournot competition. For simplicity, we assume here Cournot competition in the base scenario (the benchmark period). The following additional scenarios are defined (see Table 6.1 for a summary of the scenarios):

## Scenario 1:

In Chapter 4, it is said that consumer price of rice has been increasing since 2001. To be consistent with Chapter 4, scenario 1 simulates a 10% increase in the consumer price of rice assuming Cournot competition in the village rice export market. The consumer price is defined as the price intermediates receive when selling rice to the next actor in the marketing channel.

## Scenario 2:

From 2000 to 2003 the rice export market became more competitive (Chapter 2). Scenario 2 therefore takes into account the effects of market deregulation, e.g. the transition from Cournot competition to perfect competition.

## Scenario 3:

Scenario 3 combines scenarios 1 and 2 so it looks both at the effects of market deregulation and an increase in consumer price.

## Scenario 4:

In 2004, China's government introduced a subsidy per unit of land used for rice production in the previous year (Chapter 2). The introduction of the land subsidy can be interpreted as a new instrument to regulate agricultural markets. For Jiangxi province this subsidy equals 10 Yuan per unit of land (GAJP, 2004). Scenario 3 analyzes the effects of this subsidy. In the model we assume that the subsidy directly influences land allocation, so there is no time lag. In the model quantities are measured in base year prices. So we have to express the subsidy in a percentage of base year prices. For the base year price we take a value of 599.9 Yuan per mu<sup>59</sup> (Kuiper, 2005: 87). Therefore, we assume the subsidy equals 1.7% for one season rice and 3.3% for two season rice<sup>60</sup>.

## Scenario 5:

In 2004, China's government decided to reduce the agricultural tax by 3-7% and planned to remove it completely in a three-year period (Chapter 2). In this scenario, a complete abolition of the agricultural tax is considered. The removal of the agricultural tax is another step taken to deregulate agricultural markets.

Scenarios	Specification
Scenario 1	Market liberalization (Consumer price increases 10%);
Scenario 2	Market deregulation (Cournot $\rightarrow$ Perfect competition);
Scenario 3	Scenario 1+2: market liberalization + market deregulation;
Scenario 4	Direct land subsidy;
Scenario 5	Removal of agricultural tax.

Table 6.1 Scenarios

## 6.5.2 Results

A summary of the simulation results that mainly focus on changes in the production and consumption of one season and two season rice is presented in Table 6.2. Table 6G.1 in Appendix 6G provides an overview of changes in all the variables.

 $<sup>^{59}</sup>$  One mu is 1/15 of a hectare, i.e. 1 mu = 0.067 hectare.

<sup>&</sup>lt;sup>60</sup> Since two season rice consists of early rice and late rice, the land subsidy is therefore 20 Yuan per mu.

#### Scenario 1

Scenario 1 incorporates a 10% increase in the consumer prices of both types of rice. Table 6.2 shows that in scenario 1 the export prices that farm households receive for one season rice and two season rice both increase with 10.2%. This indicates the consumer price increase is more than fully transmitted from consumer level to farm gate in the rice marketing channel in Gangyan. The export price increase leads to an increase in rice export for one season rice and two season rice of 4.4% and 3.5% respectively. The export price increase leads to an aggregate output price increase for one season rice and two season rice by 5.7% and 4.9% respectively<sup>61</sup>. Consequently output of one season rice and two season rice increases by 2.3% and 1.1% respectively. This leads to an increase in input use. Labor input goes up with 1.5% and 0.7% in one season and two season rice production respectively. This leads to an increase in the price of labor used in rice production (labor is assumed heterogeneous in alternative usages). Land use goes up with 1.8% and 0.2% in one season and two season rice production respectively. Since the land endowment of the village is fixed, an increase in land input in rice production leads to a decrease in land use for other crop production. The increase in land demand leads to a price increase of 6.8% for land that is assumed homogenous in alternative usages. This implies that both labor and land are withdrawn from the production of other outputs. This has a negative effect on production of these outputs, and therefore, a positive effect on the output prices.

The increase in prices of labor and land lead to a full income increase of 4.7%. The increase in full income leads to an increase in consumption. The increase in the consumption of purchased goods is larger than for on-farm produced goods. This is due to the constant prices of purchased goods while prices of all on-farm produced goods increase. The increase in consumption of on-farm produced goods has a positive effect on output prices. This reduces the decrease in labor and land use in the production of these outputs.

The full income increase has a positive effect on the consumption of leisure while the increase in the price of leisure has a negative effect on the consumption of leisure. The price of leisure increases because the increase in labor use in rice production reduces the labor availability for leisure. The net effect is positive (0.8%).

The increase in labor use for rice production and leisure has a positive effect on the price of labor for on-farm use and leisure. Given that the off-farm wage remains constant this implies that off-farm labor supply decreases the most (2.0%).

Household welfare in terms of the equivalent variation in this scenario increases with 115,300 Yuan for farm households in Gangyan.

#### Scenario 2

Scenario 2 takes into account the effect of market deregulation, i.e. it compares Cournot with perfect competition in the village rice export market. The export price of one season and two

<sup>&</sup>lt;sup>61</sup> A zero profit condition equalizes the value of the aggregate output to the value of the outputs distributed. Table 6G.1 in Appendix 6G shows that price increases in rice output used as feed and household consumption are less than that of rice exported. Therefore, the price increase in aggregate rice output is less than the price increase in rice export.

season rice increases with 1.7% and 1.2% respectively (see also Table 4.3 in Chapter 4). This shows that deregulation (i.e. increasing competition) in rice purchase market leads to an increase in export price of rice that farm households receive. This leads to an increase in export of one season and two season rice by 0.9% and 0.4% respectively. The increase in export price of rice leads to an increase in aggregate output price of one season and two season rice by 0.8% and 0.7% respectively. Output of one season and two season rice therefore increases by 0.5% and 0.1% respectively. As a result, input use increases. Labor input increases with 0.3% and 0.1% in one season and two season rice production respectively. Consequently, the price of labor input increases with 1.2% and 0.7% in one season and two season rice production. The increase in land use in one season rice production (0.5%) leads to a slightly decrease in land use in two season rice production (0.3%) given the fixed land endowment. The increase in land use for two season rice production increases the land price by 1.0%. The reduction in land use for two season rice and other crop production has a negative effect on the production of the other outputs. This has a positive effect on the prices of these outputs.

Full income of farm households increases with 0.6% due to increases in the prices of labor and land. As a result there is an increase in the consumption of the farm household. Given the constant prices of purchased goods, the increase in consumption of purchased goods is larger than that for on-farm produced goods. The increase in consumption of on-farm produced goods has a positive effect on output prices, which partly offsets the decrease in labor and land use in the production of these outputs.

The price for leisure increases with 0.8% due to increases in labor use in rice and cattle production. This reduces the labor availability for leisure. However, leisure consumption increases with 0.1%. This indicates the positive effect of the full income increase is larger than the negative effect of the leisure price increase on leisure consumption.

The increase in prices of labor for on-farm use and leisure is caused by the increase in labor use for rice, cattle production and leisure. The 0.3% decrease in off-farm labor supply is due to the constant off-farm wage, so the relative price decreases.

In this scenario household welfare increases with 16,000 Yuan for farm households.

## Scenario 3

Scenario 3 compares Cournot with perfect competition in the village rice export market when the consumer prices of both types of rice increase with 10%. The results are similar to that of scenario 2 but the magnitude of the changes is larger.

Table 6.2 shows that besides that the price change is more than fully transmitted from consumer level to farm gate there is now also a positive effect on the export price because of the market deregulation. The export prices for one season and two season rice increase with 12.2% and 11.6% respectively. This leads to an increase in aggregate output price of one season and two season rice by 6.7% and 5.8% respectively (see also Table 4.3 in Chapter 4), which is much

higher than in scenario 1 and 2. Consequently, aggregate output of one season and two season rice increases with 2.9% and 1.2% respectively.

The large increase in aggregate output of one season rice leads to large increase in input use. Labor input in one season and two season rice production increases with 1.9% and 0.8% respectively. Correspondingly, the price of labor input in one season and two season rice production increases with 8.9% and 6.5% respectively. Land input of other crop production decreases with 2.0%. This is due to the increase in land input in one season (2.3%) and two season rice production (0.2%), the fixed land endowment then automatically leads to a reduction in other uses. The price of land increases with 8.0%. Compared to scenario 2, more land and labor are withdrawn from the production of other outputs. This leads to larger decreases in the quantities of these outputs produced and larger increases in their output prices.

The full income increases with 5.5% due to the increases in land and labor prices. The consumption increases more than in scenario 1 and 2. The constant price of purchased goods leads to a relatively large increase in the consumption of these goods.

There is an increase in the price of leisure of 6.7%. The positive effect on leisure consumption of the full income increase is larger than the negative effect of the leisure price increase. As a result the consumption of leisure increases with 0.9%. Given that all prices for labor use increase except the off-farm wage that remains constant, off-farm supply decreases (2.3%).

Household welfare in terms of the equivalent variation increases with 133,600 Yuan that is higher than in scenario 1 and 2.

#### Scenario 4

Scenario 4 calculates the effects of a 1.7% and 3.3% subsidy on land use in one season and two season rice production respectively. This implies that the price of land used in rice production decreases relatively to the price of land in other crop production. This implies relatively more land is used in rice production, especially in two season rice production due to higher subsidy. Table 6.2 shows that land use for two season rice production increases with 0.8%. Given the fixed land endowment land use decreases with 0.9% in one season rice production and with 0.7% in other crop production. The increase in land use for two season rice production causes an increase in the output of two season rice by 0.5%. The decrease in land input use leads to a decrease in output of one season rice with 0.7% and other crops with 0.4%. The increase in two season rice production has a negative effect on the output prices of two season rice. The decrease in one season rice and other crop production has a positive effect on the price of one season rice (0.9%) and other crops (2.1%).

The subsidy increases the prices of labor and land (the decrease in the price of land used for two season rice production is due to the negative effect of the increase in land use). The increase in prices of labor and land lead to a full income increase of 1.9%. The increase in full income leads to an increase in consumption. Consumption increases with 0.1% for one season rice and 0.5% for two season rice. This has a positive effect on the output prices of both types

of rice. For one season rice, the positive effects of an increase in consumption and a decrease in land use lead to an increase in its output price with 0.9%. For two season rice, the positive effect is larger than the negative effect from the increased land use this leads to a small but positive change in its output price. The increase in consumption of purchased goods is larger than on-farm produced goods because the prices of purchased goods remain constant while the prices of on-farm produced goods increase (except for two season rice). The increase in consumption of on-farm produced goods has positive effects on the output prices of these goods.

The increase in two season rice output has positive effects on two season rice supplied to the rest of the world (0.5%), intermediate input use (0.7%), and household consumption (0.5%). The decrease in one season rice output has negative effects on its household consumption, exports and intermediate demand. The increase in one season rice consumption leads to decrease in one season rice supplied to the rest of the world (-1.2%) and intermediate input use (-1.0%). Exporting one season rice is relatively unattractive because its export price increase is smaller than the price increases of household consumption and intermediate input demand. The price of output for both types of rice used as feed increases with 0.4%. The export of other crops decreases with 1.4% due to the decrease in the output.

The increase in full income increases the demand for leisure (0.4%). As a result the price of leisure increases with 2.4%. The increase in leisure has a negative effect on the supply of labor to alternative uses as off-farm employment ((0.8%)) and e.g. rice production ((0.6%) for one season rice and (0.1%) for two season rice). This leads to an increase in the price of labor to these alternative usages.

Household welfare in terms of the equivalent variation increases with 57,900 Yuan for farm households in Gangyan. Given the relatively small subsidy the effects are also small in this scenario.

## Scenario 5

Scenario 5 removes the agricultural tax. Since the tax is paid in terms of rice produced, the removal of the agricultural tax implies that relatively more rice will be used as feed, consumed and exported. Therefore, there is a negative effect on the price of rice (1.5% and 1.7% for one season and two season rice respectively). The export of one season and two season rice increases with 3.8% and 2.7% respectively while there is a very small but negative change in the export price for one season and two season rice. Rice supplied to intermediate input use (feed) increases with 3.3% and 2.3% for one season and two season rice respectively while the feed price decreases with 0.9%. Rice consumption increases with 1.5% for one season rice and 1.3% for two season rice. This is because the negative effect of an increase in rice supplied to consumption on the consumption price is larger than the positive effect of an increase in rice demand on the consumption price. The increase in rice consumption has a positive effect on the aggregate output price. However, this effect is smaller than the negative effect of an increase

Changes (%)	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Aggregate output					
One season rice	2.3	0.5	2.9	-0.7	0.9
Two season rice	1.1	0.1	1.2	0.5	-2.1
Aggragata autout prica					
One season rice	57	0.8	67	0.9	-1.5
Two season rice	4 9	0.7	5.8	+0.0	-1.7
i wo season nee	1.2	0.1	5.0	0.0	1.1
Export					
One season rice	4.4	0.9	5.5	-1.2	3.8
Two season rice	3.5	0.4	3.9	0.5	2.7
Enne ent mut					
One season rice	10.2	17	12.2	+0.0	.0.0
Two season rice	10.2	1.7	11.6	+0.0	-0.0
i wo season nee	10.2	1.2	11.0	.0.0	-0.0
Land					
One season rice	1.8	0.5	2.3	-0.9	1.4
Two season rice	0.2	-0.0	0.2	0.8	-1.8
D: (1 1					
Price of land	6.8	1.0	80	1.1	2.4
	6.8	1.0	8.0	1.1	-2.4
Other products	0.0 6.8	1.0	8.0 8.0	-0.5	-2.4
Other products	0.0	1.0	0.0	1.0	-2.4
Labor					
One season rice	1.5	0.3	1.9	-0.6	-0.5
Two season rice	0.7	0.1	0.8	-0.1	-2.0
Off-farm	-2.0	-0.3	-2.3	-0.8	-1.1
Leisure	0.8	0.1	0.9	0.4	0.8
Price of labor					
One season rice	7.4	1.2	8.9	0.5	1.3
Two season rice	5.7	0.7	6.5	1.4	-1.9
Off-farm	0.0	0.0	0.0	0.0	0.0
Leisure	5.7	0.8	6.7	2.4	3.8
Consumption					
One season rice	0.7	0.1	0.9	0.1	1.5
Two season rice	0.5	0.1	0.6	0.5	1.3
Consumption price					
One season rice	2.5	0.1	2.6	2.6	-4.3
Two season rice	3.9	0.6	4.7	-0.1	-2.8
Full income	4.7	0.6	5.5	1.9	1.1
Equivalent variation (10 <sup>3</sup> Yuan)	115.3	16.0	133.6	57.9	124.2

## Table 6.2Summary of simulation results

in aggregate output on the output price.

The increase in the aggregate output of one season rice leads to an increase in its land input use by 1.4% while the decrease in the aggregate output of two season rice leads to the decrease in its land input use by 1.8%. Land use in other crop production goes up (1.9%). The land price decreases with 2.4%. Labor input decreases 0.5% in one season rice production and 2.0% in two season rice production. The price of labor used for rice production increases with 1.3% for one season rice while it decreases with 1.9% for two season rice.

The decrease in land price and labor price for two season rice and cattle production has negative effects on full income while the increase in labor price for other on-farm activities and leisure has positive effects on full income. The net effect is positive but small, i.e. 1.1%. The increase in full income leads to an increase in consumption of both on-farm produced goods and purchased goods. The relatively larger increase in the consumption of purchased goods is due to their fixed prices.

The increase in full income leads to a 0.8% increase in leisure demand. As a result the price of leisure increases with 3.8%. The increase in leisure has negative effects on the supply of labor to alternative uses as off-farm employment (-1.1%) and rice production (-0.5% for one season rice and -2.0% for two season rice production).

Household welfare in terms of the equivalent variation increases with 124,200 Yuan for farm households.

## 6.6 Concluding remarks

The aim of this chapter is to analyze the effects of rice market deregulation and liberalization for farm households in Gangyan. To reach this aim a nonseparable household CGE model is developed and applied to analyze how market imperfections in the rice export markets of the village influence the production and consumption decisions of farm households. Cournot competition between rice intermediates in the village rice export market is assumed in the base scenario. Effects of an increase in competition and the effect of an increase in consumer price as a consequence of market liberalization are determined in different scenarios. In addition, the effects of the introduction of a land subsidy and the removal of the agricultural tax are also simulated. The first can be seen as a sign that the government of China still wants to influence the functioning and outcomes of markets. The second is another example of deregulation.

One advantage of the CGE model compared to the models presented in chapter 4 and 5 is that it allows calculating changes in welfare in terms of the EV. It is therefore more suitable for policy analyses. The positive welfare changes indicate that the farm households benefit from the policy changes simulated. The welfare gain of the farm households is the largest under the scenario that combines market deregulation and the consumer price increase. Farm households benefit the least from market deregulation among all the scenarios. This indicates that the degree of competition in the rice purchase market is already intense in 2000 so that the gain of

market deregulation is less obvious<sup>62</sup>. The positive effects of the land subsidy are much less than that of the removal of the agricultural tax, which is in line with findings from Heerink et al. (2006).

In Chapter 4, the export of rice increases with 3.3% and the export price of rice increases with 3.7% in the market deregulation scenario. In this chapter, the export of rice increases with 0.9% for one season rice and 0.4% for two season rice (scenario 2). The export price of rice increases with 1.7% for one season rice and 1.2% for two season rice (scenario 2). Hence we can conclude that the positive changes for the export and export price of rice in this chapter are less than that in Chapter 4. This is because Chapter 4 only modeled rice export taken rice production as given. It did not take into account the effects of market deregulation on the production of rice. In Chapter 4 rice production is allocated between rice export, household consumption of rice and rice paid as agricultural tax. Given constant rice production and agricultural tax, changes in rice export are modeled via changes in rice consumption. The rice export price equaled the rice consumption price. Rice consumption was modeled as a linear function of exogenous variables (i.e. rice export price, household full income, number of household members, and the planted area of rice) so that an increase in one exogenous variable has no effects on others. Hence an increase in rice export price only led to a decrease in rice consumption, which resulted in an increase in rice export. In addition, Chapter 4 did not differentiate one season rice from two season rice. While in this chapter the change in the export price of rice has positive effects on rice production. The fixed land endowment restricts the growth in rice production. Moreover, it implies that an increase in land use in one season rice production restricts the increase in land use in two season rice production, and therefore, restricts its output increase. Market deregulation leads to an income increase. This increase has a positive effect on the production and consumption of on-farm produced goods. This production increase and consumption increase limit the growth of rice production. The increase in leisure demand lowers on-farm labor supply, and therefore, also restricts the production growth of rice.

Our CGE model is subject to some caveats. First, simulation results are conditional upon the structure of the model. The alternatives could be, for example, a nested production technology with a more layered structure or the use of flexible functional forms. Notice however that the use of CES/CET functions in production and consumption allows for a more flexible model than the use of Cobb-Douglas and/or Leontief functions (special cases of CES/CET). Second, the outcomes of the model are subject to the selected values of the substitution and transformation elasticities which are arbitrarily chosen.

<sup>&</sup>lt;sup>62</sup> This conclusion is drawn upon simulation results based on specific assumptions applied in this thesis. According to Chapter 4 and 5, the impact of a change in market structure on farm price in a village depends on the degree of imperfect competition before market liberalization and deregulation.

## Appendix 6A Overview of the Computable General Equilibrium model

Based on the SAM a Computable General Equilibrium (CGE) model for the village is developed. The CGE model explains all commodity, factor and income flows represented in the SAM. In this model, farm households are both producers and consumers. They decide on the demand for inputs and supply of outputs to minimize their costs. They also decide on the demand for commodities and supply of their factor endowments to maximize their utility. Their demand and supply are equilibrated in markets by (shadow) prices<sup>63</sup>.

This appendix discusses and provides a mathematical description of the CGE model.

## Agricultural production

Production of crop and livestock products (the activities) takes place according to a nested production structure (see Figure 6.1). At the lowest level factor inputs are combined using a Constant Elasticity of Substitution (CES) production function into an aggregate factor input. Also at the lowest level variable inputs (intermediate and external inputs) are combined into an aggregate variable input also using a CES production function. The aggregate factor input and aggregate variable input are combined using a CES production function into an aggregate output. The CES production functions are assumed to have constant returns to scale. This implies that pure profits, profits not accruing to an input, are zero. It is assumed that at each level costs are minimized subject to the relevant CES production function. This results at each level in demand functions for inputs from the lower level.

The cost minimization of the factor inputs needed to produce the aggregate factor input is described by:

$$\min_{QFI_{af}} \sum_{f \in F_a} PFI_{af} \times QFI_{af} \qquad \qquad \forall a \in A \qquad (6A1)$$

s.t. 
$$QFIA_a = CES(QFI_a)$$
  $\forall a \in A$  (6A2)

Cost minimization results in the demand equations for individual factor inputs:

$$QFI_{af} = CES(QFIA_a, PFI_a) \qquad \forall a \in A, f \in F_a \qquad (6A3)$$

where:  $PFI_{af}$  price of factor input *f* in activity *a*,  $QFI_{af}$  quantity of factor input *f* used in activity *a*,  $QFIA_a$  quantity of aggregate factor input in activity *a*,  $QFI_a$  vector of quantities of factor inputs used in activity *a*,  $PFI_a$  vector of prices of factor inputs used in activity *a*,  $CES(\cdot)$  is CES production function of the aggregate factor input or CES factor input demand equations, *a* is activity (*a* = 1 one season rice, *a* = 2 two season rice, *a* = 3 other crops, *a* = 4 cattle, *a* = 5 pig, *a* = 6 other livestock), *f* is factor input (*f* = 1 labor, *f* = 2 land, *f* = 3 tractor).

The cost minimization of the variable inputs needed to produce the aggregate variable input is given by:

<sup>&</sup>lt;sup>63</sup> The prices in the model are in a number of cases not observed, e.g. in case of leisure. Unobserved prices are usually called shadow prices; here we just use the term prices.

$$\min_{QVI_{av}} \sum_{v \in V_a} PVI_v \times QVI_{av} \qquad \qquad \forall a \in A \qquad (6A4)$$

s.t.  $QVIA_a = CES(QVI_a)$   $\forall a \in A$  (6A5)

Cost minimization results in the demand equations for individual variable inputs:

$$QVI_{av} = CES(QVIA_{a}, PVI) \qquad \forall a \in A, v \in V_{a}$$
(6A6)

where:  $PVI_v$  price of variable input v,  $QVI_{av}$  quantity of variable input v used in activity a,  $QVIA_a$  quantity of aggregate variable input in activity a,  $QVI_a$  vector of quantities of variable inputs used in activity a, PVI vector of prices of variable inputs, CES(·) is CES production function of the aggregate variable input and CES variable input demand equations, v is variable input (v = 1 manure, v = 2 feed, v = 3 oxen, v = 4 fertilizer, v = 5 herbicide, v = 6 pesticide, v = 7 purchased seed, v = 8 purchased feed, v = 9 other inputs).

At the top of the nest, aggregate output is produced with a CES production function using the aggregate factor input and aggregate variable input as inputs. Demand for the aggregate variable input and aggregate factor input follow from cost minimization subject to the CES production function. Cost minimization is given by:

$$\min_{QVIA_a, QFIA_a} (PVIA_a \times QVIA_a + PFIA_a \times QFIA_a) \qquad \forall a \in A \qquad (6A7)$$

s.t. 
$$QOU_a = CES(QVIA_a, QFIA_a)$$
  $\forall a \in A$  (6A8)

The demand equations for the aggregate factor input and the aggregate variable input equal:

$$QFIA_{a} = CES(QOU_{a}, PVIA_{a}, PFIA_{a}) \qquad \forall a \in A \qquad (6A9)$$

$$QVIA_{a} = CES(QOU_{a}, PVIA_{a}, PFIA_{a}) \qquad \forall a \in A \qquad (6A10)$$

where:  $PVIA_a$  price of aggregate variable input in activity *a*,  $PFIA_a$  price of aggregate factor input in activity *a*,  $QOU_a$  quantity of aggregate output produced by activity *a*,  $CES(\cdot)$  is CES production function for aggregate output and the CES aggregate variable input and CES aggregate factor input demand equation.

Given that there are zero pure profits the value of the inputs equals the value of the output produced with these inputs. So we have the following three zero profit conditions:

$$PFIA_{a} \times QFIA_{a} = \sum_{f \in F_{a}} PFI_{af} \times QFI_{af} \qquad \forall a \in A \qquad (6A11)$$

$$PVIA_{a} \times QVIA_{a} = \sum_{v \in V_{a}} PVI_{v} \times QVI_{av} \qquad \forall a \in A \qquad (6A12)$$

$$POU_{a} \times QOU_{a} = PFIA_{a} \times QFIA_{a} + PVIA_{a} \times QVIA_{a} \qquad \forall a \in A \qquad (6A13)$$

where:  $POU_a$  price of aggregate output produced by activity *a*.

#### Aggregate output distribution

The aggregate output produced by the farm is assumed to be composed of three outputs: an intermediate input, consumer good and export commodity. The three outputs are assumed to be imperfect substitutes. Depending on the relative prices of the three outputs more or less will be produced of one of the outputs. Aggregate output is transformed in the three outputs using a Constant Elasticity of Transformation (CET) function (see upper part of Figure 6.1). However, for rice it is assumed that first a fixed share of rice production is paid as a tax. For livestock it is assumed that manure production is a fixed share of total production. Therefore, manure is subtracted from total livestock production and the rest is then also transformed in the three outputs using a CET transformation function. It is assumed that the farm household maximizes its revenue of distributing its aggregate output over the different outputs subject to the CET transformation function.

$$QOUZ_{g} = (1 - rtxr_{g}) \times QOU_{g} \qquad \forall g \in G \qquad (6A14)$$

$$QOUZ_{j} = (1 - rman_{j}) \times QOU_{j} \qquad \forall j \in J \qquad (6A15)$$

$$QOUZ_k = QOU_k \qquad \qquad \forall k \in K \qquad (6A16)$$

where:  $QOU_g$  quantity of aggregate rice produced by activity g,  $QOUZ_g$  quantity of aggregate rice produced by activity g excluding the agricultural tax,  $QOU_j$  quantity of aggregate livestock produced by activity j,  $QOUZ_j$  quantity of aggregate livestock produced by activity j excluding manure,  $QOU_k$  and  $QOUZ_k$  quantity of aggregate other output produced by activity k,  $rtxr_g$  tax rate for aggregate rice produced by activity g,  $rman_j$  share of manure in total aggregate output of livestock activity j, g is the index for rice (g = 1 one season rice), j is the index for livestock (j = 1 cattle, j = 2 pig), k is the index for other activities (k = 1 other crops, k = 2 other livestock).

$$\max_{QO_{am}} \left( \sum_{m \in M} PO_{am} \times QO_{am} \right) \qquad \qquad \forall a \in A \qquad (6A17)$$

s.t. 
$$QOUZ_a = CET(QO_a)$$
  $\forall a \in A$  (6A18)

where:  $PO_{am}$  price of output *m* produced by activity *a*,  $QO_{am}$  quantity of output *m* produced by activity *a*,  $QOUZ_a$  quantity of aggregate output (excluding rice tax and manure) produced by activity *a*,  $QO_a$  vector of quantities of outputs *m* produced by activity *a*,  $CET(\cdot)$  is CET transformation function for aggregate output distribution, *m* is different outputs (*m* = 1 feed, *m* = 2 oxen, *m* = 3 consumer good, *m* = 4 export).

The supply functions of outputs *m* produced by activity *a* are given by:

$$QO_{am} = CET(QOUZ_{a}, PO_{a}) \qquad \forall a \in A, m \in M \qquad (6A19)$$

where:  $PO_a$  vector of prices of outputs *m* produced by activity *a*,  $CET(\cdot)$  is CET output supply functions.

The zero profit conditions are given by:

$$POUZ_{a} \times QOUZ_{a} = \sum_{m \in M} PO_{am} \times QO_{am} \qquad \forall a \in A \qquad (6A20)$$

$$POU_{g} \times QOU_{g} = \overline{PTAX}_{g} \times rtxr_{g} \times QOU_{g} + \sum_{m \in M} PO_{gm} \times QO_{gm} \qquad \forall g \in G \qquad (6A21)$$

$$POU_{j} \times QOU_{j} = PMAN_{j} \times rman_{j} \times QOU_{j} + \sum_{m \in M} PO_{jm} \times QO_{jm} \qquad \forall j \in J$$
(6A22)

$$POU_{k} \times QOU_{k} = \sum_{m \in M} PO_{km} \times QO_{km} \qquad \forall k \in K$$
(6A23)

where:  $POUZ_a$  price of aggregate output (excluding rice tax and manure) produced by activity *a*,  $POU_g$  price of aggregate output of activity *g*,  $POU_j$  price of aggregate output of activity *k*,  $PO_{gm}$  price of output *m* produced by activity *g*,  $QO_{gm}$  quantity of output *m* produced by activity *g*,  $PO_{jm}$  price of output *m* produced by activity *j*,  $QO_{gm}$  quantity of output *m* produced by activity *j*,  $PO_{km}$  price of other output *m* produced by activity *k*,  $QO_{km}$  quantity of output *m* produced by activity *k*,  $PO_{km}$  price of other output *m* produced by activity *k*,  $PTAX_g$  price of the aggregate output *g* that is taxed,  $PMAN_j$  price of manure produced by activity *j*.

#### Household consumption

Income of the farm household comes from return on the factor inputs (labor, land, and tractor) and transfers from the rest of the world (remittances). We have:

$$Y = \sum_{a \in A} PFIA_a \times QFIA_a + \overline{TRF}$$
(6A24)

where: Y full income of farm household,  $\overline{TRF}$  transfers.

The farm household pays taxes. In the model two taxes are explicitly modeled. First, there is the rice tax. A fixed share of the aggregate rice produced has to be paid as a tax. Second, there is a fixed other tax<sup>64</sup>. Expenditure equals the full income minus both taxes.

$$TXR = \sum_{g \in G} \overline{PTAX}_g \times rtxr_g \times QOU_g \qquad \qquad \forall g \in G \qquad (6A25)$$

$$E = Y - \overline{TXY} - TXR \tag{6A26}$$

where: TXR rice tax,  $\overline{TXY}$  other tax, E expenditure.

Farm households spend their full income after having paid taxes on the consumption of goods produced on-farm, consumption of purchased goods (food, non-food, durables and other) and leisure<sup>65</sup>.

<sup>&</sup>lt;sup>64</sup> This mixture of taxes and fees includes a tax on livestock production, rent of contracted land, fees for public accumulation funds, public welfare funds, and salary of head of a village etc. The original SAM does not allow modeling these different taxes and fees separately, therefore we assume the other tax to be a fixed amount.

<sup>&</sup>lt;sup>65</sup> Savings of the farm households are not considered here because the original SAM contains no data on savings.

Household demand follows from utility maximization subject to full income. We assume the following Gorman polar expenditure function:

$$E = \sum_{\tau \in \mathbb{R}} PH_{\tau} \times QSH_{\tau} + U \times CES(PH)$$
(6A27)

where:  $PH_r$  price of consumption good r,  $QSH_r$  subsistence quantity of consumption good r, U utility,  $CES(\cdot)$  CES aggregate of prices consumption goods, PH vector of prices of consumption goods, r is index for consumption goods (r = 1 one season rice, r = 2 two season rice, r = 3 other crops, r = 4 cattle, r = 5 pig, r = 6 other livestock, r = 7 leisure, r = 8 food, r = 9 non-food, r = 10 durables, r = 11 other expenses).

From this expenditure function Marshallian demand functions for the individual consumption goods can be derived using Roy's identity (see Deaton and Muellbauer, 1983, p. 144; Peerlings, 1993, p. 65-66 and 73).

$$QH_r = ES(PH, QSH, E) \qquad \forall r \in R \qquad (6A28)$$

where:  $QH_r$  quantity of consumption good *r*, **QSH** vector of subsistence quantities of consumption goods,  $ES(\cdot)$  is the functional form of the demand function for consumption good *r* following from equation (6A27).

Labor

The aggregate labor endowment of the farm household is supplied to the different farm activities (on-farm labor), leisure, and off-farm labor (off-farm employment). These different types of labor are assumed to be imperfect substitutes. Prices equilibrate labor supply and demand for each individual type of labor. Labor endowment is divided over the different destinations using a CET transformation function. It is assumed that the farm household maximizes its revenue of distributing its aggregate labor over the different destinations subject to the CET transformation function.

$$\max_{QLA_1} \left( \sum_{l \in L} PLA_l \times QLA_l \right)$$
(6A29)

s.t. 
$$\overline{QTLA} = CET(QLA)$$
 (6A30)

where: QTLA endowment of aggregate household labor,  $PLA_l$  price of labor of type l,  $QLA_l$  quantity of labor of type l, QLA vector of quantities of different labor types,  $CET(\cdot)$  is CET transformation function for aggregate labor distribution, l is index for different types of labor (l = 1,...,6, on-farm labor supply to the different activities, l = 7 leisure, l = 8 off-farm labor supply).

The supply functions of leisure, on-farm labor supply, and off-farm labor supply are:

$$QLA_l = CET(\overline{QTLA}, PLA)$$
  $\forall l \in L$  (6A31)

where: **PLA** vector of prices of different labor types,  $CET(\cdot)$  is CET transformation function for aggregate labor distribution.

The zero profit condition is given by:

$$PTLA \times \overline{QTLA} = \sum_{i \in L} PLA_i \times QLA_i$$
(6A32)

where: PTLA price of aggregate household labor.

## Price block

It is assumed that there are no commodity taxes. This implies there are no price wedges between supply and demand prices. This implies that the prices of the outputs consumed by the household equal the prices paid by the household (m=3). Therefore:

$$PH_r = PO_{a,m=3} \qquad \qquad \forall r, a \in A \qquad (6A33)$$

This also implies that the price of the supply of feed (v = 2 and m = 1) equals the price of feed paid by the activities. Moreover, the price of feed does not vary between activities. The same goes for oxen services (v = 3 and m = 2). Therefore:

$$PVI_{v=2} = PO_{a=1,m=1} = PO_{a=2,m=1} = PO_{a=3,m=1}$$
(6A34)

$$PVI_{v=3} = PO_{a=1,m=2} = PO_{a=2,m=2} = PO_{a=3,m=2}$$
(6A35)

It is assumed that all prices of the consumer goods bought by the farm household are exogenous and constant. This also holds for the prices of the external inputs. The prices of the products exported are also assumed exogenous and constant. The price of off-farm labor supply is also assumed exogenous and constant. These assumptions imply that a change in demand or supply of the farm household does not affect prices outside the village.

It is assumed that the price of leisure consumed (r = 7) equals the price of labor supplied as leisure (l = 7). It is also assumed that the price labor (f = 1) demanded by activity a (a = 1,...,6) equals the price of labor of type l (l = 1,...,6) supplied by the farm household.

$$PH_{r=7} = PLA_{1=7} \tag{6A36}$$

$$PFI_{a,l=1} = PLA_l \qquad \qquad \forall a, l = 1, \dots, 6 \qquad (6A37)$$

#### Equilibrium conditions

The total endowment of a factor (except labor) equals the total use in different activities:

$$QTFI_{f=2} = \sum_{a \in A} QFI_{a,f=2}$$
(6A38)

$$\overline{QTFI}_{f=3} = \sum_{a \in A} QFI_{a,f=3}$$
(6A39)

where:  $\overline{QTFI_f}$  endowment of factor *f*.

The markets of feed (m=1 and v=2) and oxen services (m=2 and v=3) are in equilibrium when total supply equals total demand:

$$\sum_{a \in A} QO_{a,m=1} = \sum_{a \in A} QVI_{a,v=2}$$
(6A40)

$$\sum_{a \in A} QO_{a,m=2} = \sum_{a \in A} QVI_{a,v=3}$$
(6A41)

The consumption of good r that is produced on the farm equals the output supplied to this demand category:

$$QH_a = QO_{a,m=3} \qquad \qquad \forall a \in A \qquad (6A42)$$

The demand of leisure equals its supply:

$$QH_{r=7} = QLA_{l=7} \tag{6A43}$$

Labor demanded as a factor input in activity *a* equals labor supplied by the farm household:

$$QFI_{a,l=1} = QLA_l \qquad \forall a, l = 1, \dots, 6 \qquad (6A44)$$

## Trade Balance

The total value of purchased consumer goods, purchased variable inputs, and other tax equals:

$$IMP = \sum_{a \in Av \in V} PVI_{v} \times QVI_{av} + \sum_{r \in R} PH_{r} \times QH_{r} + \overline{TXY} \qquad \forall r = 8,...,11$$
(6A45)

where: IMP costs in the transactions with the rest of the world.

The total value of exported outputs, off-farm labor supply and transfers equals:

$$EXP = \sum_{a \in A} PO_{a,m=4} \times QO_{a,m=4} + \sum PLA_{l=8} \times QLA_{l=8} + \overline{TRF}$$
(6A46)

(6A47)

where: EXP revenue in the transactions with the rest of the world.

The trade balance is captured by the difference between the value of *IMP* and *EXP*. The trade balance should be in equilibrium:

$$BAL = IMP - EXP = 0$$

where: BAL balance of trade.

#### Welfare

Welfare changes in the model are measured using the equivalent variation:

$$EV = \frac{a(\mathbf{PH}^{\circ})b(\mathbf{PH}^{\prime}) + E^{\prime}b(\mathbf{PH}^{\circ}) - a(\mathbf{PH}^{\prime})b(\mathbf{PH}^{\circ}) - E^{\circ}b(\mathbf{PH}^{\prime})}{b(\mathbf{PH}^{\prime})}$$
(6A48)

where: EV equivalent variation, a(PH) expenditure of subsistence demand, b(PH) expenditure on supernumerary demand per unit of utility, E expenditure of the household, superscript o indicates the initial situation, i.e. the initial consumption prices and expenditure,
superscript ' indicates the new situation, i.e. the new consumption prices and expenditure (see Appendix 6D for the derivation of the EV).

In the model the prices outside the village are assumed exogenous. This implies they function as price numeraire(s) in the model. All price and income changes should be interpreted relative to these prices. Careful counting shows that the number of variables equals the number of exogenous variables plus the number of equations plus 1. Therefore we drop the balance of trade equation. This provides a powerful check, after any change of the exogenous variables the balance of trade should still be in equilibrium. Changing all exogenous prices, transfers and other tax with x% shows that all prices and income variables in the model change x% while quantities remain unchanged. The model is therefore homogenous of degree zero in prices and income.

# Appendix 6B Glossary

Sets and subsets

$A(\subset R and \subset V)$	activities / aggregate outputs
F	factor inputs
$F_a(\subset F)$	factor inputs used in activity <i>a</i>
V	variable inputs
$V_a (\subset V)$	variable inputs used in activity a
$G(\subset A)$	aggregate rice outputs (one / two season rice)
$J(\subset A)$	aggregate livestock outputs (cattle / pig)
$K(\subset A)$	aggregate other outputs (other crops / other livestock)
M	outputs (feed, oxen, consumer good, export)
K I	goods consumed
$a \in A$	activity / output a
$f \in F$	factor input f
$v \in V$	variable input v
g∈G	aggregate rice output g
j∈J	aggregate livestock output <i>j</i>
$k \in K$	aggregate other output k
$m \in M$	output m
$r \in R$	consumer good r
$l \in L$	labor type <i>l</i>
Variables	
$QFI_{af}$	quantity of factor input <i>f</i> used in activity <i>a</i>
$QVI_{av}$	quantity of variable input $v$ used in activity $a$
QFIA <sub>a</sub>	quantity of aggregate factor input in activity <i>a</i>
$QVIA_{a}$	quantity of aggregate variable input in activity $a$
$QOU_{a}$	quantity of aggregate output produced by activity <i>a</i>
$QOU_{s}$	quantity of aggregate rice produced by activity g
$QOU_i$	quantity of aggregate livestock produced by activity <i>j</i>
$QOU_k$	quantity of aggregate other output produced by activity k
QOUZ	quantity of aggregate rice produced by activity g excluding the agricultural
8	tax
$QOUZ_i$	quantity of aggregate livestock produced by activity <i>j</i> excluding manure
$QOUZ_{\mu}$	quantity of aggregate other output produced by activity $k$
QOUZ	quantity of aggregate output (excluding rice tax and manure) produced by
- u	activity a

$QO_{am}$	quantity of output m produced by activity a
$QO_{gm}$	quantity of output m produced by activity g
$QO_{jm}$	quantity of output m produced by activity j
QO <sub>km</sub>	quantity of output m produced by activity $k$
QH <sub>r</sub>	quantity of consumption good r
$QH_{a}$	quantity of consumption good supplied by activity a
QSH,	subsistence quantity of consumption good <i>r</i>
$QLA_{l}$	quantity of labor of type <i>l</i>
$PFI_{af}$	price of factor input $f$ in activity $a$
PVI	price of variable input <i>v</i>
PFIA <sub>a</sub>	price of aggregate factor input in activity <i>a</i>
PVIA <sub>a</sub>	price of aggregate variable input in activity <i>a</i>
$POU_a$	price of aggregate output produced by activity a
POUg	price of aggregate rice produced by activity g
$POU_{j}$	price of aggregate livestock produced by activity $j$
$POU_{k}$	price of aggregate other output produced by activity $k$
$POUZ_a$	price of output (excluding agricultural tax or manure) produced by activity
	а
PO <sub>am</sub>	price of output <i>m</i> produced by activity <i>a</i>
$PO_{gm}$	price of rice output <i>m</i> produced by activity g
$PO_{_{jm}}$	price of livestock output <i>m</i> produced by activity <i>j</i>
$PO_{km}$	price of other output $m$ produced by activity $k$
$PH_r$	price of consumption good <i>r</i>
$PLA_{l}$	price of labor of type <i>l</i>
PTLA	price of aggregate household labor
$PMAN_{j}$	price of manure produced by activity <i>j</i>
Y	full income
E	expenditure
U	utility
TXR	rice tax
IMP	cost with transactions with the rest of the world
EXP	revenue with transactions with the rest of the world
BAL	trade balance
Vectors	
QFI	vector of quantities of factor inputs used in activity a
QVI	vector of quantities of variable inputs used in activity a

**QO**<sub>a</sub> vector of quantities of outputs *m* produced by activity *a* 

QSH	vector of subsistence quantity of consumption good
QLA	vector of quantities of different labor types
PFI	vector of prices of factor inputs used in activity <i>a</i>
PVI	vector of prices of variable inputs
PO <sub>a</sub>	vector of prices of outputs <i>m</i> produced by activity <i>a</i>
PH	vector of price of consumption goods
PLA	vector of prices of different labor types
Parameters	
rtxr <sub>g</sub>	tax rate for aggregate rice produced by activity g
rman <sub>j</sub>	share of manure in total aggregate output of livestock activity <i>j</i>
Functions	
CES	Constant Elasticity Substitution
CET	Constant Elasticity Transformation
ES	demand function following from the selected Gorman polar expenditure
	function
Exogenous	
$\overline{\text{PTAX}}_{s}$	price of aggregate output g that is taxed
TRF	transfers
TXY	other tax
QTLA	endowment of aggregate household labor
$\overline{\text{QTFI}}_{f}$	endowment of factor f, excluding labor

Other exogenous prices are prices of purchased consumption goods, prices of purchased variable inputs, export prices of on-farm produced outputs (except one season and two season rice), and off-farm wage. They are not indicated here because these prices are part of vectors with other prices.

#### Appendix 6C Functional forms

This appendix presents the functional forms chosen in the model. Instead of presenting all functions we give some examples.

#### Cost minimization

Cost minimization given a CES production function results in the CES cost function. For the production of the aggregate variable input with the variable inputs this cost function equals:

$$CVI_{a} = QVIA_{a} \cdot \tau_{a}^{-1} \cdot \left(\sum_{v=1}^{9} \alpha_{av}^{\sigma_{a}} \cdot PVI_{v}^{1-\sigma_{a}}\right)^{\frac{1}{1-\sigma_{a}}} \qquad \begin{array}{c} 0 < \sigma_{a} < \infty, \alpha_{av} > 0 \\ \forall a \in A \end{array}$$
(6C1)

where:  $CVI_a$  minimum costs of producing the aggregate variable input in activity *a*,  $QVIA_a$  quantity of aggregate variable input in activity *a*,  $PVI_v$  price of variable input *v*,  $\tau_a$  scale parameter for the aggregate variable input in activity *a*,  $\alpha_{av}$  distribution coefficient of variable input *v* in activity *a*,  $\sigma_a$  substitution elasticity for the aggregate variable input in activity *a*.

Using Shephard's lemma the (conditional) demand function for variable input v in activity *a* can be obtained:

$$QVI_{av} = QVIA_{a} \cdot \tau_{a}^{-1} \cdot \alpha_{av}^{\sigma_{a}} \cdot PVI_{v}^{-\sigma_{a}} \cdot (\sum_{v=1}^{9} \alpha_{av}^{\sigma_{a}} \cdot PVI_{v}^{1-\sigma_{a}})^{\frac{\sigma_{a}}{1-\sigma_{a}}} \qquad \forall a \in A, v \in V_{a}$$
(6C2)

where:  $QVI_{av}$  quantity of variable input v used in activity *a*.

#### Revenue maximization

Revenue maximization given the CET transformation function results in the CET revenue function. For the production of the different outputs from the aggregate output the CET revenue function equals:

$$ROU_{a} = QOUZ_{a} \cdot \theta_{a}^{-1} \cdot \left(\sum_{m=2}^{5} \alpha_{am}^{\omega_{a}} \cdot PO_{am}^{1-\omega_{a}}\right)^{\frac{1}{1-\omega_{a}}} \qquad \qquad -\infty < \omega_{a} < 0, \alpha_{am} > 0 \qquad (6C3)$$

where:  $ROU_a$  maximum revenue of producing outputs *m* from the aggregate output in activity *a*,  $QOUZ_a$  quantity of aggregate output (excluding rice tax and manure) produced by activity *a*,  $PO_{am}$  price of output *m* produced by activity *a*,  $\theta_a$  scale parameter for the aggregate output in activity *a*,  $\alpha_{am}$  distribution coefficient of output *m* in activity *a*,  $\omega_a$  transformation elasticity for the aggregate output in activity *a*.

Using Samuelson-McFadden lemma (Peerlings, 1993:85), the supply function for output m produced in activity a can be obtained:

$$QO_{am} = QOUZ_{a} \cdot \theta_{a}^{-1} \cdot \alpha_{am}^{\omega_{a}} \cdot PO_{am}^{-\omega_{a}} \cdot (\sum_{v=2}^{5} \alpha_{am}^{\omega_{a}} \cdot PO_{am}^{1-\omega_{a}})^{\frac{\omega_{a}}{1-\omega_{a}}} \qquad \forall a \in A, m \in M$$
(6C4)

where:  $QO_{am}$  quantity of output m produced by activity a.

#### Gorman polar expenditure function

The expenditure function of subsistence demand is:

$$ESUB = \sum_{r=1}^{11} PH_r \cdot QSH_r$$
(6C5)

where: *ESUB* expenditure of subsistence demand,  $PH_r$  price of consumption good r,  $QSH_r$  subsistence quantity of consumption good r.

The expenditure function of supernumerary demand is:

where: *ESUP* expenditure of supernumerary demand, *U* utility,  $\beta_r$  distribution coefficient for consumption good *r*,  $\delta$  substitution elasticity for consumption goods.

Therefore, the expenditure function of consumption demand is (see equation 6A27):

$$E = ESUB + ESUP = \sum_{\tau=1}^{11} PH_{\tau} \cdot QSH_{\tau} + U \cdot \left(\sum_{\tau=1}^{11} \beta_{\tau}^{\delta} \cdot PH_{\tau}^{1-\delta}\right)^{\frac{1}{1-\delta}}$$
(6C7)

where: E expenditure.

Using Roy's identity Marshallian demand functions for goods r (see equation 6A28) can be obtained:

$$QH_{\tau} = QSH_{\tau} + (E - \sum_{\tau=1}^{11} PH_{\tau} \cdot QSH_{\tau}) \cdot \beta_{\tau}^{\delta} \cdot PH_{\tau}^{-\delta} \cdot (\sum_{\tau=1}^{11} \beta_{\tau}^{\delta} \cdot PH_{\tau}^{1-\delta})^{-1} \qquad \forall \tau \in \mathbb{R}$$
(6C8)

where:  $QH_r$  quantity of consumption good *r*.

#### Appendix 6D Derivation of equivalent variation

In this appendix, the derivation of equivalent variation shown in Appendix 6A (equation 6A48) is presented. For readability, we use  $\mathbf{w}$  instead of **PH** to represent the vector of consumption prices and *e* to represent expenditure.

Equivalent Variation (EV) measures the consumer's willingness to pay to avoid price changes. In other words, the EV measures how much extra income is needed to reach new utility facing the old prices. Put it into equations, we have:

 $EV = e(\mathbf{w}^{\circ}, v(e', \mathbf{w}')) - e(\mathbf{w}^{\circ}, v(e^{\circ}, \mathbf{w}^{\circ})) = e(\mathbf{w}^{\circ}, v(e', \mathbf{w}')) - e^{\circ}$ (6D1)

where: EV equivalent variation,  $e(\cdot)$  expenditure function,  $v(\cdot)$  indirect utility function, superscript *o* indicates the initial situation, i.e. the initial consumption prices and income, superscript ' indicates the new situation, i.e. the new consumption prices and income.

According to equation (6A27) in Appendix 6A, the Gorman polar expenditure function can be rewritten as:

$$e = a(\mathbf{w}) + U \cdot b(\mathbf{w}) \tag{6D2}$$

where: e expenditure,  $a(\mathbf{w})$  expenditure on subsistence demand, U utility,  $b(\mathbf{w})$  expenditure on supernumerary demand per unit of utility.

Inverting equation (6D2) yields the indirect utility function:

$$v(e, \mathbf{w}) = \frac{e - a(\mathbf{w})}{b(\mathbf{w})} \tag{6D3}$$

Applying equation (6D3) into the new situation, we have:

$$v(e', \mathbf{w}') = \frac{e' - a(\mathbf{w}')}{b(\mathbf{w}')}$$
(6D4)

Bring equation (6D3) into equation (6D1); equation (6D1) can be rewritten as:

$$EV = a(\mathbf{w}^{\circ}) + v(e', \mathbf{w}') \cdot b(\mathbf{w}^{\circ}) - e^{\circ}$$
(6D5)

Bring equation (6D4) into equation (6D5), we have:

$$EV = a(\mathbf{w}^{\circ}) + \frac{e^{\circ} - a(\mathbf{w}^{\circ})}{b(\mathbf{w}^{\circ})} \cdot b(\mathbf{w}^{\circ}) - e^{\circ}$$

$$= \frac{a(\mathbf{w}^{\circ})b(\mathbf{w}^{\circ})}{b(\mathbf{w}^{\circ})} + \frac{e^{\circ}b(\mathbf{w}^{\circ}) - a(\mathbf{w}^{\circ})b(\mathbf{w}^{\circ})}{b(\mathbf{w}^{\circ})} - \frac{e^{\circ}b(\mathbf{w}^{\circ})}{b(\mathbf{w}^{\circ})}$$

$$= \frac{a(\mathbf{w}^{\circ})b(\mathbf{w}^{\circ}) + e^{\circ}b(\mathbf{w}^{\circ}) - a(\mathbf{w}^{\circ})b(\mathbf{w}^{\circ}) - e^{\circ}b(\mathbf{w}^{\circ})}{b(\mathbf{w}^{\circ})}$$
(6D6)

# Appendix 6E Social Accounting Matrix

Table 6E.1	A Village	SAM (in text)
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	Activities			Commo	dities				Factors			Institutions		ROW	Total
	Products	Inp	outs		Consu	nption									
	Crops livestock	Intermediate inputs	External inputs	Food	Non-food	Durables	Other expenses	Labor	Land	Tractor	Households	Government	Grain tax	Outside village	
Activities:															
Crops		Domestic supply									Crop consumption		Grain tax	Crop exports	Gross crop output
livestock		Domestic supply									Livestock consumption			Livestock exports	Gross livestock output
Commodities:															
Intermediate inputs	Intermediate inputs														Intermediate input demand
External inputs	External inputs														External input demand
Food											Food consumption				Food demand
Non-food											Non-food consumption				Non-food demand
Durables											Durable consumption				Durables demand
Other expenses											Other consumption				Other demand
Factors:															
Labor	Value added										Leisure			Off-farm income	Labor income
Land	Value added														Land income
Tractor	Value added														Draught income
Institutions:															
Households								Labor income	Land income	Draught service income				Remittances	Household income
Government											Other tax				Government revenue from other tax
Grain tax											Grain tax				Government revenue from grain tax
ROW:															
outside village			Import external inputs	Import food consumption	Import non- food consumption	Import durable consumption	Import other consumption				Transfers to ROW	Other tax			Exchange outflow
Total	Costs of agricultural products	Intermediate input expenditure	External input expenditure	Food expenditure	Non-food expenditure	Durables expenditure	Other expenditure	Labor costs	Land costs	Draught service costs	Household expenditure	Government expenditure from other tax	Government expenditure from grain tax	Exchange inflow	

Source: Kuiper, 2005; Author, 2006.

# Table 6E.2 A Village SAM (in numbers)

			Activities						Commodities		
			Crops		Ι	livestock		]	Intermediate ii	nputs	
			One season rice	Two season rice	Other crops	Cattle	Pigs	Other livestock	Manure	Feed	Oxen
Activities	Crops	One season rice								228108	
		Two season rice								477672	
		Other crops								189457	
	Livestock	Cattle							72400		226682
		Pigs							114301		
		Other livestock									
Commodities	Intermediate	Manure	2229	15612	168860						
	inputs	Feed				85788	733798	75651			
		Oxen	41905	154073	30704						
	External	Fertilizer	95252	402456	52338						
	inputs	Herbicides	3402	14057	313						
		Pesticides	22408	78154	17307						
		Purchased seed	19606	87769	51878						
		Purchased feed					308551	66999			
		Other inputs	8056	48202	196	1295	71339	76359			
	Consumption	Food									
	goods	Nonfood									
		Durables									
		Other expenses									
Factors	Labor	Labor	122449	475252	339059	237732	15352	2151			
	Land	Land	648944	1434428	882470						
	Draught power	Tractor	6809	63093							
Institutions		Households									
		Government									
		Public grain tax									
		Outside village									
		TOTAL	971060	2773096	1543125	324815	1129040	221160	186701	895237	226682

# Chapter 6

(Table continued)	(Tabl	e contin	ued)
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			Commodities									
			External input	TS					Consumpti	on goods		
			Fertilizer	Herbicides	Pesticides	Purchased seed	Purchased feed	Other inputs	Food	Nonfood	Durables	Others
Activities	Crops	One season rice										
		Two season rice										
		Other crops										
	Livestock	Cattle										
		Pigs										
		Other livestock										
Commodities	Intermediate	Manure										
	inputs	Feed										
		Oxen										
	External	Fertilizer										
	inputs	Herbicides										
		Pesticides										
		Purchased seed										
		Purchased feed										
		Other inputs										
	Consumption	Food										
	goods	Nonfood										
		Durables										
		Other expenses										
Factors	Labor	Labor										
	Land	Land										
	Draught power	Tractor										
Institutions		Households										
		Government										
		Public grain tax										
		Outside village	550046	17772	117869	159253	375550	205447	573315	985287	180423	1306752
		TOTAL	550046	17772	117869	159253	375550	205447	573315	985287	180423	1306752

# A household CGE model

#### (Table continued)

			Factors		I	Institutions				
			Labor	Land	Tractor	Households	Government	Grain tax	Outside village	TOTAL
Activities	Crops	One season rice				283014		19423	440515	971060
		Two season rice				1484055		107462	703907	2773096
		Other crops				1064466			289202	1543125
	Livestock	Cattle							25733	324815
		Pigs				170520			844219	1129040
		Other livestock				146574			74586	221160
Commodities	Intermediate	Manure								186701
	inputs	Feed								895237
		Oxen								226682
	External	Fertilizer								550046
	inputs	Herbicides								17772
		Pesticides								117869
		Purchased seed								159253
		Purchased feed								375550
		Other inputs								205447
	Consumption	Food				573315				573315
	goods	Nonfood				985287				985287
		Durables				180423				180423
		Other expenses				1306752				1306752
Factors	Labor	Labor				5333184			2385801	8910980
	Land	Land								2965842
	Draught power	Tractor								69902
Institutions		Households	8910980	2965842	69902				401713	12348437
		Government				557442				557442
		Public grain tax				126885				126885
		Outside village				136520	557442			5165676
		TOTAL	8910980	2965842	69902	12348437	557442	126885	5165676	

# Appendix 6F Elasticities used in the model

Goods	Income elasticity	Goods	Income elasticity
One season rice	0.439	Leisure	1.391
Two season rice	0.439	Purchased food	1.172
Other crops	0.439	Purchased non-food	0.586
Cattle		Durables	0.879
Pig	0.439	Other expenses	0.879
Other livestock	0.439		

Table 6F.1 Income elasticity of consumption goods in the base scenario

Source: Kuiper, 2005.

Table 6F.2	Substitution	elasticities	for	production
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	Substitution elasticity	Factor inputs	Variable inputs	Aggregate inputs and
Production output		ractor inputs	variable inputs	outputs
One season rice		0.5	0.5	0.5
Two season rice		0.5	0.5	0.5
Other crops		0.5	0.5	0.5
Cattle		0.5	0.5	0.5
Pig		1.5	1.5	0.5
Other livestock		0.87	0.87	0.5

Source: Kuiper, 2005; Author, 2006.

# Table 6F.3 Substitution elasticity for household consumption and transformation elasticity of labor distribution.

	Elasticity
Substitution elasticity for consumption goods (on- farm produced, purchased, and leisure)	0.5
Transformation elasticity for labor distribution	-0.5

Source: Author, 2006.

# Appendix 6G Simulation results

Table 6G.1 Results of scenario 1-5 (changes in %)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Aggregate output					
One season rice	2.3	0.5	2.9	-0.7	0.9
Two season rice	1.1	0.1	1.2	0.5	-2.1
Other crops	-0.9	-0.1	-1.1	-0.4	1.2
Cattle	1.0	0.1	1.2	-0.1	-1.5
Pigs	-0.8	-0.1	-0.9	+0.0	2.4
Other livestock	0.9	0.1	1.0	0.4	1.0
Aggregate output price					
One season rice	5.7	0.8	6.7	0.9	-1.5
Two season rice	4.9	0.7	5.8	+0.0	-1.7
Other crops	5.2	0.7	6.1	2.1	-1.1
Cattle	4.1	0.6	4.8	1.0	-0.8
Pigs	0.9	0.1	1.0	0.3	-0.5
Other livestock	0.5	0.1	0.6	0.1	-0.3
Export					
One season rice	4.4	0.9	5.5	-1.2	3.8
Two season rice	3.5	0.4	3.9	0.5	2.7
Other crops	-3.4	-0.5	-4.0	-1.4	1.8
Cattle	-1.1	-0.1	-1.2	-0.5	-1.1
Pigs	-1.1	-0.1	-1.2	-0.1	2.6
Other livestock	0.6	0.1	0.7	0.3	1.1
Export price					
One season rice	10.2	1.7	12.2	+0.0	-0.0
Two season rice	10.2	1.2	11.6	+0.0	-0.0
Output used as intermediate input					
One season rice (feed)	0.1	0.2	0.3	-1.0	3.3
Two season rice (feed)	-0.7	-0.2	-0.9	0.7	2.3
Other crops (feed)	-2.8	-0.4	-3.2	-1.2	1.3
Cattle (oxen)	1.2	0.2	1.4	-0.1	-1.5
Price of output used as					
Crop products (feed)	13	0.2	16	0.4	-0.9
Cattle (oxen)	4.7	0.6	5.5	0.9	-0.8

(Table continued)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Consumption					
One season rice	0.7	0.1	0.9	0.1	1.5
Two season rice	0.5	0.1	0.6	0.5	1.3
Other crops	+0.0	-0.0	+0.0	+0.0	1.0
Pigs	0.6	0.1	0.7	0.4	1.2
Other livestock	1.0	0.1	1.1	0.4	0.9
Purchased food	2.9	0.4	3.4	1.3	2.2
Purchased nonfood	1.5	0.2	1.7	0.6	1.1
Purchased durable	2.2	0.3	2.5	1.0	1.6
Other expenses	2.2	0.3	2.5	1.0	1.6
Consumption price					
One season rice	2.5	0.1	2.6	2.6	-4.3
Two season rice	3.9	0.6	4.7	-0.1	-2.8
Other crops	7.3	1.0	8.5	2.9	-1.5
Pigs	3.3	0.5	3.9	0.8	-2.7
Other livestock	0.7	0.1	0.9	0.2	-0.4
<b>T</b> 1					
Land	1 0	0.5	2.2	0.0	1.4
The season fice	1.0	0.5	2.5	-0.9	1.4
Two season fice	0.2	-0.0	0.2	0.0	-1.0
Other crops	-1.(	-0.5	-2.0	-0.7	1.7
Price of land					
One season rice	6.8	1.0	8.0	1.1	-2.4
Two season rice	6.8	1.0	8.0	-0.5	-2.4
Other agricultural	6.8	1.0	8.0	2.8	-2.4
products					
Labor					
One season rice	1.5	0.3	1.9	-0.6	-0.5
Two season rice	0.7	0.1	0.8	-0.1	-2.0
Other crops	-0.2	-0.0	-0.2	-0.1	-0.2
Cattle	0.5	0.1	0.6	-0.2	-1.5
Pigs	-1.2	-0.2	-1.4	-0.3	0.5
Other livestock	-0.5	-0.1	-0.5	-0.2	-0.2
Off-farm	-2.0	-0.3	-2.3	-0.8	-1.1
Leisure	0.8	0.1	0.9	0.4	0.8
Price of labor					
One season rice	7.4	1.2	8.9	0.5	1.3
Two season rice	5.7	0.7	6.5	1.4	-1.9
Other crops	3.7	0.5	4.3	1.5	1.8
Cattle	5.2	0.7	6.1	1.2	-0.7
Pigs	1.7	0.2	2.0	0.9	3.3
Other livestock	3.2	0.4	3.7	1.3	2.0
Off-farm	0.0	0.0	0.0	0.0	0.0
Leisure	5.7	0.8	6.7	2.4	3.8

#### (Table continued)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Tractor					
One season rice	1.4	0.5	2.0	-0.8	2.9
Two season rice	-0.2	-0.0	-0.2	0.1	-0.3
Price of tractor					
Rice production	7.6	1.0	8.8	0.9	-5.2
Intermediate input					
Manure					
One season rice	3.3	0.7	4.0	-1.0	0.7
Two season rice	1.7	0.2	1.8	-0.1	-2.4
Other crops	-0.3	-0.0	-0.3	-0.0	1.2
Feed					
Cattle	2.4	0.4	2.8	0.2	-1.4
Pigs	-1.4	-0.2	-1.7	-0.2	2.9
Other livestock	0.1	+0.0	0.1	0.2	1.5
Oxen					
One season rice	2.8	0.6	3.5	-0.8	0.6
Two season rice	1.2	0.1	1.3	0.1	-2.6
Other crops	-0.7	-0.1	-0.8	0.2	1.0
Price of					
intermediate input					
Manure	3.8	0.5	4.5	1.4	-1.1
Feed	1.3	0.2	1.6	0.4	-0.9
Oxen	4.7	0.6	5.5	0.9	-0.8
Purchased variable					
Inputs					
One season rice	5.2	0.9	6.3	-0.3	0.2
Two season rice	3.6	0.4	4.1	0.6	-3.0
Other crops	1.6	0.2	1.9	0.7	0.7
Cattle	3.1	0.4	3.6	0.4	-1.9
Pigs	0.5	0.1	0.6	0.4	1.6
Other livestock	1.3	0.2	1.5	0.5	0.7
Full income	4.7	0.6	5.5	1.9	1.1
Equivalent variation (10 <sup>3</sup> Yuan)	115.3	16.0	133.6	57.9	124.2

# 7 DISCUSSION AND CONCLUSIONS

#### 7.1 Introduction

The general objective of this study is to analyze the effects of market liberalization and deregulation in the grain marketing channel on farm households in a LFA in China, taking into account the effects of market access. The study focuses on the rice purchase markets in three villages in Jiangxi province in and after 2000. The villages differ mainly by the degree of market access. After an overview of grain policies a description of the rice marketing channels in 2000-03 is provided. Marketing channel models are used to simulate the effects of market liberalization and deregulation. A nonseparable household CGE model for Gangyan is developed to analyze the effects of market liberalization and deregulation taking into account possible effects on rice production of other farm products and off-farm employment.

This chapter first presents the main findings of this study (Section 7.2). Section 7.3 discusses both data and models used in this study. Finally Section 7.4 provides a general conclusion and some suggestions for future research.

#### 7.2 Conclusions

#### Policy

As stated in Chapter 2, the motivation of China's government to liberalize and deregulate its grain market is to reduce the financial burden caused by subsidizing the SGTCs in the marketing channel. China's agricultural market liberalization and deregulation started at the end of the 1970s. Several times withdrawal of policy changes slowed down the reform progress. Nevertheless, Chapter 2 concludes that China's government has gradually liberalized and deregulated grain markets, which is in accordance with conclusions drawn from studies such as Rozelle et al. (1997), Rozelle et al. (2000), Zhong (2001), Tian and Zhang (2003), etc.

#### Rice purchase market

The majority of the private traders are rice farmers. In other words, rice trade is their off-farm activity. Most of them perform on their own while some are involved in a partnership. Some transaction costs such as networking costs (e.g. cigarettes, drinks, and meals) and search and information costs (e.g. costs of visiting farm households and costs of making phone calls) function as entry barriers in the rice purchase market. After 2000 these transaction costs have gone down due to developments in road construction and in telecommunication in the three

villages (e.g. special offers from China Unicom). The decrease in the transaction costs led to an increase in the number of private traders entering the rice purchase market. This has led to more competition. Luo and Crook (1997) found a similar development of the number of private rice millers (who process and trade rice between provinces including Jiangxi Province).

Since 1992 SGTCs had to carry out policy tasks (e.g. quota procurement) as well as commercial businesses (e.g. grain trade other than quota procurement). The policy tasks of the SGTCs in 2000 were to purchase rice at the protective price fixed by the government and losses were expected to be subsidized (the system of protective purchasing). Nevertheless subsidies did not always or only partly arrive. The SGTCs were put into a dilemma and could not comply with the policies. Given the poor functioning of these policies after 2000, they were finally abolished in 2004. SGTCs have now to function as ordinary traders. So, competition between the private traders and the SGTCs in the rice purchase market has developed in the direction of full competition. This finding supports findings from an earlier study by Rozelle et al. (2000: 245).

Private traders purchase rice in front of the houses of farm households. Purchased rice is put into the truck hired by private traders and transported directly to their next buyers. In order to compete with the private traders, the SGTCs in the study areas adopted two major strategies in 2000. One was to conclude a contract with its employees to purchase a certain amount of rice (the SGTCs corresponding with Banqiao and Shangzhu) and the other was to monopsonize the local purchase market for a short period (one month) after harvest with the help of the local government (the SGTC corresponding with Gangyan). The former strategy was similar to that of the private traders, namely, the way that the employees conduct rice trade is the same as that of private traders. The monitoring costs of the latter strategy were very high and the participation of the private traders in the rice purchase market after the monopsonistic period had negative effects on the amount of rice purchased by the SGTC in Gangyan. In 2003, the strategy of temporary monopsony was abandoned in Gangyan.

Chapter 3 shows that the government still favors the SGTCs after 2000, e.g. the SGTCs can use storage facilities and trucks owned by the state; they benefit from their formal social networks; they have access to the marketing information system and loans offered from the bank. The private traders are burdened by cumbersome licensing procedures and most of them are not registered. The non-registered private traders do not pay taxes however they do not benefit from government regulations such as the system of grain standardization and have limited access to legal means for enforcing contracts. These findings are in line with findings from Rozelle et al. (2000).

Nevertheless, farm households favor private traders due to the past monopsony position and the protective purchasing of the SGTCs that led to down-grading behavior of the SGTCs. In addition, private traders do not store rice purchased leading to less strict humidity criteria for the rice purchased.

#### Model

Given the situation in 2000 described in Chapter 3 and the model of protective purchasing developed in Chapter 4, Cournot is the most likely market structure in the rice purchase market of the three villages in 2000. For 2003 perfect competition seems to be most relevant.

#### Effects of market deregulation and liberalization

Simulation results in Chapter 4 and 5 show that market deregulation (increase in competition) leads to an increase in farm price in all the three villages keeping the consumer price (selling price of rice intermediates) constant. Simulation results in Chapter 6 show that the increase in farm price is less when taking into account the production of other farm products and off-farm employment. Chapter 4 and 5 show that market deregulation (increase in competition) in combination with an increase of 10% in consumer price (as a result of market liberalization) lead to an increase in farm price of more than 10% in all three villages. For example, in the case of Cournot competition in Chapter 4, it is 13.7% for Banqiao, 14.5% for Shangzhu, and in Gangyan it is 21.7% for the farm price paid by the SGTC and 14.2% for the farm price paid by the private traders. The magnitude of the price increase depends on the degree of imperfect competition in the rice purchase market before market deregulation and liberalization, e.g. Cournot, quantity leadership, or price leadership<sup>66</sup>.

This study focuses on the rice purchase market in the study areas in 2000-03. Wu (2002) looked at price transmission between retailers and farmers in 1996-2000. He focused on two provinces representing provinces in the North and South of China. Wu (2002) found rice markets in these two provinces were integrated. Many studies focusing on price transmission between grain markets in different provinces in China can be found, e.g. Rozelle et al. (1997), Rozelle et al. (2000), Park et al. (2002), Wu and McErlean (2003), Huang et al. (2004), etc. Common findings from these studies indicate China's grain markets between provinces have become increasingly integrated since the early 90s.

#### Farm households

Chapter 4, 5 and 6 calculate the effects of market liberalization and deregulation policies in the rice purchase market on the marketable rice supply and welfare of farm households. Studies analyzing the effects of market liberalization and deregulation on the welfare of farm households are scarce. Simulation results of Chapter 4, 5 and 6 indicate welfare gains of farm households in all three villages. Chapter 4, 5 and 6 conclude that to what extent the villages benefit depends on the market access and the amount of rice they supply. Villages with limited market access are expected to have a smaller amount of intermediates leading to more market power of these intermediates. Market deregulation increases the competition among the intermediates (decreases the degree of imperfect competition) so that the market power of the intermediates. Therefore farm households in the most remote village benefit the most

from market deregulation. However, the benefit is limited by the relatively small rice supply of the most remote village. The sum of both effects is that farm households in the most remote village benefit less than those in villages with better market access and larger rice supply. This finding supports the finding from Huang et al. (2004) that farm households from a village far away from a market receive lower prices.

Comparing results between Chapter 4 and Chapter 6, it is found that the positive effects of market liberalization and deregulation on rice supply become smaller when taking into account the production of other farm products and off-farm employment. Chapter 6 finds that the welfare effects of market deregulation are small indicating that market were already quite competitive in 2000. This finding supports the finding from Rozelle et al. (2000) that competition had already been increasing before 2000. In addition, Chapter 6 finds that farm households from Gangyan will benefit from the direct land subsidy and the removal of agricultural tax in 2004. These findings are in line with findings from Heerink et al. (2006).

#### Rice intermediates

As mentioned before, rice intermediates, i.e. SGTCs and private traders, possess most market power in the villages with limited access. Market deregulation increases the competition among the intermediates. Chapters 4 to 6 also calculate the effects of market liberalization and deregulation on the profits of rice intermediates in the purchase market. Simulation results show that an increase in the degree of competition leads to a decrease in the profits of rice intermediates. The intermediates with the most market power lose most. To the best of our knowledge this thesis is the first empirical study focusing on the effects of market liberalization and deregulation on the welfare of the intermediates.

## 7.3 Discussion

#### Policy

Although the achievement of China's government to liberalize and deregulate its agricultural markets has been broadly recognized by most studies and although the simulations in Chapters 4 to 6 assume perfect competition in the rice purchase market in 2003, findings in Chapter 3 suggest that there are still no real perfect working rice markets in China. To achieve this China's government should focus on strengthening a favorable economic and political environment to support the development of the private sector. This can be done by treating the SGTCs and private traders equal, e.g. by relaxing the strict registration criteria for private traders, treat private traders equally in the credit market, harmonizing quality and hygiene standards, etc. Important is also to introduce measures for contract enforcement to ensure the well-functioning of the markets. Furthermore, China's government should improve the physical infrastructure such as roads and transport facilities. In addition, the accessibility of market

<sup>&</sup>lt;sup>66</sup> Due to the assumptions, such as a linear rice supply function and constant marginal costs etc., made in this thesis, differences of price increases between Cournot, quantity leadership and price leadership are small.

information, e.g. on prices of rice, could be improved, i.e. to reduce costs of the private traders to obtain such information.

Chapter 2 observes frequent changes in China's agricultural policy since the late 1970s. However Chapter 3 observes that sometimes policies were/are not or only partially implemented. A reason could be the cost involved with these policies for SGTCs or local governments. Moreover, the frequent changes in policies may have negative impacts on the effectiveness of policies.

#### Data

Government grain administrations were important sources of statistical information for studies on the functioning of grain markets in China (Gale, 2002: 51). However, increased competition in agricultural markets due to market liberalization and deregulation has reduced government control over agricultural marketing leading to a lack of data on the intermediates in the rice purchase market. With respect to this study, data on the number of private traders and their traded quantities and prices could not be obtained from the official statistics. Data used in this study is collected by the SERENA project (Kuiper et al., 2001). A questionnaire at household level was designed and personal interviews were performed in 2000. The data set includes information on production, consumption, and socio aspects of the farm households. This makes this data set unique. Extra data used in this study was collected through fieldwork conducted in 2003. For consistency, quantitative (e.g. traded quantities and prices) and qualitative (e.g. opinions) data for 2000 of the actors in the marketing channel was collected in personal interviews. Additionally some data for 2003 was collected.

Fieldwork in developing countries is often considered difficult to conduct due to social, cultural, technical, and political problems (Kinsey, 1988: 98). Despite being costly and timeconsuming due to poor road conditions and lack of public transport, personal interviews are the most commonly used means of data collection in developing countries (Kinsey, 1988: 99). In China personal interviews require permission from the local government that could be timeconsuming due to bureaucracy. Once permitted, questionnaires were designed and tested in a pilot survey.

Several constraints of personal interviews described by Kinsey (1988: 99) were experienced during the pilot survey. First, opinions of the respondents may be influenced by cultural or political constraints. For example, the head of the village was found to give politically correct answers while an elderly in the village was found to give answers that represented the village opinions better. Second, answers of the respondent were often overtaken by the crowd of onlookers. Furthermore, information on prices and quantities was often considered confidential due to competition in the market. Taking these constraints into account, in addition to the improvement of the questionnaires, improving interview techniques through a pre-survey training was carried out in order to increase accuracy. All the interviewers were undergraduates from Nanjing Agricultural University (NAU) and some of them were from the study areas. The training showed the importance on the comprehension of the

questionnaires and the differences in culture (regional) as well as in language (dialect) between the interviewer and the respondent. In this way, adequate explanation was provided to the respondent when a new concept was introduced during the interview. Data collected in 2003 was focused on the activities of the respondent in 2000. This means that part of the data set, especially the price data, was based on the memory collection of the respondents. However, data on price margins was found consistent among all the respondents. It is therefore used in this study instead of prices (see Chapters 3 to 5).

#### Models

Marketing channel models The marketing channel models used in this study are grounded upon game theory, which has become the most useful tool in the field of industrial organization (Tirole, 1988: 423). A strong point of the marketing channel models is that they do not require massive data sets (Tirole, 1988: 4). In addition, this approach allows case-specific modifications that yield many interesting economic insights (Tirole, 1988: 4; Shy, 1995: 5). Given that no study has been found that uses marketing channel models to analyze the effects of market liberalization and deregulation on farm households in China, this study may serve as a building block in this type of extended analysis.

A few points about the models deserve some attention here. First, only competition in rice purchase market of the rice marketing channel is modeled. Analysis on competition in other stages of the grain marketing channel in China can be found in Wu (2000). Second, the short-term feature of the model indicates that rice production is assumed given and the effects of changes in farm price on rice production are not considered. Third, welfare analysis for farm households only includes changes in farm profit caused by marketable rice supply. The effects of changes in rice production and the effects of changes in production and consumption of other goods and off-farm employment on marketable rice supply are not taken into account. Finally, rice is assumed to be a homogeneous product. However, in practice there are three varieties, namely, early rice, late rice, and one-season rice. Price differences exist among varieties though not substantial.

Nonseparable household CGE model One way to cope with the caveats of the marketing channel models is the nonseparable household CGE model developed in Chapter 6. The only study that applies this approach at the micro level in the context of China is done by Kuiper (2005). In her study, Kuiper (2005) analyzed the impact of interactions within a Chinese village community on rural household decisions. The nonseparable household CGE model developed in this study incorporates imperfect competition in the village rice purchase market and can serve as a starting point for future studies in the same area. Here some of the qualifications of the model are mentioned. First, the model developed assumes identical production and consumption responses of all the farm households since there is only one representative farm household. Second, the model requires considerable data. This is the reason the model is only developed for Gangyan. Third, part of the private traders is farmers. However, the data did not

allow including the income from rice trade in the model. Finally, due to data limitations, some parameters are chosen arbitrarily, which may influence model outcomes.

#### 7.4 General conclusion and future research

Market liberalization and deregulation change the institutional and policy context, and therefore, the welfare of farm households. Results from this study show that China's government has gradually introduced the market mechanism into its agricultural markets. China's grain markets have become more competitive. Moreover, rice market liberalization and deregulation improve household welfare. Inevitably this study is partial. Given the large economic and social reforms in China what happens in the rice purchase market is also influenced by factors outside the rice marketing channel. The development of non-farm employment is such a factor. In future research the influence of non-farm employment on farm household welfare and agricultural production is worthwhile studying. The nonseparable household CGE developed in this study can serve as a first step for such research. Constructing a nonseparable household CGE model at a more disaggregated level may provide more insights in the heterogeneity of farm households and how that affects their behavior. Furthermore, policy changes in the land market may have effects on rice production and thus indirectly affect the rice purchase market. Focusing on the same study areas, Feng (2006) has analyzed the determining factors for the participation of farm households in land and off-farm labor markets and its consequences on agricultural productivity. Her thesis may provide useful insights for future studies that take into account the influences of the land market on the rice purchase market. Finally, the reaction to policies also depends on non-economic factors such as gender. The reason to take women into account in policy analysis is not only to change the subordinate status of women but also to formulate more effective policies to improve welfare of farm households. Focusing on Bangladesh, this issue has been examined by Ali (2005) and Ahmed  $(2006)^{67}$ .

<sup>&</sup>lt;sup>67</sup> Just as this research the work of Feng (2006), Ali (2005) and Ahmed (2006) were part of the RESPONSE (**Re**gional Food Security **Policies** for Natural Resource Management and Sustainable Economies) program.

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#### SUMMARY

For decades, reducing the financial burden has been the motivation of China's government for market liberalization and deregulation. The process of market liberalization and deregulation started at the end of 1970s and has undergone a series of back-and-forth transitions. As a result, the structure of China's grain marketing channel has gradually changed, which affects the degree of price transmission. Important in this study is how price changes in consumer markets are transmitted via the marketing channel to farm households. Grain supply to markets by farm households is one of the important indicators for food security both at the national level and the household level. Therefore, the well functioning of the marketing channel is essential for poverty alleviation and food security. The general objective of this study is to analyze the effects of market liberalization and deregulation in the grain marketing channel on farm households in a less favored area in China, taking into account the effects of market access.

Three villages were selected using a series of criteria, which include economic development level, market access and geographical conditions. They are Banqiao, Shangzhu, and Gangyan in Jiangxi Province. Gangyan has the best market access while Shangzhu has the worst, and Banqiao has an intermediate position. Market access is measured in this study by the costs that private traders make to transport rice from the village to their buyers. The marketing channel models used in this study are extensions of simple models of competition, i.e. monopsony, Cournot, quantity leadership, price leadership, and perfect competition. To account for other factors than rice market liberalization and deregulation affecting village rice exports a nonseparable household CGE model is developed. The model accounts for non-separability of household decision making and for imperfect competition in the village rice export market (rice purchase market).

To analyze the effects of grain market liberalization and deregulation on farm households, it is important to understand China's grain market policies and how they have changed over time. **Chapter 2** provides an overview of policies in China's grain market since the 1950s. To assure food security and to reduce the budget burden, China's central government has been switching its agricultural policy a few times over the last decades. Every time after a reform (1985 and 1993), falling grain production and rising grain prices made China's government stop its attempts and return to its monopsony position. In 1998, a new round of reforms attempted to create monopsony profits of the SGTCs to recoup the losses. However the policy failed and the financial burden increased instead of decreased. In 2000, China's central government opened the grain purchase market for low-quality grain (such as early rice) to individual private traders and private enterprises. Meanwhile, a system of protective purchasing was active. At the end of 2002, the procurement of grain quota was abolished in some provinces in China. Early 2004, China's government issued a series of policies facilitating

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further market liberalization and deregulation. Chapter 2 concludes that China's government has gradually brought the market mechanism into play, which has, to a large extent, relieved the fiscal budget from the burden of subsidizing the SGTCs. Nevertheless, the road towards market liberalization and deregulation has not yet reached the end.

Policy changes described in Chapter 2 have influenced the structure of the rice marketing channels. **Chapter 3** examines the structure of the rice marketing channels in 2000-03 in the selected three villages putting special attention on rice assemblers (i.e. the private traders and the SGTCs). Information used in this chapter is collected from interviews in the three selected villages and their associated regions in 2000 and 2003. The rice marketing channel in the study areas covers farm households, assemblers, processors, wholesalers, and retailers. Based on the description of the rice purchase market, this chapter also discusses the effects of policy changes in 2000-03 on the private traders and the SGTCs. Comparing with policy descriptions provided in Chapter 2, Chapter 3 concludes that state grain policies were not functioning in the period of 2000-03. Competition has become more intensive in the rice purchase market. State grain policies favored the SGTCs, which created an unfair competition environment for private traders. Despite this, private trade survived and has grown. The pressure for further reforms to create a fair competition environment remains.

Using the information provided by Chapter 2 and 3, Chapter 4 first presents a model of protective purchasing, capturing all possible outcomes under the system. Given the situation in 2000 described in Chapter 3, possible outcomes under the protective purchasing system depend on the type of competition between the private traders and the SGTCs, e.g. Cournot, quantity leadership, and price leadership competition. Following the most likely outcome, Chapter 4 develops and applies a marketing channel model to analyze the effects of market liberalization and deregulation on farm households in the three villages (with different market access) in 2000 and in 2003. Cournot competition in the rice purchase market is applied for Banqiao and Shangzhu in 2000. A two-stage competition model with monopsony in the first stage and Cournot competition in the second stage is developed and applied for Gangyan in 2000. Perfect competition is assumed for all the three villages in 2003. Scenarios simulated in Chapter 4 compare the rice purchase market in 2000 with that in 2003. Simulation results show that when keeping consumer price constant, market liberalization and deregulation lead to an increase in farm price of 3.3% in Banqiao, 3.9% in Shangzhu, 10.5% and 3.7% in Gangyan. Chapter 4 concludes that rice producers benefit from market liberalization and deregulation. How much they benefit depends on the degree of market imperfection before market liberalization and deregulation, the amount of rice traded and the degree of market access. Smaller amounts of traded rice and restricted market access lower the benefit.

As a continuation of Chapter 4, **Chapter 5** analyzes other possible outcomes under the system of protective purchasing, i.e. quantity leadership and price leadership competition between the intermediates in the rice purchase market. Chapter 5 applies quantity leadership and price leadership competition for all the three villages in 2000 and assumes perfect competition in 2003. The SGTC is assumed to be the leader and the private traders to be the

followers in both types of competition. Following Chapter 4, scenarios simulated in Chapter 5 compare the rice purchase market in 2000 with that in 2003. The simulation results show that when keeping consumer price constant, market liberalization and deregulation lead to an increase in farm price of 3.3% in Banqiao, 3.9% in Shangzhu, and 3.7% in Gangyan. The increase in farm profit indicates that farm households benefit from market liberalization and deregulation. To what extent they benefit depends on the market access of their villages and the amount of rice supplied. The outcomes of the model show that China's government made the right decision to abolish the system in early 2004. Results also show that improving market access of remote villages (e.g. by road construction and telecommunication improvement) would be welfare improving for farm households.

The marketing channel models developed in Chapter 4 and 5 are subject to some qualifications, e.g. the effects of rice production and the effects of consumption of other goods on marketable supply of rice are not taken into account, farm profits are used instead of utility as a welfare measure, and the effect of off-farm employment on rice supply is not included. A nonseparable household CGE model at village level, that takes these qualifications into account, is therefore developed in **Chapter 6**. The model is for Gangyan, data are from a Social Accounting Matrix constructed by Kuiper (2005). The village CGE model developed by Kuiper (2005) differs from the model developed, e.g. the model developed here has a higher level of aggregation (one representative household). In addition, imperfect competition between the intermediates in the village rice export market (rice purchase market) is taken into account. The scenarios simulated in Chapter 6 focus on the effects of market liberalization and deregulation, namely, the transition from imperfect competition (Cournot) to perfect competition in the rice export market, the increase in consumer price, the introduction of a land-based income subsidy for rice producers and the removal of the agricultural tax.

The positive welfare changes indicate that farm households benefit from the policy changes simulated. The welfare gain of the farm households is the largest under the scenario that combines market liberalization and deregulation and the consumer price increase. Farm households benefit the least from market liberalization and deregulation among all the scenarios. This indicates that the degree of competition in the rice purchase market is already intense in 2000 so that the gain of market liberalization and deregulation is less obvious. The positive effects of the land subsidy are much less than that of the removal of the agricultural tax. Chapter 6 also concludes that the positive changes for the export and export price of rice in this chapter are less than that in Chapter 4 and 5. This is because Chapters 4 and 5 only modeled rice export taken rice production as given. It did not take into account the effects of market liberalization on the production of rice.

**Chapter 7** first synthesizes the main findings of this study. It then discusses the contributions of this study to the relevant economic literature, and provides recommendations for further research. No study has been found that uses marketing channel models to study the effects of market liberalization and deregulation on farm households in China. Chapter 7 confirms that findings of this study are largely in line with those from literature. Chapter 7

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further suggests that China's government should focus on strengthening a favorable economic and political environment to support the development of the private sector. This chapter also suggests that frequent changes in policy not only induce costs for central and local government but also have negative impacts on the effectiveness of policies. Data used in this study are collected through personal interviews conducted in the study areas. Given the constraints of personal interviews, several measures such as a pilot survey and a pre-survey training were adopted to improve the accuracy of the data collected. A strong point of the marketing channel models is that they do not require massive data sets. A number of caveats of the marketing channel models are taken care of by the nonseparable household CGE model developed in Chapter 6. Unique for this household CGE model developed is that it both incorporates the behaviour of households and imperfect competition in the village rice purchase market. Therefore it can serve as a starting point for future studies in the area of determining the consequences of market liberalization and deregulation in China's grain markets.
## SAMENVATTING

De afgelopen decennia is het terugdringen van de financiële lasten de belangrijkste reden geweest voor de Chinese overheid om over te gaan tot het liberaliseren en dereguleren van markten. Liberalisatie en deregulatie startten aan het eind van de zeventiger jaren maar kenden ook perioden waarin ze al dan niet gedeeltelijk werden teruggedraaid. Als gevolg van liberalisatie en deregulatie is de structuur van de keten voor graan in China geleidelijk veranderd. Dit heeft gevolgen voor de mate waarin prijsveranderingen op consumentenmarkten doorwerken op het niveau van agrarische huishoudens. Het aanbod van graan door agrarische huishoudens is een belangrijke indicator voor voedselzekerheid zowel nationaal als op het niveau van agrarische huishoudens. Als gevolg hiervan is het goed functioneren van agrarische ketens belangrijk voor de armoedebestrijding en voedselzekerheid. De algemene doelstelling van dit onderzoek is het analyseren van de gevolgen van de liberalisatie en deregulatie van markten in de keten voor graan voor agrarische huishoudens in drie economisch achtergebleven dorpen in China met inachtneming van de mate van markttoegang.

Drie dorpen werden geselecteerd op basis van een aantal criteria waaronder mate van economische ontwikkeling, markttoegang en geografische kenmerken. De dorpen zijn Banqiao, Shangzhu, en Gangyan in de provincie Jiangxi. Gangyan heeft de beste markttoegang, Shangzhu de slechtste. Banqiao neemt een middenpositie in. Markttoegang is gemeten aan de hand van de kosten die private handelaren maken om rijst te transporteren van het dorp naar de dichtstbijzijnde kopers. De mededingingsmodellen die in dit onderzoek worden gebruikt zijn uitbreidingen op eenvoudige modellen van monopsonie, Cournot, hoeveelheidleiderschap, prijsleiderschap en volledige mededinging. Om rekening te houden met andere factoren dan liberalisatie en deregulatie van markten die de export van rijst door een dorp beïnvloeden is een niet-separabel algemeen evenwichtsmodel op dorpsniveau ontwikkeld. In het model wordt verondersteld dat het dorp kan worden weergegeven door een representatief huishouden. Het model houdt rekening met het feit dat beslissingen van een agrarisch huishouden wat betreft productie en consumptie niet zijn te scheiden (niet-separabel zijn) én met imperfecte mededinging in de exportmarkt (aankoopmarkt) voor rijst van het dorp.

Om de effecten van liberalisatie en deregulatie van graanmarkten voor agrarische huishoudens te analyseren is het belangrijk om het Chinese graanmarktbeleid en haar ontwikkeling in de tijd te begrijpen. **Hoofdstuk 2** geeft een overzicht van het Chinese graanmarktbeleid sinds de jaren vijftig. De wens om voedselzekerheid te garanderen én de wens om de financiële lasten van de overheid terug te dringen hebben ertoe geleid dat perioden van liberaliseren en dereguleren werden afgewisseld met perioden waarin de hervormingen al dan niet gedeeltelijk werden teruggedraaid. Elke keer na een hervorming (bijv. 1985 en 1993) leidden de teruggelopen graanproductie en gestegen graanprijzen tot het terugdraaien van de hervorming en terugkeer naar een monopsoniepositie van de Chinese overheid. In 1998 probeerde de overheid monopsoniewinsten te creëren om de verliezen van de staatsbedrijven die de handel in graan verzorgen (SGTCs) te compenseren. Dit mislukte en de financiële lasten voor de overheid stegen in plaats van dat ze daalden. Als reactie hierop opende de Chinese overheid in 2000 de aankoopmarkt voor rijst van lage kwaliteit (vooral vroege rijst) voor private handelaren en bedrijven. Tegelijkertijd werd een systeem ingevoerd waarin agrarische huishouden verplicht werden een deel van hun rijst tegen een vooraf vastgestelde prijs aan SGTCs te verkopen. Tegen het einde van 2002 werd dit systeem weer afgeschaft in sommige provincies in China. Begin 2004 gebeurde dat in geheel China. In 2004-05 lanceerde de Chinese overheid nieuw beleid om tot een verdergaande liberalisering en deregulering van graanmarkten te komen. Hoofdstuk 2 concludeert dat de Chinese overheid geleidelijk het marktmechanisme heeft geïntroduceerd wat heeft geleid tot terugdringing van de financiële lasten die gepaard gingen met het subsidiëren van de SGTCs. Desondanks is er nog niet sprake van een volledige liberalisatie en deregulatie.

Het beschreven beleid in hoofdstuk 2 heeft de structuur van de keten voor rijst gewijzigd. **Hoofdstuk 3** onderzoekt de structuur van de rijstketen in 2000-03 in de drie geselecteerde dorpen. Centraal daarbij staan de private handelaren en de SGTCs. De informatie die in dit hoofdstuk wordt gebruikt is verzameld met behulp van interviews in de drie geselecteerde dorpen en de regio's waarin ze liggen in 2000 en 2003. De actoren in de rijstketens zijn de agrarische huishoudens, de private handelaren, de SGTCs, groothandelaren en detailhandelaren. Naast het geven van een beschrijving van de aankoopmarkt voor rijst analyseert hoofdstuk 3 ook de gevolgen van de beleidshervormingen in de periode 2000-2003 voor de private handelaren en SGTCs. Hoofdstuk 3 concludeert dat het beleid in die periode niet goed functioneerde. De concurrentie en private handel is in de periode 2000-2003 toegenomen hoewel het overheidsbeleid de SGTCs bevoordeelde ten koste van de private handelaren. Desondanks bestaat bij de private handelaren de behoefte aan een eerlijkere handel.

In **hoofdstuk 4** wordt op basis van de informatie uit hoofdstuk 2 en 3 een algemeen mededingingsmodel ontwikkeld waarmee de situatie op de aankoopmarkt in 2000 en 2003 voor rijst kan worden beschreven. De uitkomsten van het model hangen af van de vorm van concurrentie tussen private handelaren en SGTCs. De onderscheiden vormen zijn monopsonie, Cournot, hoeveelheidleiderschap, prijsleiderschap en volledige mededinging. Gebaseerd op de meest waarschijnlijke situatie op de rijst aankoopmarkt is Cournot concurrentie verondersteld voor Banqiao en Shangzhu in 2000. Een twee stappen concurrentiemodel met monopsonie in de eerste en Cournot in de tweede stap is opgesteld voor Gangyan in 2000. Met de ontwikkelde modellen wordt de liberalisatie en deregulatie van de rijst aankoopmarkt geanalyseerd. In alle drie de dorpen wordt daartoe volledige mededinging verondersteld in 2003. Daarnaast wordt verondersteld dat de consumentenprijzen voor rijst veranderen door o.a. vermindering van de internationale handelsbelemmeringen. De resultaten laten zien dat met constante consumentenprijzen voor rijst de prijzen die de agrarische huishoudens voor hun rijst ontvangen stijgen met 3.3% in Banqiao, 3.9% in Shangzhu en 10.5% en 3.7% (afhankelijk van

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de periode) in Gangyan. Hoofdstuk 4 concludeert dan ook dat agrarische huishoudens profiteren van liberalisatie en deregulatie van de aankoopmarkt voor rijst. Hoeveel ze profiteren hangt af van de mate van imperfecte mededinging voor de liberalisatie en deregulatie, de hoeveelheid verhandelde rijst en het niveau van markttoegang. Kleinere verhandelde hoeveelheden rijst en beperkte markttoegang verminderen het voordeel.

Als vervolg op hoofdstuk 4 analyseert **hoofdstuk 5** andere mogelijke vormen van concurrentie tussen de handelaren in de rijst aankoopmarkt in 2000 namelijk hoeveelheidleiderschap en prijsleiderschap in alle drie de dorpen. Zowel bij hoeveelheidleiderschap als bij prijsleiderschap wordt verondersteld dat de SGTCs de leider zijn. De zelfde scenario's als in hoofdstuk 4 worden doorgerekend. De resultaten laten zien dat met een constante consumentenprijs de prijs van rijst voor de agrarische huishoudens met 3.3% in Banqiao, 3.9% in Shangzhu, en 3.7% in Gangyan stijgt. Net als hoofdstuk 4 concludeert hoofdstuk 5 dat de agrarische huishoudens profiteren van liberalisatie en deregulatie van de aankoopmarkt voor rijst. De omvang van het voordeel hangt af van de mate van markttoegang en de hoeveelheid rijst die wordt aangeboden. De uitkomsten van hoofdstuk 4 en 5 illustreren dat de gevolgde politiek van liberalisatie en deregulatie een goede was. Ze laten ook zien dat het verbeteren van markttoegang welvaartverhogend werkt voor de agrarische huishoudens.

De modellen zoals ontwikkeld in hoofdstuk 4 en 5 hebben hun beperkingen. Zo worden de effecten van rijstproductie en de consumptie van andere goederen op het aanbod van rijst niet in beschouwing genomen, winsten in plaats van nut worden als welvaartsmaatstaf gebruikt en de effecten van werkgelegenheid buiten het bedrijf op het rijstaanbod worden niet meegenomen in de analyse. Om tegemoet te komen aan die bezwaren wordt een zogenaamd niet-separabel algemeen evenwichtsmodel op dorpsniveau in **hoofdstuk 6** ontwikkeld. Het model is alleen toegepast voor Gangyan, de data komen uit een Nationale Rekeningen Matrix die samengesteld is door Kuiper (2005). Het algemene evenwichtsmodel op dorpsniveau ontwikkeld door Kuiper verschilt met het hier ontwikkelde model, bijvoorbeeld het model in hoofdstuk 6 kent een veel hoger aggregatieniveau (slechts een representatief huishouden). Het hier ontwikkelde model neemt, in tegenstelling tot dat van Kuiper, imperfecte mededinging op de rijst aankoopmarkt in beschouwing. De scenario's in hoofdstuk 6 richten zich op de effecten van liberalisatie en deregulatie van de rijst aankoopmarkt. Zo worden de gevolgen berekend van transitie van imperfecte mededinging (Cournot) naar volledige mededinging, de consumentenprijsveranderingen, de introductie van inkomenstoeslag op basis van grond in gebruik voor rijstproductie en het opheffen van de zogenaamde landbouwbelasting (belasting met als grondslag de rijstproductie).

De positieve welvaartsveranderingen laten zien dat de agrarische huishoudens profiteren van de gesimuleerde beleidsveranderingen. De welvaartswinst is het grootst bij het scenario dat liberalisatie en deregulatie combineert met een consumentenprijsstijging. De welvaartswinst is het kleinst bij alleen liberalisatie en deregulatie. Dit resultaat laat zien dat de concurrentie in 2000 op de rijst aankoopmarkt al behoorlijk groot is zodat de winst van liberalisatie en deregulatie relatief beperkt is. De positieve effecten van de inkomenstoeslag zijn geringer dan Samenvatting

die van afschaffing van de landbouwbelasting. Hoofdstuk 6 laat zien dat de positieve gevolgen voor de export en exportprijs van rijst kleiner zijn dan in hoofdstuk 4 en 5. Dit komt o.a. doordat de in hoofdstuk 4 en 5 gekeken wordt naar de export van rijst gegeven een bepaalde omvang van de rijstproductie. In hoofdstuk 6 wordt de omvang van de rijstproductie door het model bepaald.

Hoofdstuk 7 vat de belangrijkste bevindingen samen, bediscussieert de belangrijkste bijdragen aan de literatuur en sluit af met aanbevelingen voor verder onderzoek. Het gebruik van mededingingsmodellen om de effecten van liberalisatie en deregulatie voor agrarische huishoudens in China te bepalen is nog niet eerder gebeurd. De uitkomsten van dit onderzoek komen grotendeels overeen met wat elders in de literatuur wordt gevonden. In hoofdstuk 7 wordt aanbevolen dat de Chinese overheid haar beleid richt op het scheppen van de economische en politieke voorwaarden om de ontwikkeling van de private sector te versterken. In het hoofdstuk wordt ook aangegeven dat al te frequente veranderingen in het beleid niet alleen kosten veroorzaken voor de centrale en lokale overheden maar ook de effectiviteit van het beleid schaden. De data die in dit onderzoek worden gebruikt zijn verzameld door middel van persoonlijke interviews die zijn gehouden in de studiegebieden. Om de kwaliteit van de interviews, en daarmee van de data, te vergroten werd een proefenquête gehouden en een training aan de interviewers gegeven. Een sterk punt van de modellen in dit onderzoek is dat de data behoefte relatief gering is. Een aantal beperkingen van de mededingingsmodellen worden ondervangen door het niet-separabele algemeen evenwichtsmodel uit hoofdstuk 6. Kenmerkend voor dit model is dat het naast het gedrag van agrarische huishoudens ook imperfecte mededinging in de rijst aankoopmarkt modelleert. Hiermee kan dit model dienen voor verder onderzoek op terrein van de gevolgen van liberalisatie en deregulatie van graanmarkten in China.

## **CURRICULUM VITAE**

Le Chen was born on May 19, 1975 in Jiangsu, P. R. China. In June 1997, she obtained a B.Sc. degree from Nanjing Agricultural University in Land Use Planning. From 1997-99, she worked in the Agriculture Office at the district government in Nanjing. In 1999, she received a fellowship from NUFFIC (the Netherlands organization for international cooperation in higher education). She started her M.Sc. education in Environmental Economics and Natural Resources at Wageningen University in September 1999. Her M.Sc. thesis was conducted within the context of the SERENA project, a cooperation between Nanjing Agricultural University (China), Wageningen University, and the Institute of Social Studies (The Hague), financed by the Netherlands Ministry of Development Cooperation (DGIS). She participated in an explorative household survey of the SERENA project in 2000. An article based on her M.Sc. thesis was published in an international journal (Ecological Economics). In March 2001, she obtained a M.Sc. degree in Agricultural Economics and Management from Wageningen University.

In September 2001, she started her Ph.D. project at Agricultural Economics and Rural Policy group of Wageningen University. The Ph.D. project was conducted within RESPONSE program, a cooperation between Wageningen University and the International Food Policy Research Institute (IFPRI, Washington DC). She designed questionnaires to collect data for her Ph.D. work. In 2003, she carried out a pilot survey in March and an official survey in July leading a group of 6 undergraduates from Nanjing Agricultural University (China).

## TRAINING AND SUPERVISION PLAN

Activity	Institute	Year	<b>Credits</b> <sup>1</sup>
General courses			
Social Science Research Methods	Mansholt Graduate School & RESPONSE <sup>2</sup>	2001	1
Techniques for Writing and Presenting a Scientific Paper	Mansholt Graduate School	2001	1
Career perspectives	Wageningen Graduate School	2005	1
Mansholt-specific courses			
Mansholt introduction course	Mansholt Graduate School	2001	1
Mansholt Multidisciplinary Seminar	Mansholt Graduate School	2005	1
Presentation of final PhD thesis proposal	Mansholt Graduate School & RESPONSE	2002	1
Discipline-specific courses			
Agricultural Models	Wageningen University	2000	5
Econometrics II	Wageningen University	2000	3
Maximum Entropy Econometrics	Mansholt Graduate School	2001	2
Pathways for Agricultural Intensification	Mansholt Graduate School & RESPONSE	2001	2
Applied Microeconomics	CentER, Tilburg University	2001	4
The Economics of Household Behaviour	Netherlands Network of Economics	2001	2
Economic Organisation Theory	Netherlands Network of Economics	2002	2
Advanced Industrial Organisation	Netherlands Network of Economics	2002	2
NAKE workshop on Game Theory	Netherlands Network of Economics	2002	2
Food Policy in an Era of Globalization	Mansholt Graduate School	2004	3
Agro-ecological Approaches for Rural Development	The C.T. de Wit Graduate School & RESPONSE	2001	1
Presentations at international conferences			2
the X <sup>th</sup> Congress, European Association of Agricultural Economists	EAAE <sup>3</sup> , Zaragoza, Spain	2002	
the 25 <sup>th</sup> International Conference of Agricultural Economists	IAAE <sup>4</sup> , Durban, South Africa	2003	
An international seminar "Economic Transition and Sustainable Agricultural Development in East Asia"	Nanjing Agricultural University, Nanjing, China	2003	

## Total (minimum 20 Credits)

36

1 One credit on average is equivalent to 40 hours of course work.

2 RESPONSE stands for Regional Food Security Policies for Natural Resource Management and Sustainable Economies.

3 EAAE stands for European Association of Agricultural Economists.

4 IAAE stands for International Association of Agricultural Economists.



Regional Food Security Policies for Natural Resource Management and Sustainable Economies

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

RESPONSE is one of the six multi-annual research programmes of the Interdisciplinary Research and Education Fund (INREF) of Wageningen University, launched in 2000. INREF enables the cooperation of Wageningen University researchers with international and local institutions in the South. The RESPONSE programme includes 10 sandwich PhD students from East Africa (Ethiopia, Kenya and Uganda) and Southeast Asia (China, Bangladesh and the Philippines). Fieldwork activities have been co-funded by the Dutch Ministry of Foreign Affairs (Directorate General for International Cooperation/DGIS), the European Union and the Neysvan Hoogstraten Foundation.