Distortions to Agricultural Incentives in China

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The purpose of this paper is to present estimations of indicators of direct and indirect interventions of China's government in agriculture. In order to put these indicators in context, the paper reviews China's experience with policy reforms since the 1950s and the measures the effects of these reforms on the agriculture sector. Unfortunately, due to data constraints, we can only produce quantitative measures of distortions since the early 1980s, that is for the past 25 years. Due to the nature of China's agricultural experience over the last six decades, this review emphasizes the sectoral and macroeconomic policies and elements of the institutional framework that have influenced the incentive framework facing the sector and factor markets. The trade- and price/marketing-policy-related changes in incentives for different products are reflected in estimated rates of government assistance (Nominal Rates of Assistance—NRAs, Direct Rates of Assistances—DRAs and consumer subsidies).

The main finding of our paper is that the nature of policy intervention into China has changed dramatically over the past 25 years, propelling the agricultural sector from one characterized by high distortions to one that was relatively liberalized. In the 1980s and early 1990s (henceforth the *early reform period*) there were distortions in both external and domestic policies that isolated domestic producers and consumers from international markets. Importantly during the early reform period domestic marketing and pricing policies actually served to make the prices that domestic producers and consumers faced almost independent from the effects of trade policy. Because of this even in the case of an exportable commodity (e.g., rice), a commodity that appears to

have been subject to little distortion at the border (meaning that that the international price of rice and the free market price of rice were nearly identical), domestic pricing and marketing policies did not allow producers to reap the profits from international-level prices and instead forced farmers to sell much of their surplus to the state at an artificially low price. Hence, domestic policies levied a tax on farmers even though there was little distortion at the border. Similar dynamics characterized importable commodities (e.g., wheat and soybeans) where despite fairly high rates of protection from trade policies, consumers were still being implicitly taxed and producers were receiving much less protection than they would have had their been a free domestic market for the importable.

In contrast, since the late 1980s and early 1990s (the *late reform period*), the liberalization of domestic markets has resulted in the reduction of distortions from domestic policies. During the late reform period the market gradually replaced the state procurement system as the primary mechanism for allocating resources and market-generated prices have become the basis of farmer production and marketing decisions. At the same time, especially in the case of importable commodities, trade policy has also become more liberalized, with distortions from border measures falling substantially. As a result, we find that by the end of the late reform period (that is, after 2000) China's agriculture is much less distorted in two ways. First, the differences between international and domestic market prices have narrowed considerably for many commodities due to trade policy liberalization. Second, the elimination of domestic policy distortions mean that when trade liberalization allows for the increased import or export of agricultural commodities, prices in China's domestic market change and farmers are directly affected by them.

In addition, we also examine the effect of input-oriented policies and exchange rate policies. We find that input-related policies have generated few distortions in the case of China since 1980. However, exchange rate policy, like changes to pricing and marketing and trade policies, has played a more important role. In the early reform era exchange rates were highly distorted and served to place an implicit tax (or reduce the amount of protection) on the agricultural economy. By the late reform era, however, exchange rate reforms gradually eliminated the distortions, reinforcing the gradual shift towards a more liberalized agricultural economy.

Despite the finding that considerable liberalization has occurred due to policy reforms in both the domestic and external economy, in the mid-2000s 25 years after the beginning of reforms, there are still distortions to agriculture. In some cases, remaining distortions are mainly coming from the current tariff lines. While low in international comparisons, China's tariffs are still providing a degree of protection for a number of importable commodities (e.g., wheat and soybeans). In the case of other importable commodities (e.g., maize), the use of export subsidies (which in fact are mostly disguised as domestic marketing, transport and storage subsidies allowed to developing countries under WTO rules) continue to keep a wedge between the domestic price in China and the international market.

To more fully show these results and provide the reader with a fuller discussion of recent changes to the structure of China's economy, the policy environment within which the changes have been occurring and the analytical approach and findings of the distortion analysis, the rest of the paper is organized as follows. In the next section (section II) we present two sets of discussion, one that examines the changes in the

performance of the economy and the other that reviews the policy environment and reform agenda that is occurring during the periods of change. We examine the changes for two separate time periods: the Socialist era (1950 to 1979) and the Reform era (1980 to the present). The period is split like this, not only because of the differences in performance and policy changes between the two eras, but also because in the subsequent distortion analysis, we are only able to quantify the effect of China's liberalizing domestic and external changes after 1980. In the following section III, we discuss our quantitative approach and sources of data. The results of the distortion analysis are presented and discussed in section IV. And the final section concludes.

Growth and structural change of agriculture over the past 50 years
The Socialist Era: 1950-1978

Socialist policies dominated the 1950s, 1960s and 1970s in China and had a profound and complicated effect on agriculture. In this section, we briefly review the performance of the agricultural sector, laying out the successes and failures of the sector. Second, we recount the major policies—inside and outside of agriculture—that we believe are responsible for producing the outcomes that were realized during the Socialist period.

Performance during the socialist period

The record on the performance of agriculture in producing food and other raw materials for industry during the Socialist period is mixed and in part depends on the standard against which the sector's performance is being judged. On the one hand aggregate trends show that agriculture played an important role in increasing food availability, especially that of staple grains (Huang et al., 2006). Between 1952 and 1978

total sown area only changed marginally, increasing by 6.3 percent; likewise, grain sown

area was about steady, declining by 2.7 percent. Grain yields, in contrast, increased by 91

percent from 1952 to 1978, an annual growth of 2.8 percent. In the aggregate, China's

grain production rose by 86 percent, a rise of 2.5 percent per year. Indeed, the growth rate

of grain production outpaced that of the population (1.9 percent), meaning that China's

agricultural sector increased per capita calorie availability during the Socialist period.

While credit has to be given to leaders to increasing the absolute and per capita

levels of food and agricultural raw material availability during a time that many other

nations in the world were suffering from falling food production, it is hard to argue that

agriculture's performance was stellar enough as to be considered a transformative force

of the Socialist-era economy. Throughout the 1950s, 1960s and 1970s, China's

consumers remained on strictly rationed diets. Coarse grains—maize, sweet potato, millet

and sorghum—made up much of an average citizen's staple food intake. Cooking oil,

sugar, meat and vegetables were not available on a daily basis for the typical consumer

during many years. Most telling, despite the growth, the average level of consumption in

urban areas in the 1970s was still low, only 2328 calories per capita; per capita calories

was less for the average rural resident—barely at the UN's average minimum

requirement of 2100). Moreover, food production systems at time also were so fragile

that at time it was subject to catastrophic failure as was experienced during the famine of

1959 to 1961, a famine that killed more than 30 million people (Ashton *et al*., 1984).

In fact, food availability became such an issue that during the late 1960s and

1970s China began to turn to international markets to supplement domestic production.

Between 1973 and 1980, China imported on average more than 6 million tons of grain,

mostly wheat. During the peak import years, grain accounted for a large percentage (in value terms) of China's imports. Obviously, at a time when China's planners were trying to jump-start China's industrialization with imported machinery and other technologies, the inability of the agricultural sector to produce enough food (not to mention for foreign exchange earnings from exports) put a drag on the nation's development.

Structural Stagnation

Beyond the performance of the food production sector of the rural economy (which is at best mixed), almost everything else about the record of structural change during the first three decades of agricultural development during the People's Republican period is negative (Huang et al., 2006). For example, the production structure of cropping showed almost no change at all. In 1952 grain accounted for 88 percent of sown area; grain was still being sown on 83 percent of the nation's sown area in 1970. Likewise, there was little change in the structure of the agricultural sector, according to a broader definition. The value of the cropping sector as a share of total agricultural output value was 83 percent in 1952 and was still 75 percent in 1970. Perhaps of greatest importance, income per capita of rural farmers and other metrics of wealth also showed the stagnation of the agricultural sector. Despite the rise in grain output, earnings per capita in the 1970s were almost the same as they were in the mid-1950s (Lardy, 1983). Annual per capita levels of rural consumption even by 1978—nearly 30 years after the start of the Socialist era—of almost every food in an absolute sense were low—only 1.1 kilograms of edible oil and 6.4 kilogram of meat (Huang and Bouis, 2001). The poverty rate was between 30 and 40 percent.

The stagnation of income, given (even modest) rising output, suggests that productivity growth was low. Although data sources do not facilitate rigorous analysis of total factor productivity, there appears to have been a complete absence of productivity gain or allocative efficiency increase. In fact, the work of Stone and Rozelle (1995) and Wen (1993) support just such a conclusion. Using aggregate data, both papers end up concluding that total factor productivity growth between 1950 and 1978 was zero or close to zero.

Finally, there also was almost no sign of shift in the employment structure in the economy. While other rapidly developing countries in East Asia were diversifying the sources of income of the rural population and expanding employment in the off farm sector, little was happening in China's rural sector (Lardy, 1983). In 1957 about 84 percent of the population was in the agricultural sector; by 1970, the share of the population in the agricultural sector actually had risen to 85 percent (CNBS, 2000). In 1980 it was still 83 percent. In 1980, of the more than 400 million people in China's rural labor force, only 4 percent had a full time off farm job (deBrauw *et al.*, 2002). In fact, according to data on percent of population in agriculture and GDP (World Bank, 1985), for its level of income, there were more people living and working in the agricultural sector than in any other country.

Socialist policies and institutions

Blame for the poor performance of the agricultural sector almost certainly can be placed squarely on the shoulders of poor policy. Even while local leaders were experimenting with privatized land through an ambitious set of land-to-the-tiller policies in the early 1950s, other factions of the Socialist leadership were already developing

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policies that were threatening the incentives embodied in private land ownership (Lardy, 1983, p17). The levels of investment believed to be required to promote industrialization were, in part, obtained through transfers from the agricultural sector. During the planning era, the prices of agricultural products were depressed to allow food to be sold at low, rationed prices to non-agricultural sector consumers. Yao (1994, p138) reports Guo Shutian's estimates of the 'scissors difference'—the extent to which the agricultural sector was taxed by the prices of agricultural goods being set below their market values and the prices of industrial goods being set above their market prices. These involved an estimated taxation rate of 26 percent in 1957 and 27 percent in 1978, primarily from direct taxation of the prices of agricultural goods.

After the early 1950s farmers were organized into collectives and then communes, eliminating the household farm in China. The main negative effect of the communization movement was one of absence of incentives. The basic problem was that individual families were not the residual claimant of production and decision making was left to collective leadership that was not doing all of the work (Putterman, 1993). Instead, farm workers were assigned points based on tasks which were difficult to monitor. While there is a debate over the extent to which the collectives were able to motivate farmers to exert effort and attempt to increase the efficiency of production on their farms (Dong and Dow, 1993; Lin and Yang, 2000; Chang and Wen, 1995), most scholars believe that free riding and the inability to monitor agricultural labor undermined the incentives in agriculture.

Socialist era pricing and marketing policies also did little to either encourage the efficient production or allocation goods and services. Prices were fixed by the state (Sicular, 1988b). Between 1962 and 1978, the price of grain remained almost unchanged,

being adjusted only three times, rising by a total of less than 20 percent. Input prices played mainly an accounting function as shortages kept most producers from having access to the quantities that they demanded. Marketing institutions—monopolized by government parastatals—also did not encourage the development of agriculture; there was little competition and marketing officials did not have an incentive to search out low cost or quality producers. Through plans directed by the marketing system, production was carried out based on (mostly) planned acreage, target volume, quality and variety of production. Even the ratio between home consumption and marketed surplus was stipulated.

The system also served to help—at least in the short run—the state's effort at forced industrialization by keeping down the price of staples in order to allow the state to keep wages low. Except for the amount used for the farm-households' home consumption for food, feed and seeds, all production of grains and edible oils and fiber crops was procured only by the state at quota prices for a specified (compulsory) amount (Sicular, 1988b). After the early 1960s, the state also procured any surplus production beyond the quota and home consumption at a somewhat higher above-quota price to provide an incentive to increase production. The incentives, however, were targeted at collective leaders and not the farmers on whose effort labor depended. To suppress the demand for agricultural products that were in short supply (and priced low), marketing policy also exercised tight control over food marketing in urban areas. Almost all major commodities were sold by government agencies to urban consumers and rural households in grain deficit regions at ration prices upon presentation of coupons.

During this same time fertilizer and pesticides and other material inputs, where available were also sold through marketing channels monopolized by the state (Stone, 1988). The Agricultural Inputs Corporation sold fertilizer on the basis of a carefully formulated plan stretching from the province to the village. Collective leaders needed fertilizer coupons to buy fertilizer and other inputs that were in short supply.

In an agricultural system dominated by either tens of millions of individual farmers or hundreds of thousands of brigades and teams there is a need for the state to play a major role in organizing investments since individuals have little incentives to make a wide set of investments. In a number of areas, the China government between 1950 and 1978 did make such investments. National leaders arguably put its greatest effort into water conservancy (Nickum, 1998). In the early 1950s, China's irrigation and flood control systems were a shambles. Irrigated area was less than 20 percent of total cultivated area (Stone 1988b). After more than 20 years of investment by both national and local government and with the aid of uncountable man-years of corvee labor, China's irrigation area reached more than 40 percent by 1978. By the mid-1970s, every major river system also was protected by an intricate network of dikes, dams and flood diversion projects. In addition, led by a fully publicly-funded research and development system, China's agricultural scientists led the developing world in many areas and were responsible for generating many new breakthroughs. Breeders developed semi-dwarf, high-yielding rice varieties several years before the Green Revolution began in other parts of Asia (Stone, 1988). Farmers were able to use hybrid maize and disease resistant wheat varieties in the 1960s and 1970s, long before such technologies were available elsewhere in most parts of the developing world. In 1976 Yuan Longping created and

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commercialized the world's first hybrid rice variety (Lin, 1991; Huang and Rozelle, 1996). An extension system with nearly 500,000 agents was in charge of introducing the technology to brigade technicians (Hu and Huang, 2004). By the mid-1970s most of China's cereals were improved varieties.

Non-agricultural policies and institutions and agricultural stagnation

China's approach to planning and its placement of the rural economy into the unplanned sector also had a dramatic effect on the nature of employment and China's structural stagnation (Lyons, 1987). Because China's agricultural sector was so large and undeveloped, leaders decided to make a sharp distinction between those that lived in rural and those that live in urban areas. Agriculture became part of the collective sector. In return for shipments of fertilizer and small amounts of capital and other inputs, the agricultural sector was expected to supply food and non-food commodities to the urban-industrial parts of the economy. All of the rest of the needs of the collective agricultural sector were supposed to be taken care of by the leadership of the collective with its own resources. Farmers were not allowed to freely move out of their collectives. The scope and magnitude of the gap in housing, educational, health, welfare and other services between rural and urban widened throughout the Socialist period. Without a doubt the *hukou* policies and other restrictions preventing rural people from moving into manufacturing and service provision artificially limited the structural change that took place during the Socialist era and suppressed incomes and productivity.

Two key external policies also worked against agriculture in the Socialist era. First, agricultural trade in the pre-reform era was also subject to the plan (Huang and Chen, 1999; Lardy, 2001). In essence, it was a tool that was to be used to supplement the

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plan of the domestic economy. Given the nation's commitment to self-sufficiency in all areas of the economy, imports were to be used only for procuring those products—most of which were machinery and other productive investments—that could not be manufactured domestically and which would help facilitate meeting the plan. Almost all trade was made through eight state-owned trading firms. In the 1970s, the agricultural state trading firms monopolized nearly all food imports and exports. Hence, it was not in the nature of the institutional structure of the state trade apparatus that would allow the specialization in labor-intensive export crops which could be offset by imports of land-intensive staple crops. Agriculture trade was primarily looked upon as a means to generate foreign exchange.

Summary: Socialist agriculture a policy-driven disaster

After nearly 30 years of development, China's agriculture was a mess. It was not really playing any of its roles effectively. Although output was up, this was only due to enormous investments of central and local government funds and mostly corvee labor financed mostly by the sweat of farmers. Productivity was stagnant. Incomes were stagnant. There was no structural shift towards a more productive, higher efficiency sector. The population was locked into agriculture. The most dismal finding of the analysis of the Socialist era is, of course, is that this dismal performance was due mostly to more than two decades of the implementation of Socialist policies—both inside and outside the agricultural sector. The organization of production, pricing system and marketing institutions provided no incentives. Some of the investments were effective but far too few to offset the negative effects of the poor incentives. Perhaps most inimical were the policies that trapped the rural population in a system that designated them as

second class citizens and did not give them their fair share of investment, services or opportunities. In short, the agricultural and non-agricultural policy environment undermined the role that agriculture plays in a healthy modern economy.

Agriculture in China's transition era: current successes

In this section, we follow two main themes. First, we describe the performance of the agricultural sector and examine the role that it has begun to play since the onset of the Reform era in the late 1970s. Second, we examine in greater depth the policy initiatives—inside and outside of agriculture—that have helped launch and guide China's agricultural transition. We examine the reform strategy by looking at its various components, their implementation and the objectives of and rationale for each reform component.

Agriculture in the Transition Era—Performance

The ups and downs that characterized the performance of agriculture in the pre-reform period disappeared after 1978. Whatever metric of success that there was in agricultural production in China during the 1950s, 1960s and 1970s was surpassed during the reform era and agriculture finally began to carry out its various roles in the development process. Compared to the early and mid-1970s when agricultural GDP rose by 4.9 percent annually, the annual growth rate almost doubled to 8.8 percent during the initial Reform period, 1978 to 1984, and rose further, to 9.7 percent, in 1985-95 before slowing to 8.l2 percent in 1996-2000 (Table 1, row 1). These are extraordinarily high rates of agricultural growth over such a sustained time period; such rates of the growth rarely have been matched during any development experience in history.

At least in the early reform period, output growth—driven by increases in yields—was experienced in all subsectors of agriculture. Between 1978 and 1984, grain production, in general, increased by 4.7 percent per year (Table 1, rows 2 to 4). Production rose for each of the major grains—rice, wheat and maize (rows 5 to 13). The success of agriculture in playing its role of supplying high-quality, inexpensive food can be illustrated by an examination of grain prices in China. During the Reform era, with the exception of price spikes in 1988 and 1995 the real prices of rice, wheat and maize have fallen between 33 percent (maize) and 45 percent (wheat) between the late 1970s and early 2000s.

Far more fundamental than rises in output and yields of the grain sector (although this certainly is connected with and in part made possible by the success in grain production), China's agricultural economy has steadily been remaking itself from a grain-first sector to one producing higher valued cash crops, horticultural goods and livestock/aquaculture products. Like the grain sector, cash crops, in general, and specific crops, such as cotton, edible oils and vegetables and fruit, also grew rapidly in the early reform period when compared to the 1970s (Table 1, rows 14 to 21). Unlike grain (with the exception of land-intensive staples, such as cotton), the growth of the non-grain sector continued throughout the reform era. Moreover, the rise in some sectors has been so fast that it almost defies description. For example, between 1990 and 2004 the increase in vegetable production capacity has been so fast that China as a nation is adding the equivalent of the production capacity of California (the world's most productive vegetable basket) every two years. When compared on the basis of the share of cultivated area dedicated to fruit orchards, the share in China (over 5 percent) is more than double

the share of the next closest major agricultural nation (including the US, the EU, Japan, India). China today can more closely be said to following "taking apples and onions as the key link" than being a grain-first agriculture as in the Socialist era.

China also is moving rapidly away from a cropping agricultural mentality. The rise of livestock and fishery sectors outpaces the cropping sector, in general, and most of the subcategories of cropping (Table 1, rows 22 and 23). Livestock production rose 9.1 percent in the early reform period and has continued to grow at between 6.5 to 8.8 percent since 1985. The fisheries subsector is the fastest growing component of agriculture, rising more than 10 percent per year during the Reform era. Today, more than 70 percent of the world's fresh water aquaculture is produced in China. And, the rapid and continuous rise in livestock and fisheries has steadily eroded the predominance of cropping (Table 2). After remaining fairly static during the Socialist era, the share of agriculture contributed by cropping fell from 76 percent to 56 percent between 1980 and 2000. At the same time, the combined share of livestock and fisheries rose to 41 percent, more than doubling their 1980 share (only 20 percent). It is projected that by 2008, cropping will account for less than 50 percent of agricultural output in China.

Moving off the farm

The Reform-era has brought even more fundamental, transformative changes when looking at a picture of the rural economy based on a definition that is broader than agriculture. While the average annual growth of agriculture (as seen above) averaged about 5 percent throughout the entire reform period, the growth rate of the economy as a whole and of the industrial and service sectors were faster (Table 1, rows 1 to 4). In fact, since 1985, the growth of industry and service sector has been two to three times faster

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than agriculture. Because of the differences in the sectoral growth rates, agriculture's share of GDP has fallen from 40 percent in 1970 to 16 percent in 2000. Projection models of the economy predict that the share of agriculture will fall under 10 percent before 2010. The shifts in the economy can also be seen in employment. Agriculture employed 81 percent of labor in 1970. By 2000, however, as the industrial and service sectors grew in important, the share of employment in agriculture fell to below 50 percent (CNBS).

Agricultural trade liberalization

While so much has been made of China's accession to the WTO as a turning point in its relationship with the world, in fact China's open door policy started much earlier (Huang *et al*., 1999). In the process, China has turned itself from a hermit country into one of the world's great trading nations, including in the area of agricultural trade. From 1980 to 2000, the total value of China's agricultural trade grew by about 6.0% on an annual basis. Since 2000, it has more than doubled, making China the fourth largest importer of agricultural commodities in the world (Gale, 2006). However, China is more than an importer, since the reforms, in almost every year the level of agricultural exports has exceeded that of imports (Huang *et al*., 1999).

Perhaps more remarkably, is the shift in the composition of trade that China has experienced over the past 25 years. Figure 1 shows that net exports of *land-intensive bulk commodities*, such as grains, oilseeds and sugar, have fallen; exports of higher-valued, more *labor-intensive products*, such as horticultural and animal products (including aquaculture) have risen. In other words, China's has begun to export those commodities in which it has a comparative advantage and import those in which it does not have an

advantage. Disaggregated, crop-specific trade trends also show the same sharp shifts (Anderson et al., 2004).

The production and marketing environment

After more than 25 years of reform one of the most striking differences in the nature of agriculture is the role of government and local leaders in the production and marketing process. In contrast with the time during the Socialist era when local (commune and brigade) officials and bureaucrats in government supply and marketing agencies were deeply involved with all aspects of pre- and post-harvest decisions, by 2005 the situation had changed dramatically. Indeed, one of the most notable features of China's agricultural economy today (with several exceptions) is the limited extent of government involvement. In fact, restrictions on land ownership aside, China today may have one of the least regulated, domestic agricultural economies in the world. In a recent survey done by the Center for Chinese Agricultural Policy, with the exception of farmers that were renting village-owned orchards that had been planted in the 1980s and early 1990s, in 100 percent of the responses, the farmer said that he/she made the planting decision and was not compelled by local officials (Rozelle *et al.*, 2006). In another survey of households in eight provinces, every farmer in the survey stated that they purchased all of their chemical fertilizer on their own and that local officials had no role in the transaction (Zhang *et al*., 2005). All purchases were made from private suppliers.

On the procurement side, whereas it used to be that government parastatals were responsible for purchasing the output of China's farms, today, a large majority of sales of grains and oilseeds and fiber crops and literally all purchases of horticultural and livestock products are to small, private traders (Wang *et al*., 2006). Indeed, even with the

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rise of supermarkets and processing firms that are catering to the retail needs of the urban population, a recent survey discovered that almost all purchases of fruit, vegetables, nuts and livestock products are by individual entrepreneurs who are trading on their own account. The existence of millions of small traders that are competing with virtually no regulation has meant that China's markets have become integrated and efficient (Park *et al.*, 2002; Huang *et al.*, 2004; and Rozelle and Huang, 2004; 2005).

Productivity trends and rural incomes

While it is possible that agricultural productivity trends tell a somewhat different story of how transition affects agricultural performance that for the case of output (as was the case in the pre-reform period), this is not the case in reform China. First, as seen in Table 1, output per unit of land (or yields) all rose sharply. In addition, for the entire reform period, trends in agricultural labor productivity (ALP), measured as output per farm worker, parallel those of yield. Moreover, several series of TFP estimates have been produced for China's agriculture (McMillan et al., 1989; Fan, 1991; Lin, 1992; Wen, 1993; Huang and Rozelle, 1996; Fan, 1997; Jin et al., 2002). The studies uniformly demonstrate that in the first years after reform (1978 to 1984), comprehensive measures of productivity (either constructed TFP indices or their regression-based equivalents) rose by 5 to 10 percent per year.

In part due to rising productivity, and perhaps even more due to the increasing efficiency associated with specialization, shifting to the production of more higher value crops and livestock commodities and the expansion of off farm work, rural incomes during the reforms have steadily increased (Table 3). Between 1980 and 2000, average rural per capita incomes have risen (in real terms) from 771 to 2347 yuan. This annual

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rise (6 percent) is remarkable and is as high as the growth rates experienced in Japan and Korea during their take-off years. Hence, it seems surprising the amount of attention given to the rural income problem by the media; the problem, however, no doubt is rooted in the relative rise between the rural and the urban that both started from a higher base and rose faster than rural incomes. The inequality between rural and urban also has a parallel with the rural economy, between those that began relatively rich and those that began the period relatively poor. The growth rate of rural per capita income for those in the richest decile is higher than average, at more than 8 percent annually. In contrast, although incomes are rising (at 3 percent annually), the rates of increase are far lower than the richest, meaning in relative terms the poorest of the rural poor are falling behind.

Summary: agriculture's performance during the reform era

In summary, whereas the Socialist era saw little transformation, during the transition period China's agricultural sector has changed dramatically. Although the sector grew, its fall in the importance in the overall economy in both terms of output value and employment characterize modern growth. The structure of the sector itself also is changing, diversifying out of coarse grains into fine grains, out of staple grains into higher valued crops, and out of cropping into livestock and aquaculture. Trade patterns are also changing more in line with China's comparative advantage. One of the largest shifts is in the nature of the production and marketing environment; they have almost become laissez-faire and have little government intervention. Although the most dramatic changes have taken place most rapidly among the richer households, change is also occurring among the poor.

Institutions and policy bases of reform

Unlike in the transitional economies in Europe, leaders in China did not move to dismantle the planned economy in favor of liberalized markets during the initial stages of reform (Rozelle and Swinnen, 2004). Policymakers only began to shift their focus to market liberalization in 1985 after decollectivization was complete. Even then, liberalization was start and stop (Sicular, 1995). Lin, Cai and Li (1996) argue that leaders were mainly afraid of the disruption that would occur if the institutions through which leaders controlled the main goods in the food economy (such as grain, fertilizer, and meat products) were eliminated without the institutions in place that work to support more efficient market exchange. Throughout, leaders also were investing and changing the rules under which domestic producers and consumers interacted with the external economy.

Pricing policies

Although early in the reforms China's leaders had no concrete plan to liberalize markets, they did take steps to change the incentives faced by producers that were embodied in the prices that producers received for their marketed surplus. Hence, perhaps one of the least appreciated moves of the early reformers was their bold decision to administratively increase the prices received by farmers (Lardy, 1983; Sicular, 1988b). Between 1978 and 1983, in a number of separate actions, above-quota prices, the payments farmers received for voluntary sales beyond the mandatory deliveries, were increased by 41 percent for grain and by around 50 percent for cash crops (Sicular, 1988b). According to State Statistical Bureau data, the relative price of grain to fertilizer rose by more than 60 percent during the first 3 years after reform. During the early

reform years, the rise in the above-quota price (a state-set price) represented a higher output price at the margin to farmers (Sicular, 1995).

The important contribution of China's pricing policy was in the timing and breadth of the policy change. The first major price rise occurred in 1979, almost at the time reformers were deciding to decollectivize. However, given the leadership's decision to gradually implement the Household Responsibility System (HRS—discussed below), beginning first in the poorest areas of China, the price increases immediately affected all farmers, both those in areas that had been decollectivized and those that had not. By 1981, the time of the second major price increase, according to Lin (1992), less than half of China's farmers had been allowed to dismantle their communes. Hence, as long as there was some, albeit weak, link between the output price and production, the plan-based price rise would have led to increases in China's farm output. Empirical studies on China confirm a strong impact of these price changes on output during the first years of transition (Lin, 1992; Fan, 1991; Huang and Rozelle, 1996; Fan and Pardey, 1997).

Increased incentives

China's rural economic reform, first initiated in 1979, was founded on the household responsibility system (HRS). The HRS reforms dismantled the communes and contracted agricultural land to households, mostly on the basis of family size and number of people in the household's labor force. Most importantly, after the HRS reforms, control and income rights belonged to individuals. With the exception of rights to sell their land[1], farmers, above all, became the residual claimants to their effort.

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[1] Even here, markets for the transfer of land use rights have emerged.

There is little doubt that the changes in incentives resulting from property rights reforms triggered strong growth in both output and productivity. In the most definitive study on the subject, Lin (1992) estimates that China's HRS accounted for 42 to 46 percent of the total rise in output during the early reform period (1978 to 1984). Fan (1991) and Huang and Rozelle (1996) find that even after accounting for technological change, institutional change during the late 1970s and early 1980s contributed about 30 percent of output growth. Empirical researchers also have documented impacts that go beyond output. For example, McMillan et al. (1989) document that the early reforms in China also raised total factor productivity, accounting for 90 percent of the rise (23 percent) between 1978 and 1984. Jin et al. (2002) show that the reforms had a large effect on productivity, contributing greatly to a rise in TFP that exceeds 7 percent annually.

Domestic output market liberalization policies

In addition to pricing changes and decollectivization, another major task of reformers is to create more efficient institutions of exchange. Markets—whether classic competitive ones or some workable substitute—increase efficiency by facilitating transactions among agents to allow specialization and trade and by providing information through a pricing mechanism to producers and consumers about the relative scarcity of resources. Reformers in China and the major changes to agricultural commerce in the early 1980s almost exclusively centered on increasing the purchase prices of crops (Sicular, 1988b; Watson, 1994). In this way, the decision to raise prices (discussed above), however, should not be considered as a move to liberalize markets since planners in the Ministry of Commerce made the changes administratively and the price changes

mostly were executed by the national network of grain procurement stations acting under direction of the State Grain Bureau.

An examination of policies and the extent of marketing activity in the early 1980s illustrate the limited extent of changes in the marketing environment of China's food economy before 1985. It is true that reformers did allow farmers increased discretion to produce and market crops in 10 planning categories, such as vegetables, fruits, and coarse grains. Moreover, by 1984 the state only claimed control over 12 commodities, including rice, wheat, maize, soybeans, peanuts, rapeseed, and several other cash crops (Sicular, 1988b). However, while this may seem to represent a significant move towards liberalization, —the crops that remained almost entirely under the planning authority of the government still accounted for more than 95 percent of sown area in 1984. Hence, by state policy and practice, the output and marketing of almost all sown area was still directly influenced by China's planners. Reforms proceeded with equal caution when reducing restrictions on free market trade.

After 1985, although the process proceeded in a stop and start manner, market liberalization began in earnest. Changes to the procurement system, further reductions in restrictions on trading of commodities, moves to commercialize the state grain trading system and calls for the expansion of market construction in rural and urban areas led to a surge in market-oriented activity (Sicular, 1995). For example, in 1980 there were only 241,000 private and semi-private trading enterprises registered with the State Markets Bureau; by 1990, there were more than 5.2 million (deBrauw et al., 2003).

Despite its start and stop nature, as the right to private trading was extended to include surplus output of all categories of agricultural products after contractual

obligations to the state were fulfilled, the foundations of the state marketing system began

to be undermined (Rozelle et al., 2000). Other than for rice, wheat, maize and cotton,

reformers eliminated all planned procurement of agricultural products; government

commercial departments could only continue to buy and sell through the market. For

grain, incentives were introduced through reductions in the volume of the compulsory

delivery quotas and increases in procurement prices. Even for grain, after the share of

grain compulsory quota procurement in grain production reached 29% in 1984, it

declined to 18% in 1985 and 13% in 1990. The share of negotiated procurement at

market price increased from 3% only in 1985 to 6% in 1985 and 12% in 1990.

Technology and water infrastructure development

Agricultural research and plant breeding in China remain almost completely

organized by the government. Reflecting the urban bias of food policy, most crop

breeding programs have emphasized fine grains (rice and wheat). For national food self-

sufficiency considerations, high yields have been major target of China's research

program except in recent years when quality improvement was introduced into the

nation's development plan. Although there have been several private domestic and joint

venture investments in agricultural research and development, policies still discriminate

against them.

Today, the record on reform of the agricultural technology system is mixed and its

impact on new technological developments and crop productivity is unclear. Empirical

evidence demonstrates the declining effectiveness of China's agricultural research

capabilities (Jin *et al*., 2002). Our previous work found that while competitive grant

programs probably increased the effectiveness of China's agricultural research system,

the reliance on commercialization revenue to subsidize research and make up for falling budgetary commitments weakened the system.[2] It is possible that imperfections in the seed industry partly contributed to the ineffectiveness of research reform measures in crop breeding. In recent years (since the late 1990s) there has once again been a sharp rise in spending on agricultural research and development.

The investment by the state in water control—both irrigation and flood control— swamps the amount invested into agricultural research. As noted above, in the 1950s to the 1970s most of the state's effort was focused on building dams and canal networks, often with the input of corvee labor from farmers. After the 1970s, greater focus was put on increasing the use of China's massive groundwater resources (Wang et al., 2005a). By 2005 China had more tubewells than any country in the world, except possibly for India. Although initially investment was put up by local governments with aid from county and provincial water bureaus, by the 1990s the government was encouraging the huge shift in ownership that was occurring as pump sets and wells and other irrigation equipment went largely into the hands of private farming families (Wang *et al.*, 1995b). At the same time private water markets (whereby farmers pump water from their own well and sell it to other farmers in the village) were also encouraged. The main policy initiative after the mid-1990s in the surface water sector was management reform with the goal of trying to make water use more efficient.

Trade policy

In addition to important changes in foreign exchange policy (changes that saw the nation's currency depreciated steeply and trading rights become more accessible to

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[2] Findings based on a series of intensive interviews and survey data gathered from a wide range of agricultural ministry personnel, research administrators, research staff, and others involved in China's agricultural research system.

traders during the 1980s and 1990s), there has been a number of other fundamental reforms to China's international trading system. Lower tariffs and rising imports and exports of agricultural products began to affect domestic terms of trade in the 1980s. In the initial years most of the fall in protection came from a reduction in the commodities that were controlled by single desk state traders (Huang and Chen, 1999). For many products, competition among non-state foreign trade corporations began to stimulate imports and exports (Martin, 2002). Although many major agricultural commodities were not included in the moves to decentralize trade, the moves spurred the export of many agricultural goods. In addition, policy shifts in the 1980s and 1990s also changed the trading behavior of state traders. Leaders allowed the state traders to increase imports in the 1980s and 1990s.

Moves to relax rights of access to import and export markets were matched by actions to reduce the taxes that were being assessed at the border. After the fall of restrictions on imports and exports of many of China's agricultural commodities, a new effort began in the early 1990s to reduce the level of formal protection. From 1992 to 1998, the simple average agricultural import tariff fell from 42.2 percent in 1992 to 23.6 percent in 1998 to 21 percent in 2001 (Rosen *et al.*, 2004).

Overall, protection in the agricultural sector has declined in the past 20 years (Huang and Rozelle, 2002). Much of the falling protection in agriculture has come from decentralizing authority for imports and exports and relaxing licensing procedures for some crops (e.g., moving oil and oil seed imports away from state trading firms) and foreign exchange rate changes. Other trade policies have reduced the scope of NTBs, relaxed the real tariff rates at the border and changed quotas (Huang and Chen, 1999).

Despite this real and in some areas rapid set of reforms, the control of a set of commodities that leaders consider to be of national strategic importance, such as rice, wheat and maize, remain with government officials a much larger extent (Nyberg and Rozelle, 1999).

Given the changes made prior to the nation's accession to the WTO, it is not surprising that, while it was a major event in China (and it will have an effect on many sectors), in its most basic terms it is really a continuation of previous policies. Hence, the commitments embodied in China's WTO accession agreement in the agricultural sector—market access, domestic support and export subsidies—are essentially what China was doing in the 1990s.

Summary: China's transition era agricultural policies

The scope of China's policy efforts during the transition era is impressive. Policy shifts were made in pricing, the organization of production, marketing, investments, technology and trade. Although the rate of investment has risen during the reforms China is still underinvesting in agriculture compared to other countries. Taxes—both those that are explicit and those implicit in pricing and trade policies—also have fallen. Although China certainly did not reach the point during the transition era that it began to heavily subsidize the agricultural economy in a way that characterizes its neighbors in East Asia, it appears to be heading in the direction noted by Timmer (1997) in which developing nations a certain point begin to turn from a period of extraction from agriculture to a period of net investment in the sector.

In addition, outside of agriculture, many policies and other factors affected the sector. Other rural policies, for example, such as those that govern fiscal reform,

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township and village enterprise emergence and privatization and rural governance almost certainly have a large, albeit indirect, effect on agriculture. Urban employment policies, residency restrictions, exchange rate management and many other policy initiatives also affect agriculture by affecting relative prices in the economy, the access to jobs off the farm and the overall attractiveness of staying on the farm.

When taken together, these policies have been shown to have a dramatic effect on China's agricultural sector. They have increased output of food, driven prices down and improved supplies of non-grain food and raw materials for industry. The mix of policies—pricing; improved property rights; market liberalization; investment; trade—also have made producers more efficient, they have freed up labor and resources that are behind the structural transformation in the agricultural economy, specifically, and the rural economy, more generally. One of the most convincing indicators showing that agriculture in China is beginning to play effective roles in the nation's development is that the importance of grain in shrinking inside the cropping sector; the importance of the cropping sector is shrinking inside the overall agricultural sector; and the importance of agriculture is shrinking in the general economy. Rural incomes are up; productivity is up. Many of the rises in welfare, however, are being generated by individuals (and there have been more than 200 million of them) that have been able to escape grain and move into high-valued crops; escape cropping and move into livestock and fisheries production; and most importantly escape agriculture (the rural economy) and move into off farm jobs (in the city).

Approach, exchange rates and data sources

In this paper, we have utilized the approach specified in Anderson, Martin, Sandri and Valenzuela (henceforth, Anderson et al., 2006). This approach is broadly based on comparisons between domestic and international prices. During the reform era these price comparisions provide valuable indicators of the incentives for production, consumption and trade, and of the income transfers associated with interventions. This approach is much less suited to analysis during the pre-reform era, when prices played only an accounting function and key prices such as the exchange rate were enormously distorted. During the reform era, however, the price comparison approach is essential because of the complexity and non-transparency of the trade barriers applying to agriculture, including tariffs, licenses, quotas, tariff-rate-quotas, and state trading. Exchange rate distortions present particular measurement problems and require detailed analysis if price-comparison-based measures are not to be misleading.

Our approach essentially creates four measures of distortions for each major commodity in the agricultural economy. The most basic measure is the Nominal Rate of Assistance (NRA). The NRA is used to compare the price of a commodity in the domestic economy (which is priced in the port so it can be compared to the international price) with in the international price of the commodity at the border (that is, cif in the port for an importable good; fob in the port for an exportable). Conceptually, with the NRA we are trying to measure the extent of the distortions due to tariffs, exchange rate distortions, and other non-tariff barriers—at the border.

Because of barriers within the domestic economy, the extent of protection (or dis-protection) that is afforded by trade policies may not be the same as the real rate of

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protection to farmers. Because we have independent observations on the prices obtained

by farmers in local markets we are able to estimate the *nominal rate of assistance at the

farm level* taking into account *both* border distortions and domestic distortions affecting

farmer returns (NRA_f). In contrast to the NRA, NRA_f is the difference between the price

that the farmer actually receives and the international price at the border. The measures of

NRA and NRA_f are both calculated after allowing for transport, storage and handling

costs in moving from the farm to the wholesale level. Their difference arises from

subsidy or transfer payments that cause the prices received by farmers to differ from what

they would receive under competitive internal market conditions. As we will see, these

internal subsidy/tax measures had enormous impacts on the returns to Chinese farmers,

particularly in the early reform era.

While the NRA (and NRA_f) only measure differences in output prices, there may

also be distortions on the input side. To capture those, we use a measure called the Direct

Rate of Assistance (DRA). DRAs are exactly the same are NRAs, except that the DRA

also considers the differences between the international prices of inputs and the prices

that farmers pay for inputs. While such a difference (between NRA and DRA) is almost

certainly large and important in many countries, in our study of China, we argue (and will

show) that distortions to intermediate input prices are generally relatively small and so

we mainly focus on the NRA_f measure when examining distortions to producers.

Finally, while most of the focus is on agricultural producers we also consider the

extent to which consumers are taxed or subsidized. To do so, we use a measure called the

Consumer Tax Equivalent (CTE). This measure is created by comparing the price that

consumers pay for their food commodity and the international price at the border. As

with the NRA, differences between the NRA and the CTE arise from distortions in the domestic economy that are caused by transfer policies and taxes/subsidies that cause the prices paid by consumers (adjusted to the wholesale level) to differ from domestic market prices. If a consumer subsidy measure is negative, it means that consumers are paying a price that is above the international market prices and that consumers are being taxed (or negatively subsidized). For the exact methodology used to calculate these measures, see Anderson et al. (2006).

The foreign exchange regime

Prior to 1981 the official exchange rate was seriously over-valued in China. While this did not directly affect exports and imports because decisions on their levels were made by planners, it did create serious accounting difficulties since exports generally incurred a loss (Lardy 1992). If the official exchange rate is nevertheless used, it provides misleading indicators of the incentives created by the foreign exchange regime—since it makes all foreign goods look inexpensive in domestic currency, it over-estimates the extent of any protection provided to any good being considered.

In 1981, an Internal Settlement Rate intended to be aligned with the average cost of earning foreign exchange was introduced, providing at least some basis for meaningful comparisons between domestic and international prices.[3] The introduction of the Internal Settlement Rate, at 2.8 Yuan per dollar for trade transactions in 1981, represented a near-50 percent devaluation relative to the official exchange rate, which remained in use only for non-trade transactions. This internal rate remained at 2.8 until January 1985, when it was merged with the official exchange rate.

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[3] Of course, the average cost of earning foreign exchange is a flawed measure, and provided flawed incentives, since the marginal cost of earning foreign exchange is the conceptually relevant measure.

During most of the reform period, the Chinese foreign exchange regime was relatively transparent in its effect. Between the late 1970s and 1994, the Chinese system was one of those characterized by Kiguel and O'Connell (1995) as involving differential rates for different types of current account transactions. The overvalued official exchange rate was a key element of this system. Prior to 1979, enterprises had to surrender all of their foreign exchange earnings at that rate. However, a right for exporting enterprises to retain some of their foreign exchange earnings was introduced in 1979 (Lardy 1992, p707). Given the pervasive shortage of foreign exchange in the economy, it is clear that the value placed on these retained earnings was, on average, considerably above the official exchange rate, even though its value was diminished by restrictions on its tradability between enterprises, whose needs for foreign exchange inevitably varied considerably.

Under this system the official exchange rate was overvalued, and there was a higher (more depreciated) secondary market exchange rate. Exporters were required to surrender at least part of their foreign exchange earnings at the official exchange rate, and permitted to retain the remainder either for their own use. Exporters also were gradually allowed to sell foreign exchange on a network of increasingly-legal and well-regulated secondary markets for foreign exchange. There was always a shortage of foreign exchange at the official exchange rate, forcing importers to meet their needs for additional foreign exchange at the secondary market rate. Under these circumstances, the exchange rate system created a distortion analogous to a tariff or an export tax. The exchange rate received by exporters differed from that paid, at the margin, by importers.

To account for the effects of the exchange rate system, we construct an exporter exchange rate series using the retention ratio to calculate a weighted average of the official and the secondary market exchange rates. We use the secondary market exchange rate as an indicator of the price paid for foreign exchange, at the margin, by importers. Following the methodology outlined in Anderson et al. (2006), we calculate an estimated equilibrium exchange rate as the simple average of the importer and the exporter exchange rates. The difference between the importer exchange rate and the equilibrium exchange rate was used as a measure of the exchange rate distortion component of protection.

The share of export earnings eligible to be retained rose over time, and the extent to which these rights were tradable increased. Initially there were limited opportunities to trade these rights, and their value clearly varied considerably from firm to firm. However, it was quickly recognized that the value of retained foreign exchange varied enormously between enterprises, and that it was important to be able to able to transfer foreign exchange between firms. Lardy (1992, p58) notes that foreign exchange trading rooms were established in 1980 in Guangzhou and 1981 in Shanghai. However, the exchange rates in these markets tended to be heavily managed, with the government seeking to set the selling price at, for example, the Internal Settlement Rate (Lardy 1992, p58).

Formal foreign exchange adjustment centers (FEACs) began to be established on a large scale after 1985. These allowed firms with excess foreign exchange earnings to sell to ventures that sold their output domestically and needed foreign exchange (Lardy 1992, p58). Over the next few years, a large network of these centers was established, with their transactions becoming more closely linked over time. By 1988, Lardy (1992,

p63) concluded that the price in the Shanghai market was subject to supply and demand, subject to the conditions on use of foreign exchange, including licensing requirements and import duties on imported goods. In parallel, the pricing policies for imported goods were becoming more liberal, with 90 percent of all imported goods being based on the import price, plus costs such as transport and tariffs, by 1990 (Lardy 1992, p76).

During the transition period, the exchange rate regime was an extremely important influence on the returns obtainable from exported goods, and the prices paid for imported goods. Even in the absence of explicit trade policies, overvalued official exchange rates tended to lower the returns to exported goods, and to increase the cost of imported goods, often by large amounts. The combination of an overvalued official exchange rate, and a secondary market rate exchange rate at which importers could purchase foreign exchange legally to purchase imported goods allows us to assess the effects of the foreign exchange regime, and to be begin to assess the impacts of other trade policies.

The analytics of a multi-tier exchange rate system are relatively clear and easily seen in a partial equilibrium setting. Figure 2 shows the determination of the exchange rate in a market characterized by an upward-sloping supply of foreign exchange (perhaps determined by the marginal cost of generating additional assets) and a downward sloping demand for foreign exchange (perhaps determined by the extent of substitutability of imports for domestic goods). If there is an official exchange rate, E_0, at which exporters must surrender their foreign currency to the central bank, and a secondary market exchange rate, E_m, at which importers can buy foreign exchange, then the two-tier exchange rate system functions as a uniform tax on all exports or (equivalently) a

uniform tax on all imports. Figure 2 shows the effect of such a regime. Setting the official

exchange rate at E_0 reduces the returns to exporters relative to the equilibrium rate E. The

resulting shortage of foreign exchange drives up its scarcity value and, in the presence of

a secondary market, its market price for sale to importers, to E_m. Under these

circumstances, the two-tier exchange rate reduces export earnings from Q_E to Q_S.

Introducing a foreign exchange retention scheme of the type used in China during

the transition raises the return to exports by allowing them to convert some of their

foreign exchange earnings at the higher secondary-market rate. The result of this is to

increase the supply of foreign exchange from Q_S to $Q_S\bullet$. The increase in the supply of

foreign exchange allows its price on the secondary market to fall to EM$\bullet$. This reduces the

cost of imported goods, and increases the demand for imports from Q_S to $Q_S\bullet$.

When China used this arrangement, the tax on exporters was diminished by the

fact that exporters were allowed to retain some of their foreign exchange earnings and

sell them on the Secondary market. These retention rates have been estimated roughly as

20 percent between 1981 and 1984, 25 percent in 1985 and 1986, 44 pct between 1987

and 1990 and 80 percent between 1991 and 1994. The resulting blended average received

by exporters is shown as E'_x in the figure. The introduction of the foreign exchange

retention scheme reduces the secondary market rate because of the increased incentive to

supply foreign exchange.

We generally use the average of the exporters' exchange rate and the importers'

exchange rate to get an estimate of the equilibrium rate (this assumes equal elasticities of

demand and supply for foreign exchange) but the final result doesn't matter as we just use

this to divide the total wedge between taxes on imports and taxes on exports (by Lerner Symmetry they have the same effect).

Using these principles, we obtain the results in Table 4. Over time, we used several different series for secondary market exchange rates—the internal settlement rate in 1981-1984; an estimated secondary market exchange rate in 1985-6; and the FEAC rate from 1987 to 1994. The idea was to take into account the information on the average exchange rates applying in Foreign Exchange Adjustment Centres when they operated (1987-94).

Raw data on the official exchange rate and several measures of the secondary market rate are presented in Table 4, together with the estimated foreign exchange retention rates and calculated measures of the exchange rates applying, at the margin, to exporters and importers during the period. The final column of the table shows the "equilibrium" rate calculated assuming that the elasticities of supply and demand for foreign exchange are equal. This assumption is highly conjectural. While it will influence the allocation of the estimated protection between import protection and export taxation, this attribution does not, by Lerner Symmetry, influence the estimated total cost of protection. The full set of data for the exchange rates is in Appendix Table 1.

Data

In compiling our data we necessarily had to make choices on the coverage of the commodities included in the study. Overall we have included 11 commodities: rice, wheat, maize, soybeans, cotton, pork, milk, poultry, fruit, vegetables and sugar. Over the study period. these commodities account for between 75 percent (in the late 1980s) and

60 percent (during the early 2000s) of the total value of agricultural output in China (Figure 4).

The data used in our study come from a number of sources, depending on the time period of analysis and the commodity. The international price data come from the FAO website, supplemented by sources from the USDA website. These data are adjusted by international transportation and insurance rates to create series of international price, cif or fob, China. Because the responses of production and consumption to China's internal market prices were only gradually being allowed to respond to domestic prices, and because we have no firm data on the secondary market exchange rate prior to 1981, we focus on data from the period beginning in 1981.

The market price data for China are primarily from two sets of statistical yearbooks compiled by the China National Statistical Bureau (CNSB): The China Statistical Yearbook and the China Agricultural Yearbook. These data cover all major commodities, including grain, cash crops, livestock commodities and horticultural crops. The data come from their reporting system that is reported by crop and by region.

Historic price data for China are fairly accurate. While the share of grain sold and bought on free markets in the early reform period was fairly small, the share sold to the state was not. The large volume of grain that was bought (from farmers through the rural procurement system) and sold (to consumers through the urban rationing system) made it imperative for the government to collect price data, even though it was not generated by the market and was set administratively. As a result, the price data for the procurement price and sales price to urban residents are relatively high quality.

Much of the data on margins, transportation costs and other transaction costs are from an extensive set of surveys that that authors did throughout the 1990s and the early 2000s. Some of this was previously reported in Rozelle et al. (2000) and Huang et al. 2004). For more recent years, a survey team from CCAP interviewed traders in 10 cities around China in 2006.

The data for all of the commodities are in Appendices 2a to 2i.

Quantifying the distortions to China's agriculture

One indicator of the success of China's reform policies can be seen indirectly by examining series of free market prices on four of China's most important crops (Figure 4). Despite the sharp rise in demand after 1980 for all commodities, as a result of increases in the population, rapid increases in income, the shift of the population from rural to urban and gradual marketization, prices were relatively stable over time and showed little trend. With an overall self sufficiency rate for rice, wheat, maize and soybeans during the 1980s and 1990s of near 100 percent, it is clear that China's supply kept up with demand. The rise in supply as well as total factor productivity is shown in many papers to come from a reduction in the distortions to production incentives that were driven by a combination of improved property rights, access to new technologies and other factors (Lin, 1992; Fan, 1991; Huang and Rozelle, 1996; Jin et al., 2002).

The role of domestic price and marketing policy

Before examining the role of distortions at the border, it is useful to examine the relationship between the available domestic price series for farm and retail prices for the major grain crops (Figure 5, Panels A, B and C). The importance (and role) of China's

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domestic price and marketing policy for rice, wheat and maize (the three largest crops in China) can be seen by comparing the state-set urban retail price and the state-set rural farm-gate procurement price with the rural retail price, a free market price. As discussed above, until 1992 the urban retail price for rice was generally substantially below the price that grain was selling at on the free market in rural areas, despite the costs associated with transferring rice to the urban area. This was a consequence of a procurement price system designed to provide urban residents with relatively inexpensive food. Because of the low, below-market prices, urban residents could only buy rice with ration coupons that were available only in limited quantity.

In addition, the marketing and procurement system may have been the source of additional distortions. The relatively low price of the selling price of grain at the farmgate by farmers shows that China's food system in the 1980s was set up to transfer income from rural to urban (Table 5, Panels A, B and C).. The amount that farmers received for the mandatory deliveries was far below the free market price. However, there is some question about the effects on incentives for production and consumption given the infra-marginal nature of many of these transfers (Sicular 1988). This is because after the mid-1980s after delivering a fixed quota quantity at the low purchasing price, many farmers were able to sell additional amounts at higher market prices. If the farmers sold more grain than was required by his delivery quota, and the above quota price was determined by market forces, there may have been less of a distortions. Ultimately, however, even such policies are not fully decoupled from incentives, with seemingly infra-marginal transfers away from rural households, for instance, giving their members an incentive to move out of agriculture. These linkages have been shown by Wang et al. (1999). To the

extent that there are distortions created by the domestic marketing and procurement systems, there may be another layer of regulations that are insulating China's farmers from international prices.

From 1992, however, changes to China's domestic marketing and procurement system appears to have eliminate this additional layer of regulation for producers of rice, wheat and maize (Figure 5, Panels A, B and C). In the early 1990s the urban price began to rise above the farm gate price; urban and rural retail prices also came much closer together. Such a movement in prices reflects the phasing out of the implicit taxation of farmers through the grain procurement system. The gap between urban and rural retail prices essentially disappeared. And the gap between the rural retail price and the farm price declined, possibly suggesting an improvement in marketing efficiency (Park et al. 2002). With the disappearance of the distortions from the marketing and procurement system, if there are overall distortions faced by farmers between international and domestic, farmgate prices, the source of distortions after the mid-1990s will be due to only trade policies and not trade and domestic policies.

Nominal rates of assistance (NRAs and NRAfs) for China's main agricultural commodities

In this section we focus on the distortions faced by farmers in China between 1980 and 2005. To do so, we plot NRAs and NRAf's over time for each of the 11 commodities. Because input subsidies are so trivial—and Direct Rates of Assistance (DRAs) are nearly indistinguishable from NRAs, we do not clutter the analysis and ignore DRAs in the rest of the paper. We report the consumer subsidy measures in the aggregate (for all of China's agriculture) in the next section. As discussed above, all NRAs and NRAfs are computed at adjusted exchange rates since we believe this measure

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is the right one to use to calculate the true rate of protection. In Martin, Huang and Rozelle (2006) we report how the measures of distortions vary when using official and adjusted exchange rates.

Staple Grain Crops: Rice, Wheat and Maize

The distortions to the rice economy of China in the 1980s and early 1990s are characterized by two important features (Figure 6). First, the NRA of rice, an exportable commodity, is negative in every year between 1980 and 1995. Ranging between -40 and -10, the negative NRAs demonstrate that China was competitive in international rice markets during these years. Trade policy, however, kept exporters from shipping large quantities of rice onto world markets and kept the free market price of rice in China's port cities below the world price. Clearly this demonstrates China's commitment to keep domestic prices low. Even if there had been no other distortions in the rice economy, producers would have faced prices below world market prices.

The second feature demonstrates how domestic marketing and procurement placed a greater tax on farmers and insulated the domestic price of rice from the world market price even if trade policy had been liberalized (Figure 6). Because of China's marketing policy that lasted through the mid-1990s, the state's artificially low procurement price kept the price received by farmers systematically below the free market price of rice as seen by the NRAfs. Because of this the tax on rice ranged between -70 in the early 1980s to -30 in the early 1990s. Rice producers were among the most heavily taxed farmers in China—given the large share of the crop's sown area and large negative rates of disprotection. Importantly, our analysis shows how the state used trade and procurement policy to tax its rice farmers.

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Unlike rice, the measures of NRA show that trade policy offered high rates of protection for wheat farmers in China between 1980 and the mid-1990s (Figure 7). After 1980, during most years, the free market price of wheat in China's port cities was about 60 percent higher than the international price of wheat (CIF, China's port cities), ranging between 50 and 70 percent. Unlike rice, which China produced competitively during the 1980s, wheat producers—which have been shown to produce at a higher cost than many other producers in other countries (citation)—received strong protection from trade policy. This policy on its own, unlike that for rice, would not be consistent with providing inexpensive food for consumers. It would, however, be consistent with a policy of food self-sufficiency since it would encourage greater production by keeping out imports and keeping domestic prices high.

Domestic marketing policies, however, were working in the opposite direction of trade policies. The trends of the NRAfs show how the forced deliveries of wheat quotas insulated the farmers from the high rates of protection (Figure 7). Although there was still positive protection for wheat farmers in most years between 1980 and 1995, the rates were lower (all below 50 percent except for in 1994 and 1995) and were zero and even slightly negative in 5 of the 16 years (1981; 1982; 1990; 1992; 1993). These figures—along with those for rice—show that at least for China's staple food crops, leaders were not trying to use prices to encourage food security.

The story of maize is one that is a mix of those for rice and wheat (Figure 8, Panel C). In some years, trade policy was providing positive protection for maize (1980; 1983 to 1987; 1989; and 1994). However, in other years, the domestic price of maize was lower than the world market. On average, trade policy—as seen through the lower

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NRAs—protected maize only marginally between 1980 and 1995. Like the case of both rice and wheat, procurement policy further depressed the price of maize in China's farmers. In fact, except for 1985 and 1994, from the 1980s to early 1990s the net effect of international trade and domestic marketing policy was to tax China's maize producers.

Distortions to the Grain Economy after 1995. After 1995 our distortions analysis shows that China's international trade and domestic marketing policies have changed strikingly (Figure 6 to 8—right hand sides of graphs). It is apparent from the way the differences in the estimates of NRAs and NRAfs narrow that China's domestic marketing policy finally was able to eliminate the procurement policies that had been taxing rice, wheat and maize farmers (either by increasing the tax imposed by trade policy as in the case of rice or reducing the protection as in the case of wheat). In other work, Huang et al. (2005) show that the elimination of the procurement quota contributed significantly to a reduction in the tax burden shouldered by farmers.

The liberalization of domestic markets in the mid-1990s was accompanied by a liberalization of trade policy, at least in the case of China's major food grains (Figures 6 and 7). After 1995, the taxation and subsidization of rice and wheat clearly are being phased out as the NRAs for rice steadily rose (became less negative) and the NRAs for wheat fell. Likely in part in preparation for its accession to the WTO, China's leaders liberalized trade for its main food grains to such an extent that between 1995 and 2001 most of the protection for the crops were eliminated. Since 2001, the NRAs for both rice and wheat are almost zero.

Interestingly, the case of maize is a bit different than the other crops (Figure 8, Panel C). While NRAs moved towards zero in the case of maize, in a number of years

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after 2000, the NRA for maize has been positive. This indicates that at least in some years national leaders have been protecting maize producers. In part, as discussed in Rozelle and Huang, this may in part be due to the rise of the Jilin lobby in the government that has been successful in gaining protection for the producers of its most important crop.

Cash crops: edible oil and cotton

The biggest difference between the analysis of distortions of grain crops and for cash crops (at least for soybeans and cotton) is that domestic marketing policy has played less of a role. Although in some counties in China there was a procurement delivery quota for soybean producers, it was not as widespread as the case of grain (in many counties soybeans were not procured by the state procurement system. In addition, the implicit tax on soybeans in places where soybean quotas were collected was lower than that for the staple grain crops. Therefore, there is little difference between the graphs for NRAs and NRAfs. The same is true for cotton, except in the case of cotton through the mid-1990s free market procurement of cotton by private traders was not allowed. When reform finally came to the cotton industry in the mid-1990s, leaders did not move to a two-tier pricing system, but instead allowed for both private trade and commercialized government cotton procurement stations. As a result, in the case of cotton the measures of distortion for NRAs and NRAfs are nearly the same. In fact, the same is true for all of the rest of the commodities (livestock; horticulture and milk and sugar). As a result, the discussion in the rest of this section—for both the 1980s, 1990s and post 2000 period—focuses on trade policy.

Before 1995, while not perfectly correlated with the trends of maize, our analysis shows that soybeans also fluctuates from being protected to taxed to protected to taxed to

protected (Figure 9). Although the average level of protection is almost zero, in some years soybeans received protections of up to nearly 30 percent while in other years they were being taxed by 20 percent. In a paper by Rozelle and Huang (2004) it is shown that a lot of this fluctuation is due to domestic production policy that would encourage soybeans, then discourage them, then encourage them while national planners allowed little trade.

The trends in the NRAs after 1995 show the strong commitment to trade liberalization for soybeans (Figure 9). Beginning in the late 1990s and continuing through to 2005 the protection for soybeans fell from around 30 percent to almost zero. This falling protection, in fact, should not be a surprise given the integration of China into world soybean markets and the monotonic rise in imports (which exceeded 25 million tons in 2005). The story of soybeans—and the fall in protection and almost full liberalization—stands in sharp contrast to that of maize which enjoyed increasing protection. Because of the competition of maize and soybeans for land and other resources, it appears that at the very time that Jilin's influence began to provide protection for maize farmers, soybean farmers were subject to sharp liberalization.

The distortion analysis for cotton, in some sense, produces results similar to those for rice (Figure 10, Panel C). The combination of trade and monopoly procurement policy kept domestic cotton prices lower than world market prices in the 1980s and early 1990s. Clearly it appears as if China's planners are taxing cotton farmers to supply its emerging textile industries with relatively inexpensive raw materials. It is no wonder with such high implicit taxes on cotton that the lack interest by many suppliers (and serious insect problems) led to stagnant and even falling area in many regions (Qiao et al., 2006).

After 1995, however, with the liberalization of domestic markets (mostly) and increased trade liberalization (somewhat) there clearly been a shift in the level of distortions faced by cotton producers (Figure 10, Panel C). Although there were years in which there was fluctuation (protection was high in 2000; and cotton was implicitly taxed in 1999 and 2001), since the mid-1990s the NRA has been nearly zero. In recent years, despite the fact that national leaders could impose tariff rate quotas (TRQs) on cotton after a certain amount is imported, in fact, trade officials essentially have left the level of imports in most years to be determined by the market.

Livestock and Horticultural Commodities

With the exception of several years in the late 1980s and early 1990s for fruit, the pattern of distortions to China's livestock and horticultural sectors are remarkably similar (Figures 11 and 12, Panels A and B). In all cases in the early reform era there is heavy implicit tax on livestock and horticultural commodities. In part, as noted by Huang et al. (2004), this situation was created by China's grain first policy. Although China can competitively produce livestock and horticultural production, producers were neither encouraged to produce or export these commodities on a large scale. In another part there were also trade barriers that were set up against China. While there quite possible were grounds for some of the barriers (for example, foot and mouth disease is widespread in China), even if a claim was blatantly false they could not be adjudicated effectively since China was not part of WTO. As a consequence, China's livestock and horticultural producers produced commodities far below the world market price and were neither inclined nor able to increase exports into global markets.

Since the late 1990s the taxation on livestock and horticultural producers has fallen (Figures 11 and 12). Emerging markets and relaxation of grain first policies (often called structural adjustment policies) allowed producers to greatly expand livestock and horticultural production in a large part to meet the rising demand inside China (Rosen et al., 2004). At the same time China's accession to the WTO and the appearance of a large export-oriented segment of the livestock and horticultural industry has increased interest in and feasibility of participating in international horticultural markets. In response, the NRA measures have risen towards zero for all commodities—pork, poultry, vegetables and fruit. It should be noted, however, that the NRAs are all still negative. If anything as China's presence in global food markets has given rise to more stringent rules and regulations on the import of livestock and horticultural commodities from China. In summary during the past decade many, but not all, of the distortions have been eliminated from China's livestock and horticultural markets,

Commodities for processing: milk and sugar

The story for milk and sugar is exactly opposite as that for livestock and horticultural commodities. During the 1980s, the NRAs for milk and sugar were positive and large (Figure 13, Panels A and B). Those for milk ranged from 50 to more than 200 percent between 1980 and 1987. Those for sugar were above 40 percent through the late 1990s. Although beginning earlier and falling further, by the late 1990s and after 2000 (in the early 1990s for milk), NRAs for milk and sugar were falling (to around 20 percent by 2003) and for milk were near zero. In other words, the pattern for milk and sugar are nearly the mirror image of those for livestock and horticultural commodities.

China's processing sector also is not overly protected, especially when accounting for the protection/tax of inputs (Figure 14). Although the rates of protection (NRAs) for the processed sugar industry are positive, when accounting for the higher price of inputs (since sugar is protected), the sugar industry has protection rates around zero.

Agricultural distortions in China: the aggregate picture

Aggregating the 11 commodities in our study together (and by importables and exportables) and assuming that our study commodities largely reflect the distortions to all of China, there is a striking pattern (Figure 15—left hand side of figure). In the 1980s and through the mid-1990s, importables (such as wheat, soybeans, milk and sugar) were protected. On average, the protection rates were between 15 to 35 percent. The same was true for exportables, except the distortions show that commodities such as rice, livestock commodities and horticultural commodities were implicitly taxed. The implicit tax rates ranged from 40 to 50 percent. Overall, since the value of exportables accounted for a greater part of the economy than importables, throughout the early reform era, China's agricultural was highly distorted and on average the distortion were negatively. In other words, China was taxing its agriculture—with both its international trade and domestic marketing policies.

One of the main findings of this study is seen by examining the right hand side of Figure 15. After 1995, the DRAs of importables fall from around 20 percent to less than 10 percent. During this same time period, the DRAs of exportables rises, or the implicit tax falls, from about 40 percent to around 15 percent. When taken together, the distortions in China's agriculture fall to less than 10 percent. In many years the overall protection is between 0 and -5 percent. Clearly, the combination of domestic marketing

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reforms and international trade liberalization has generated an economy that, on average, is one of the least distorted in the world.

Not all distortions of been eliminated, however. When aggregating over 2000 to 2005, there are still some commodities that have relatively high rates of protections on both sides of the balance sheet (Figure 16). For example, sugar and milk are still around 20 percent or greater. Maize and soybeans are around 10 percent. In the exportable categories, fruit, vegetables and poultry are still being implicitly taxed. While in all cases the average level of distortions are lower than they were 10 years ago, China's farmers still are facing distortions.

This elimination of distortions has not only affected farmers. A similar picture is created when looking at consumer tariff equivalents (CTEs—Figure 17). In the 1980s and early 1990s, consumers were being taxed by the high distortions and positive protection on importables. However, because China was implicitly taxing agriculture, consumers were gaining from being able to consumer exportables that were being implicitly subsidized (by marketing policies and from trade policies). On average, China's consumer were winners as they were receiving a net implicit subsidy. Clearly this is evidence that China was relying on taxing agriculture to subsidize consumer in the urban sector as part of their forced industrialization plan. reform and liberalization-induced

After 1995, as the distortion disappeared to producers and markets became the main mechanism for food flows, the distortions fell. For the consumer, however, this has not necessarily been good news. The implicit subsidy has fallen from around 20 percent to nearly zero. This means that the 20 percent implicit subsidy disappeared.

Conclusions and implications

The main finding of our paper is that the nature of policy intervention into China has changed dramatically over the past 25 years, propelling the agricultural sector from one characterized by high distortions to one that is relatively liberal. In the 1980s and early 1990s (henceforth the *early reform period*) there were distortions in both external and domestic policies that isolated domestic producers and consumers from international markets. Importantly during the early reform period domestic marketing and pricing policies actually served to make the prices that domestic producers and consumers faced almost independent from the effects of trade policy. Because of this even in the case of a exportable commodity (e.g., rice), a commodity that enjoyed little protection at the border from tariffs (meaning that that the international price of rice and the free market price of rice were nearly identical), domestic pricing and marketing policies did not allow producers from reaping the profits from international-level prices and instead forced farmers to sell much of their surplus to the state at an artificially low price. Hence, domestic policies levied a tax on farmers even though there was little protection at the border. Similar dynamics characterized importable commodities (e.g., wheat and soybeans) where despite fairly high rates of protection from trade policies, consumers were still being implicitly taxed and producers were receiving much less protection than they would have had their been a free domestic market for the importable.

In contrast, since the late 1980s and early 1990s (the *late reform period*), the liberalization of domestic markets has resulted in the reduction of distortions from domestic policies (as the market gradually has replaced the state as the primary mechanism for allocating resources and has became the basis of farmer production and

marketing decisions). At the same time, especially in the case of importable commodities, trade policy has also become more liberalized, with distortions from border measures falling substantially. As a result, we find that in recent years (that is, by the end of the late reform period) China's agriculture is much less distorted in two ways. First, the differences between international and domestic market prices have narrowed considerably for many commodities due to trade policy liberalization. Second, the elimination of domestic policy distortions mean that when trade liberalization allows for the increased import or export of agricultural commodities, prices in China's domestic market change and farmers are directly affected by them.

In addition, we also examined the effect of input-oriented policies. We find that input related policies have generated few distortions in the case of China since 1980. In terms of our analysis, of course, this means that working with NRAs and DRAs are the same.

Despite the finding that considerable liberalization has occurred due to policy reforms in both the domestic and external economy, in the mid-2000s, 25 years after the beginning of reforms, there are still distortions to agriculture. In some cases, remaining distortions are mainly coming from the current tariff lines. While low in international comparisons, China's tariffs are still providing a degree of protection for a number of importable commodities (e.g., wheat and soybeans). In the case of other importable commodities (e.g., maize), the use of export subsidies (which in fact are mostly disguised as domestic marketing, transport and storage subsidies) continues to keep a wedge between the domestic price in China and the international market.

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Table 1. The annual growth rates (%) of Agricultural economy by commodity, 1970-2000.

Commodity	Pre-reform	Reform period		
	1970-78	1978-84	1985-95	1996-2000
Agricultural Gross Domestic Product	4.9	8.8	9.7	8.2
Grain total				
Production	2.8	4.7	1.7	0.03
Sown area	0.0	-1.1	-0.1	-0.14
Yield	2.8	5.8	1.8	0.17
Rice				
Production	2.5	4.5	0.6	0.3
Sown area	0.7	-0.6	-0.6	-0.5
Yield	1.8	5.1	1.2	0.8
Wheat				
Production	7.0	8.3	1.9	-0.4
Sown area	1.7	-0.0	0.1	-1.4
Yield	5.2	8.3	1.8	1.0
Maize				
Production	7.4	3.7	4.7	-0.1
Sown area	3.1	-1.6	1.7	0.8
Yield	4.2	5.4	2.9	-0.9
Total cash crop area	2.4	5.1	2.1	3.5
Cotton				
Production	-0.4	19.3	-0.3	-1.9
Sown area	-0.2	6.7	-0.3	-6.1
Yield	-0.2	11.6	-0.0	4.3
Edible oil crops	2.1	14.9	4.4	5.6
Vegetable area	2.4	5.4	6.8	9.5
Fruit				
Orchards area	8.1	4.5	10.4	1.5
Outputs	6.6	7.2	12.7	8.6
Meat (pork/beef/poultry)	4.4	9.1	8.8	6.5
Fishery	5.0	7.9	13.7	10.2

Note: Growth rates are computed using regression method. Growth rates of individual and groups of commodities are based on production data; sectoral growth rates refer to value added in real terms.
Sources: CNSB, 1980-2001 and MAO, 1980-2001.

Table 2. Changes in structure (%) of China's agricultural economy, 1970-2000.

	1970	1980	1985	1990	1995	2000
Share in agricultural output						
Crop	82	76	69	65	58	56
Livestock	14	18	22	26	30	30
Fishery	2	2	3	5	8	11
Forestry	2	4	5	4	3	4

Source: CNSB, Chinas' Statistical Yearbook, various issues and China Rural Statistical Yearbook, various issues.

Table 3. Rural Income per Capita in China, 1980 to 2000 (in real 2000 yuan).

Income group	1980	1985	1990	1995	2000	2001	Annual Growth Rate, 1980 to 2001
Average	711	1248	1305	1702	2253	2347	6%
Bottom decile (poorest)	312	448	442	493	579	578	3%
Top decile (richest)	1530	2486	3253	4763	6805	7159	8%

Data source: CNBS.

Table 4. Exchange rates and related measures for China, 1980-2004

	Official	Secondary	Internal settlement	FEAC average	Retention rate	Exporter ER	Importer ER			Implied Equilibrium ER
1980	1.498	1.948				1.498	1.498			1.498
1981	1.705	2.045	2.8		0.2	2.800	2.800			2.800
1982	1.893	2.271	2.8		0.2	2.800	2.800			2.800
1983	1.976	2.392	2.8		0.2	2.800	2.800	Internal settlement		2.800
1984	2.327	2.688	2.8		0.2	2.800	2.800			2.800
1985	2.937	3.045	2.8		0.25	2.861	3.045	2ndary rate		2.953
1986	3.453	4.025			0.25	3.596	4.025			3.811
1987	3.722	4.401		5.9	0.44	4.680	5.900			5.290
1988	3.722	6.500		6.6	0.44	4.988	6.600			5.794
1989	3.766	6.600		5.4	0.44	4.485	5.400			4.942
1990	4.784	6.600		5.7	0.44	5.187	5.700	FEAC rates		5.444
1991	5.323	6.603		5.9	0.8	5.785	5.900			5.842
1992	5.515	6.925		7.3	0.8	6.943	7.300			7.122
1993	5.762	8.282		8.7	0.8	8.112	8.700			8.406
1994	8.619	8.700		8.7	0.8	8.684	8.700			8.692
1995	8.351	8.681				8.351	8.351			8.351
1996	8.314	8.069				8.314	8.314			8.314
1997	8.290	7.720				8.290	8.290			8.290
1998	8.279	7.710				8.279	8.279			8.279
1999	8.280	7.479				8.280	8.280			8.280
2000	8.280	7.488				8.280	8.280	Official		8.280
2001	8.277	7.497				8.277	8.277			8.277
2002	8.278	7.506				8.278	8.278			8.278
2003	8.278	7.515				8.278	8.278			8.278
2004	8.277	7.524				8.277	8.277			8.277

Net exports
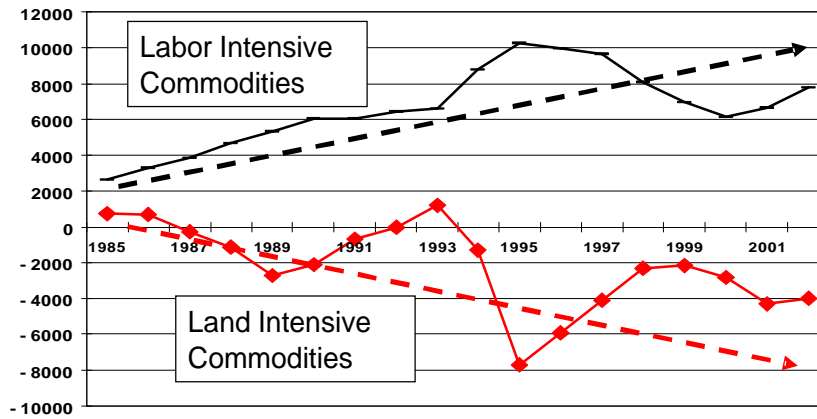
Data source: Rosen et al., Forthcoming.

Notes: Labor intensive commodities include fruits, vegetables, meat products and
aquaculture products; land intensive commodities include food an d feed grains, soybeans,
edible oils and cotton.

Figure 1. Agricultural Trade Balance by Factor Intensity, 1984 to 2002 (mil US$)
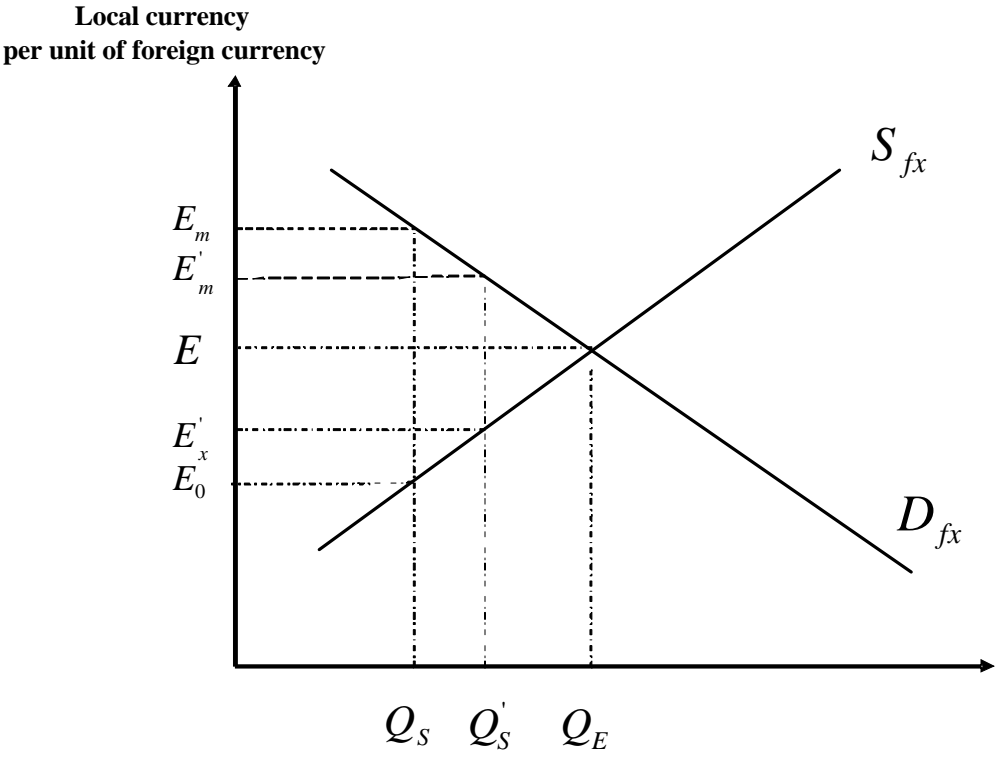
Figure 2: The domestic market for foreign currency

Proportion of Total Agricultural Value

Top part of graph shows proportion of total agricultural value *not* covered by study

Legend:
- Residual
- Sugar
- Vegetable
- Fruit
- Poultry
- Milk
- Pork
- Cotton
- Soybean
- Maize
- Wheat
- Rice

Percent

Year: 1980-84, 1985-89, 1990-94, 1995-99, 2000-2005
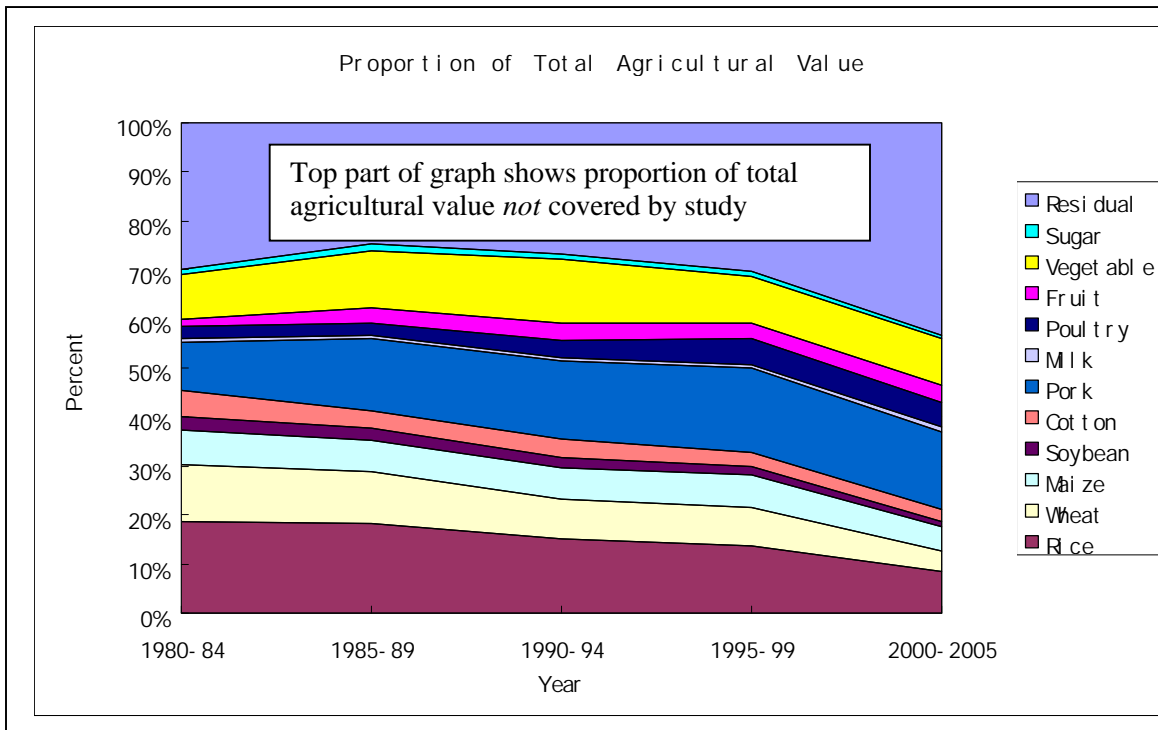
Data sources: Estimated by authors based on output and farm-gate prices (from China Statistical Yearbook and other official publications).

Figure 3. Agricultural production shares by farm product, China 1980 to 2005 (percent, five-year averages)
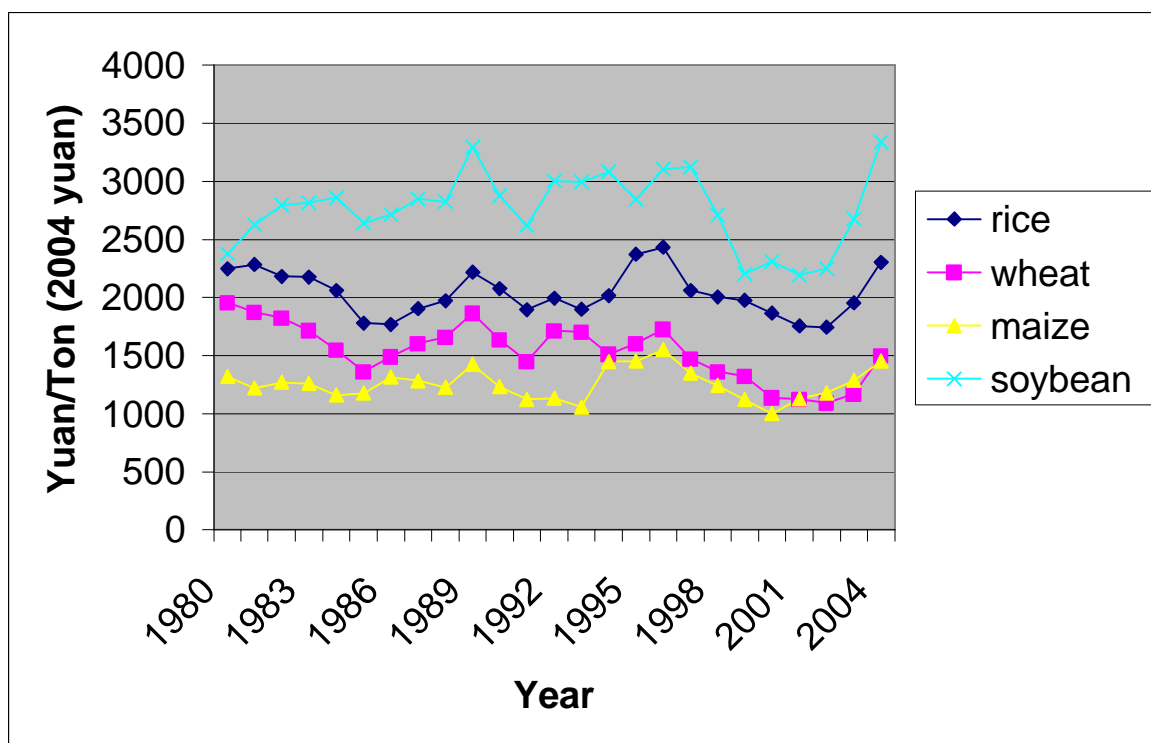
Data source: China Price Yearbook, 2005. Deflator: China Statistical Yearbook, 2005.

Figure 4. Real Prices of Rice, Wheat, Maize and Soybeans in China, 1980 to 2004.

Panel A. Rice
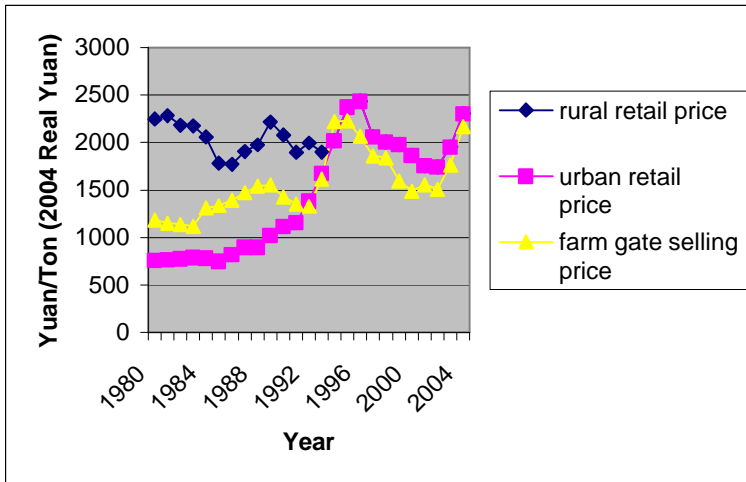
Panel B. Wheat
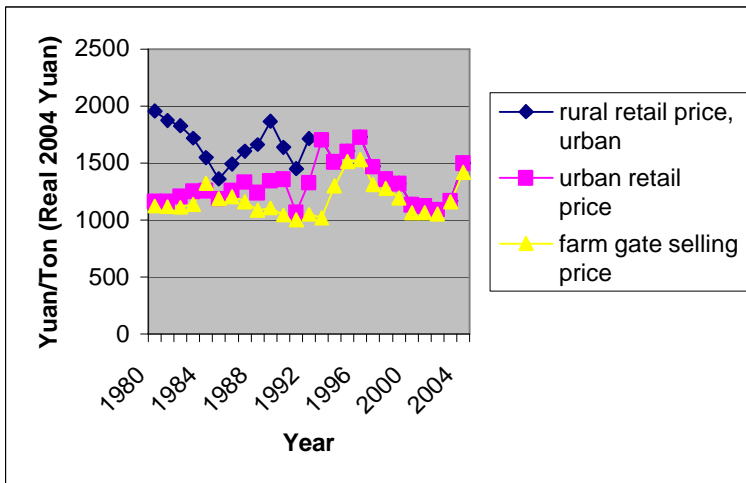
Panel C. Maize
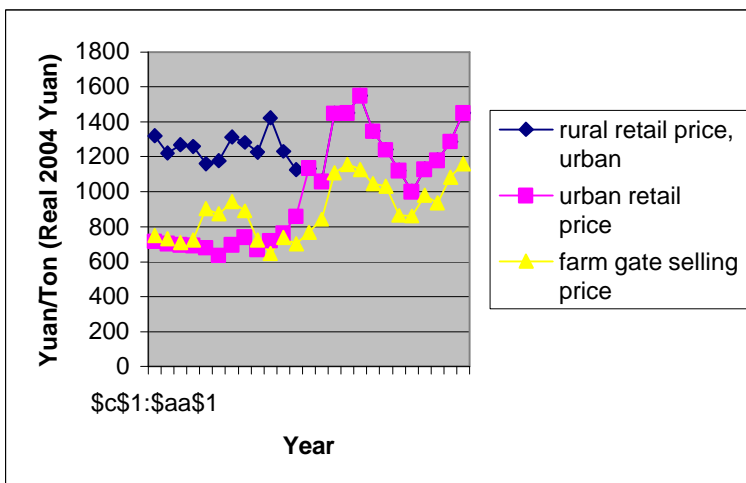
Data Source: China Price Yearbook, 2005

Figure 5. Rural Retail Price (free market price), Urban Retail Price and Farm-gate Sales Price in China, 1980 to 2004 (Real 2004 Yuan).
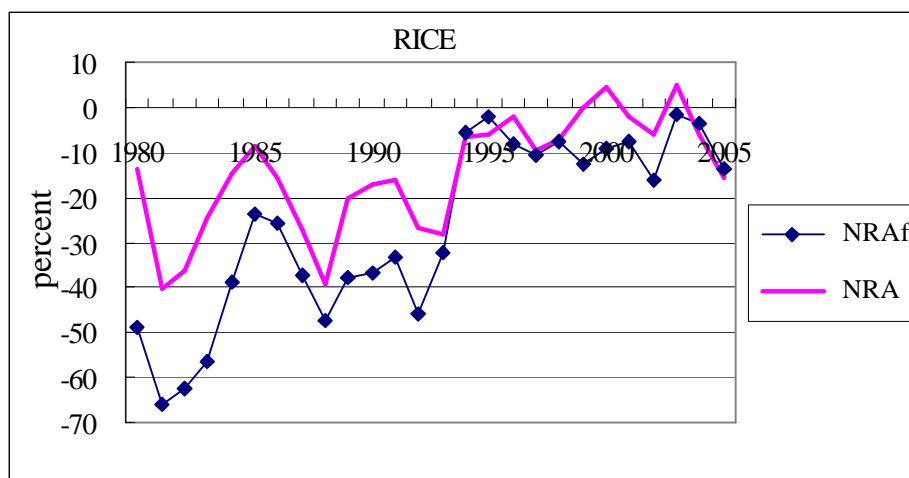
Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 6. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for rice in China, 1980-2005
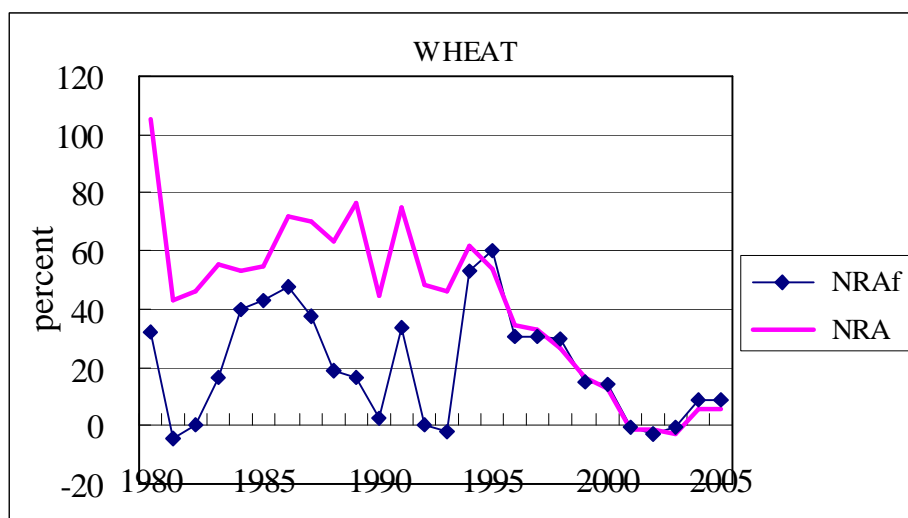
WHEAT

Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 7. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for wheat in China, 1980-2005

Panel A. Protection measures for maize (if imported), 1980-2005.
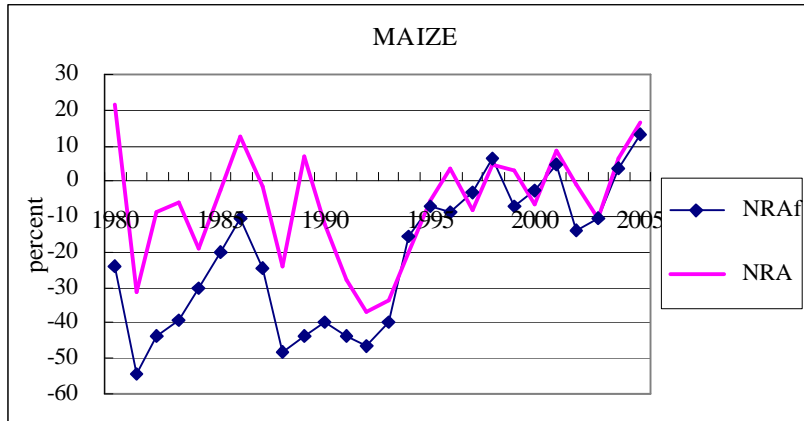
Panel B. Protection measures for maize (if exported), 1980-2005.
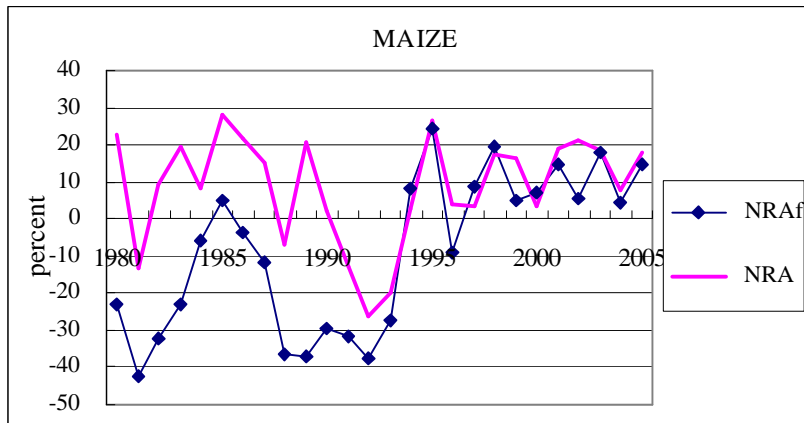
Panel C. Protection measures for maize based on trade status, 1980-2005.
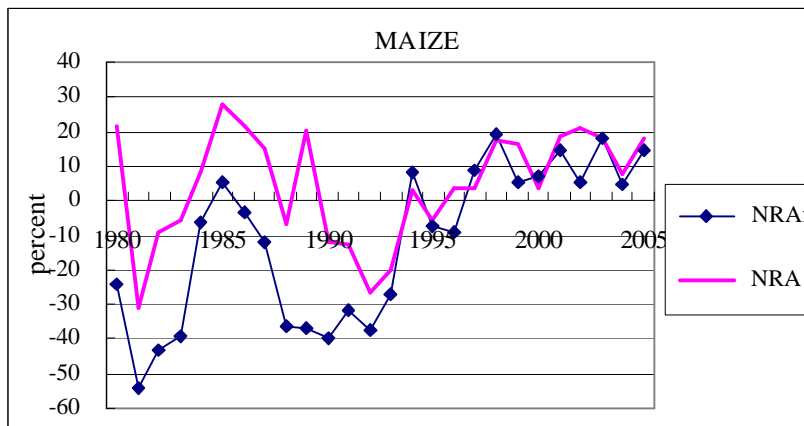
Notes: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected. Protection measure based on trade status uses the figure from Panel A in years when China is a net importer and figures from Panel B in years when China is a net importer.

Figure 8. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for maize in China, 1980-2005
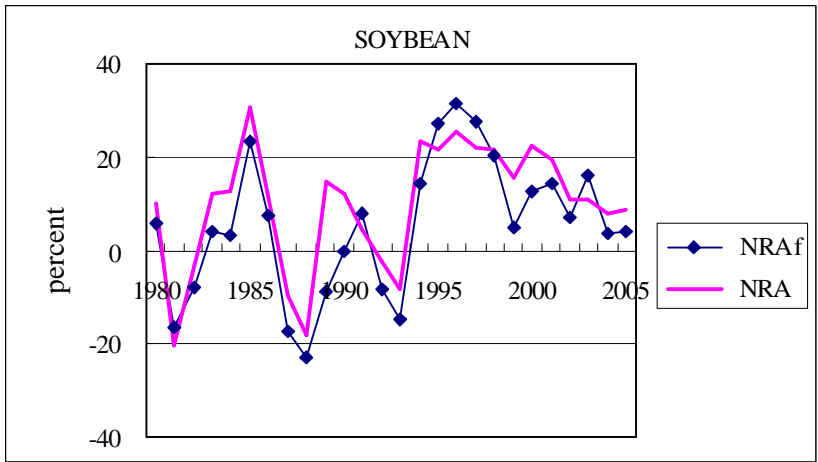
SOYBEAN

Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 9. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for soybeans in China, 1980-2005

Panel A. Protection measures for cotton (import), 1980-2005
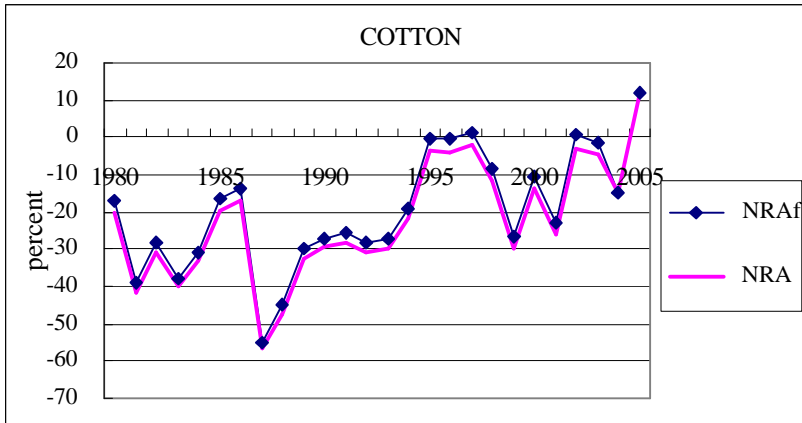
Panel B. Protection measures for cotton (export), 1980-2005
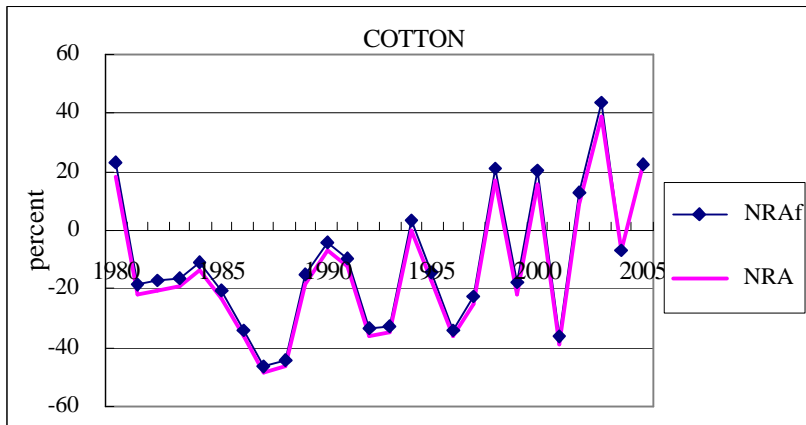
Panel C. Protection measures for cotton based on trade status, 1980-2005
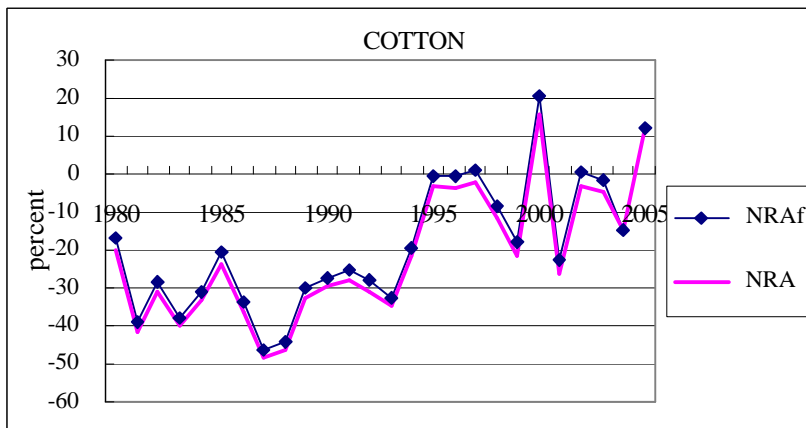
Notes: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected. Protection measure based on trade status uses the figure from Panel A in years when China is a net importer and figures from Panel B in years when China is a net importer.

Figure 10. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for cotton in China, 1980-2005

Panel A. Protection measures for pork
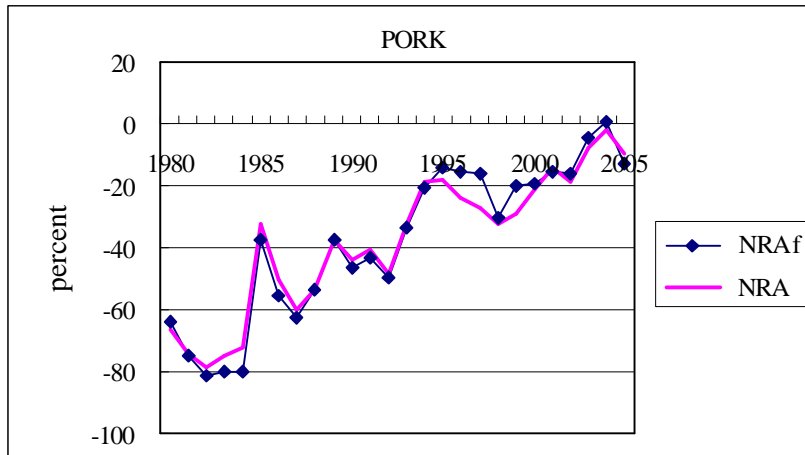
Panel B. Protection measures for poultry
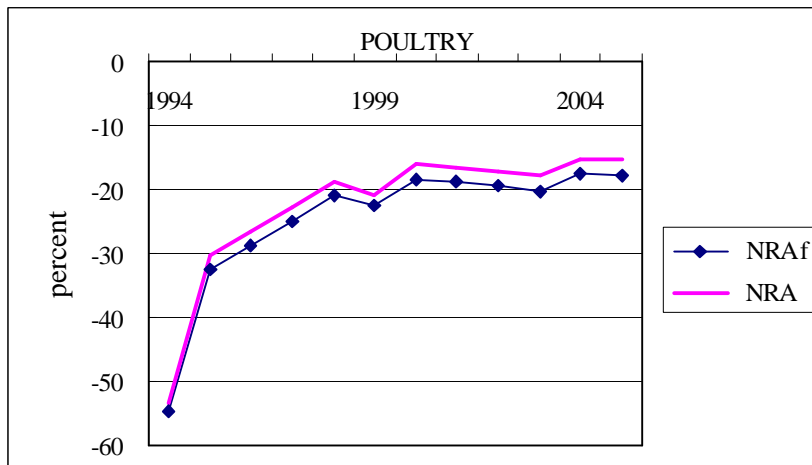
Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 11. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for livestock commodities (pork and poultry) in China, 1980-2005

Panel A. Protection Measures for Vegetables

VEGETABLE
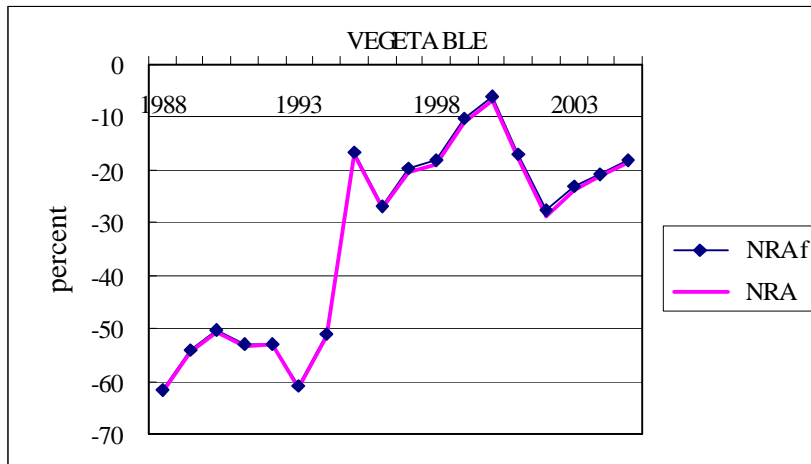
Panel B. Protection measures for fruit
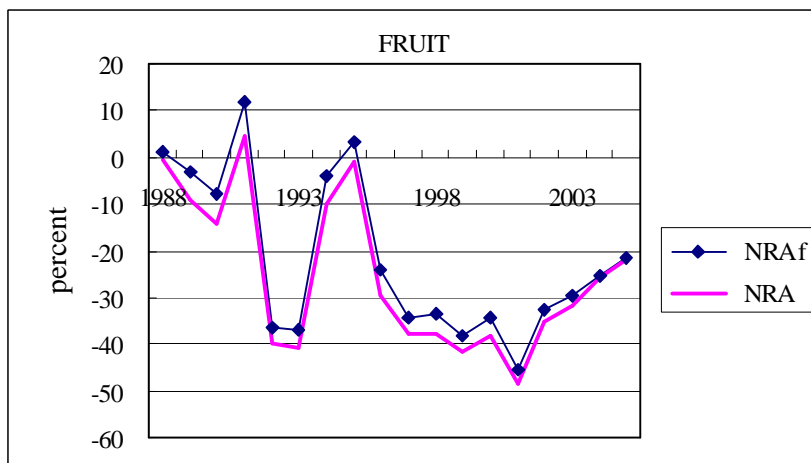
FRUIT

Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 12. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for vegetables and fruit in China, 1980-2005

Panel A. Protection measures for milk
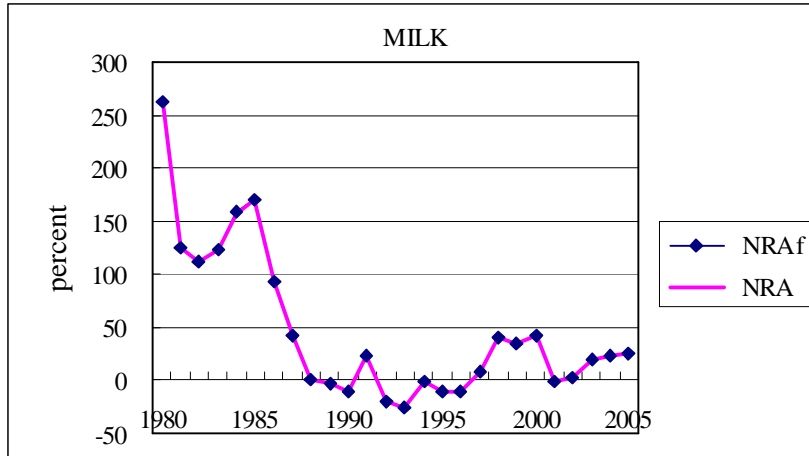
Protection measures for sugar
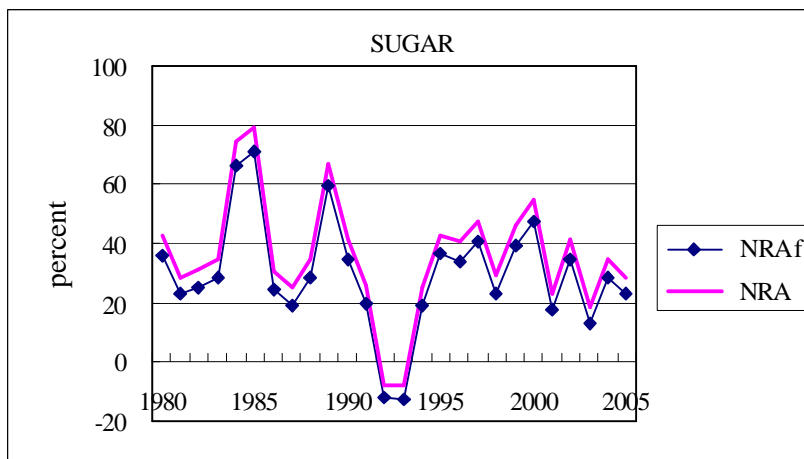
Note: Negative NRAs and NRAfs mean that agriculture is being disprotected or taxed; positive NRAs and NRAfs mean agriculture is being protected.

Figure 13. Nominal Rates of Assistance (NRAs) and Nominal Rates of Assistance for Farmers (NRAfs) for industrial processed goods (milk and sugar production) in China, 1980-2005
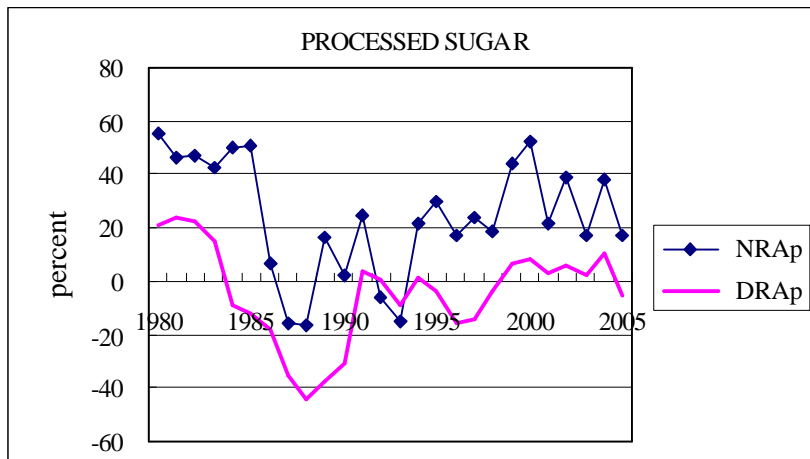
Figure 14. Protection measures (NRAs and DRAs) for sugar processors, 1980-2005
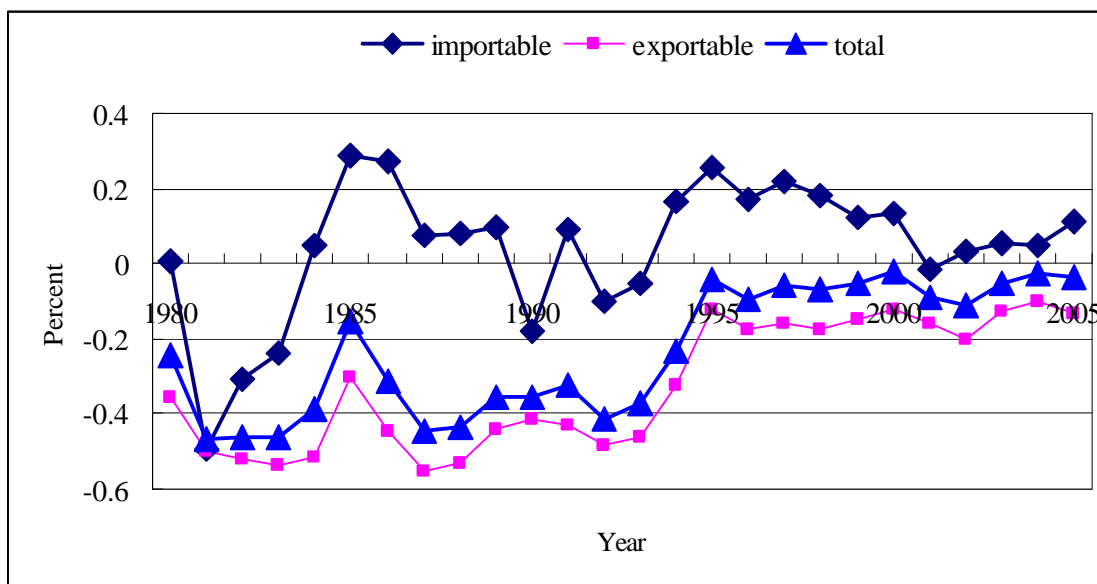
Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Notes: Negative DRAs mean that agriculture is being disprotected or taxed; positive DRAs mean agriculture is being protected. Since the distortions to inputs are so small, the graphs for NRAfs are exactly the same.

Figure 15. Direct Rates of Assistance (DRAs) for Farmers that Produce Importable Commodities, Exportable Commodities and for All of Agriculture (11 commodities) in China, 1980-2005

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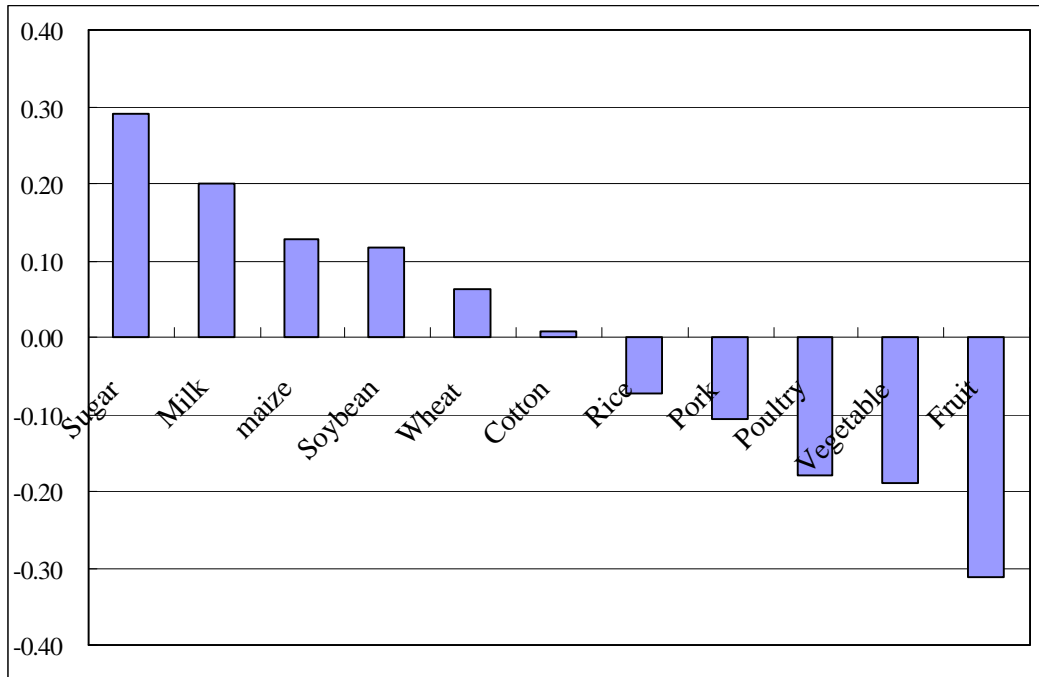
Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Figure 16: Average Direct Rates of Assistance (DRAs) for Farmers that Major
Commodities in China, 2000-2005
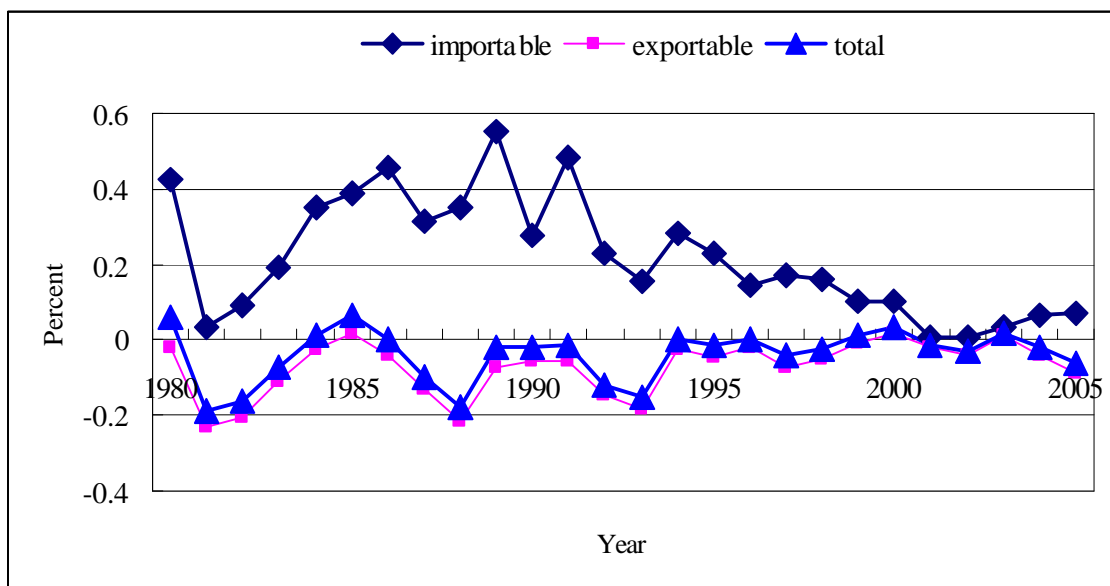
Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Notes: Positive CTEs mean that consumers of food are being taxed; negative CTEs mean consumers of food are being subsidized.

Figure 17. Consumer Tariff Equivalents (CTEs) for Consumers of Food that Consume Importable Commodities, Exportable Commodities and for All of Agriculture (11 commodities) in China, 1980-2005

Appendix Table 1: Raw numbers for exchange rate analysis, China, 1980 to 2005

Year	Official rate[a]	Commodity specific rate	Secondary market rate[b]	Retention rate[c]	Discount to secondary market rate	Estimated equilibrium exchange rate[d]
1980	1.50	n. a.	1.95	0.20	1.95	1.95
1981	1.71	n. a.	2.05	0.20	2.05	2.80
1982	1.89	n. a.	2.27	0.20	2.27	2.80
1983	1.98	n. a.	2.39	0.20	2.39	2.80
1984	2.33	n. a.	2.69	0.20	2.69	2.80
1985	2.94	n. a.	3.05	0.25	3.05	2.95
1986	3.45	n. a.	4.03	0.25	4.03	3.81
1987	3.72	n. a.	4.40	0.44	4.40	5.29
1988	3.72	n. a.	6.50	0.44	6.50	5.79
1989	3.77	n. a.	6.60	0.44	6.60	4.94
1990	4.78	n. a.	6.60	0.44	6.60	5.44
1991	5.32	n. a.	6.60	0.80	6.60	5.84
1992	5.52	n. a.	6.92	0.80	6.92	7.12
1993	5.76	n. a.	8.28	0.80	8.28	8.41
1994	8.62	n. a.	8.70	0.80	8.70	8.69
1995	8.35	n. a.	n. a.	n. a.	n. a.	8.35
1996	8.31	n. a.	n. a.	n. a.	n. a.	8.31
1997	8.29	n. a.	n. a.	n. a.	n. a.	8.29
1998	8.28	n. a.	n. a.	n. a.	n. a.	8.28
1999	8.28	n. a.	n. a.	n. a.	n. a.	8.28
2000	8.28	n. a.	n. a.	n. a.	n. a.	8.28
2001	8.28	n. a .	n. a.	n. a.	n. a.	8.28
2002	8.28	n. a.	n. a.	n. a.	n. a.	8.28
2003	8.28	n. a.	n. a.	n. a.	n. a.	8.28
2004	8.28	n. a.	n. a.	n. a.	n. a.	8.28
2005	8.19	n. a.	n. a.	n. a.	n. a.	8.19

Source:
[a] NBSC
[b] Huang and David, 1995
[c] The proportion of foreign currency actually sold by all exporters at the parallel market rate.
[d] See Anderson et al. (2006, pp. 52-54) on the exchange rate methodology used in this study

Appendix Table 2a: Prices and NRAs and NRAf for rice (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	378	740	-0.49	640	740	-0.14
1981	377	1115	-0.66	667	1115	-0.40
1982	381	1020	-0.63	650	1020	-0.36
1983	382	878	-0.57	659	878	-0.25
1984	461	751	-0.39	642	751	-0.15
1985	507	663	-0.24	605	663	-0.09
1986	562	756	-0.26	638	756	-0.16
1987	635	1013	-0.37	737	1013	-0.27
1988	788	1498	-0.47	906	1498	-0.40
1989	935	1509	-0.38	1200	1509	-0.20
1990	879	1388	-0.37	1150	1388	-0.17
1991	856	1286	-0.33	1080	1286	-0.16
1992	883	1633	-0.46	1200	1633	-0.27
1993	1216	1800	-0.32	1293	1800	-0.28
1994	2034	2152	-0.05	2005	2152	-0.07
1995	2352	2403	-0.02	2258	2403	-0.06
1996	2298	2507	-0.08	2459	2507	-0.02
1997	2079	2329	-0.11	2101	2329	-0.10
1998	1989	2150	-0.07	1993	2150	-0.07
1999	1674	1913	-0.12	1907	1913	0.00
2000	1540	1695	-0.09	1774	1695	0.05
2001	1569	1695	-0.07	1658	1695	-0.02
2002	1446	1729	-0.16	1628	1729	-0.06
2003	1713	1738	-0.01	1822	1738	0.05
2004	2264	2348	-0.04	2210	2348	-0.06
2005	2316	2679	-0.14	2261	2679	-0.16

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2b: Prices and NRAs and NRAf for wheat (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	359	272	0.32	557	272	1.05
1981	367	384	-0.04	548	384	0.43
1982	373	372	0.00	544	372	0.46
1983	390	335	0.17	520	335	0.55
1984	441	315	0.40	482	315	0.53
1985	428	299	0.43	462	299	0.55
1986	462	313	0.48	537	313	0.72
1987	502	365	0.37	621	365	0.70
1988	556	467	0.19	763	467	0.63
1989	666	573	0.16	1011	573	0.76
1990	644	628	0.03	906	628	0.44
1991	631	472	0.34	826	472	0.75
1992	698	696	0.00	1031	696	0.48
1993	768	782	-0.02	1142	782	0.46
1994	1190	776	0.53	1254	776	0.62
1995	1592	995	0.60	1530	995	0.54
1996	1701	1302	0.31	1750	1302	0.34
1997	1470	1129	0.30	1502	1129	0.33
1998	1385	1070	0.29	1356	1070	0.27
1999	1254	1094	0.15	1277	1094	0.17
2000	1102	964	0.14	1084	964	0.12
2001	1074	1083	-0.01	1066	1083	-0.02
2002	1010	1037	-0.03	1023	1037	-0.01
2003	1127	1130	0.00	1095	1130	-0.03
2004	1478	1362	0.09	1442	1362	0.06
2005	1442	1330	0.08	1410	1330	0.06

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2ci: Prices and NRAs and NRAf for maize (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	239	311	-0.23	382	311	0.23
1981	241	417	-0.42	362	417	-0.13
1982	238	351	-0.32	384	351	0.10
1983	248	324	-0.23	387	324	0.19
1984	318	338	-0.06	367	338	0.08
1985	332	316	0.05	405	316	0.28
1986	381	394	-0.03	480	394	0.22
1987	385	437	-0.12	503	437	0.15
1988	370	582	-0.36	541	582	-0.07
1989	391	619	-0.37	746	619	0.20
1990	455	645	-0.30	660	645	0.02
1991	444	649	-0.32	567	649	-0.13
1992	512	818	-0.37	601	818	-0.26
1993	636	874	-0.27	700	874	-0.20
1994	1016	939	0.08	967	939	0.03
1995	1221	983	0.24	1242	983	0.26
1996	1255	1379	-0.09	1430	1379	0.04
1997	1172	1076	0.09	1111	1076	0.03
1998	1120	939	0.19	1100	939	0.17
1999	909	865	0.05	1005	865	0.16
2000	893	832	0.07	859	832	0.03
2001	990	864	0.15	1026	864	0.19
2002	872	828	0.05	1001	828	0.21
2003	1054	892	0.18	1055	892	0.18
2004	1214	1160	0.05	1249	1160	0.08
2005	1160	1010	0.15	1192	1010	0.18

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2cii: Prices and NRAs and NRAf for maize (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	239	315	-0.24	382	315	0.21
1981	241	527	-0.54	362	527	-0.31
1982	238	421	-0.43	384	421	-0.09
1983	248	410	-0.39	387	410	-0.06
1984	318	454	-0.30	367	454	-0.19
1985	332	415	-0.20	405	415	-0.02
1986	381	426	-0.11	480	426	0.13
1987	385	511	-0.25	503	511	-0.02
1988	370	713	-0.48	541	713	-0.24
1989	391	697	-0.44	746	697	0.07
1990	455	752	-0.40	660	752	-0.12
1991	444	786	-0.44	567	786	-0.28
1992	512	953	-0.46	601	953	-0.37
1993	636	1055	-0.40	700	1055	-0.34
1994	1016	1208	-0.16	967	1208	-0.20
1995	1221	1315	-0.07	1242	1315	-0.06
1996	1255	1380	-0.09	1430	1380	0.04
1997	1172	1208	-0.03	1111	1208	-0.08
1998	1120	1052	0.06	1100	1052	0.05
1999	909	976	-0.07	1005	976	0.03
2000	893	919	-0.03	859	919	-0.07
2001	990	944	0.05	1026	944	0.09
2002	872	1010	-0.14	1001	1010	-0.01
2003	1054	1175	-0.10	1055	1175	-0.10
2004	1214	1175	0.03	1249	1175	0.06
2005	1160	1024	0.13	1192	1024	0.16

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2ciii: Prices and NRAs and NRAf for maize (trade status change), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	239	315	-0.24	382	315	0.21
1981	241	527	-0.54	362	527	-0.31
1982	238	421	-0.43	384	421	-0.09
1983	248	324	-0.23	387	324	0.19
1984	318	338	-0.06	367	338	0.08
1985	332	316	0.05	405	316	0.28
1986	381	394	-0.03	480	394	0.22
1987	385	437	-0.12	503	437	0.15
1988	370	582	-0.36	541	582	-0.07
1989	391	619	-0.37	746	619	0.20
1990	455	752	-0.40	660	752	-0.12
1991	444	649	-0.32	567	649	-0.13
1992	512	818	-0.37	601	818	-0.26
1993	636	874	-0.27	700	874	-0.20
1994	1016	939	0.08	967	939	0.03
1995	1221	1315	-0.07	1242	1315	-0.06
1996	1255	1380	-0.09	1430	1380	0.04
1997	1172	1076	0.09	1111	1076	0.03
1998	1120	939	0.19	1100	939	0.17
1999	909	865	0.05	1005	865	0.16
2000	893	832	0.07	859	832	0.03
2001	990	864	0.15	1026	864	0.19
2002	872	828	0.05	1001	828	0.21
2003	1054	892	0.18	1055	892	0.18
2004	1214	1160	0.05	1249	1160	0.08
2005	1160	1010	0.15	1192	1010	0.18

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2d: Prices and NRAs and NRAf for soybean (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	652	615	0.06	677	615	0.10
1981	804	964	-0.17	767	964	-0.20
1982	791	860	-0.08	833	860	-0.03
1983	791	760	0.04	853	760	0.12
1984	796	773	0.03	871	773	0.13
1985	804	652	0.23	851	652	0.30
1986	939	874	0.07	978	874	0.12
1987	1011	1222	-0.17	1102	1222	-0.10
1988	1220	1582	-0.23	1296	1582	-0.18
1989	1420	1555	-0.09	1785	1555	0.15
1990	1415	1418	0.00	1591	1418	0.12
1991	1543	1430	0.08	1493	1430	0.04
1992	1699	1855	-0.08	1807	1855	-0.03
1993	1902	2229	-0.15	2040	2229	-0.08
1994	2369	2074	0.14	2559	2074	0.23
1995	2843	2234	0.27	2714	2234	0.21
1996	3296	2505	0.32	3144	2505	0.26
1997	3339	2617	0.28	3192	2617	0.22
1998	2671	2218	0.20	2698	2218	0.22
1999	1935	1845	0.05	2131	1845	0.16
2000	2022	1794	0.13	2200	1794	0.23
2001	1990	1738	0.14	2074	1738	0.19
2002	2028	1892	0.07	2100	1892	0.11
2003	2609	2252	0.16	2500	2252	0.11
2004	3079	2972	0.04	3210	2972	0.08
2005	2793	2688	0.04	2920	2688	0.09

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2ei: Prices and NRAs and NRAf for cotton (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	3315	2684	0.23	3179	2684	0.18
1981	3155	3858	-0.18	3014	3858	-0.22
1982	3203	3858	-0.17	3075	3858	-0.20
1983	3224	3858	-0.16	3115	3858	-0.19
1984	3447	3858	-0.11	3340	3858	-0.13
1985	3242	4069	-0.20	3113	4069	-0.23
1986	3471	5251	-0.34	3338	5251	-0.36
1987	3921	7290	-0.46	3767	7290	-0.48
1988	4449	7984	-0.44	4272	7984	-0.46
1989	5782	6811	-0.15	5577	6811	-0.18
1990	7197	7501	-0.04	6993	7501	-0.07
1991	7290	8051	-0.09	7043	8051	-0.13
1992	6539	9813	-0.33	6274	9813	-0.36
1993	7811	11584	-0.33	7549	11584	-0.35
1994	12355	11983	0.03	11975	11983	0.00
1995	15489	18078	-0.14	15031	18078	-0.17
1996	15235	23093	-0.34	14704	23093	-0.36
1997	14896	19232	-0.23	14395	19232	-0.25
1998	12554	10351	0.21	12119	10351	0.17
1999	8161	9932	-0.18	7784	9932	-0.22
2000	10967	9108	0.20	10566	9108	0.16
2001	8094	12648	-0.36	7727	12648	-0.39
2002	10153	8978	0.13	9764	8978	0.09
2003	13642	9489	0.44	13200	9489	0.39
2004	11514	12378	-0.07	11500	12378	-0.07
2005	13795	11270	0.22	13778	11270	0.22

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2eii: Prices and NRAs and NRAf for cotton (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	3315	3982	-0.17	3179	3982	-0.20
1981	3155	5159	-0.39	3014	5159	-0.42
1982	3203	4465	-0.28	3075	4465	-0.31
1983	3224	5184	-0.38	3115	5184	-0.40
1984	3447	4991	-0.31	3340	4991	-0.33
1985	3242	3887	-0.17	3113	3887	-0.20
1986	3471	4018	-0.14	3338	4018	-0.17
1987	3921	8708	-0.55	3767	8708	-0.57
1988	4449	8097	-0.45	4272	8097	-0.47
1989	5782	8263	-0.30	5577	8263	-0.33
1990	7197	9888	-0.27	6993	9888	-0.29
1991	7290	9784	-0.25	7043	9784	-0.28
1992	6539	9088	-0.28	6274	9088	-0.31
1993	7811	10747	-0.27	7549	10747	-0.30
1994	12355	15300	-0.19	11975	15300	-0.22
1995	15489	15549	0.00	15031	15549	-0.03
1996	15235	15301	0.00	14704	15301	-0.04
1997	14896	14710	0.01	14395	14710	-0.02
1998	12554	13737	-0.09	12119	13737	-0.12
1999	8161	11082	-0.26	7784	11082	-0.30
2000	10967	12273	-0.11	10566	12273	-0.14
2001	8094	10465	-0.23	7727	10465	-0.26
2002	10153	10082	0.01	9764	10082	-0.03
2003	13642	13840	-0.01	13200	13840	-0.05
2004	11514	13507	-0.15	11500	13507	-0.15
2005	13795	12299	0.12	13778	12299	0.12

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2eiii: Prices and NRAs and NRAf for cotton (trade status change), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	3315	3982	-0.17	3179	3982	-0.20
1981	3155	5159	-0.39	3014	5159	-0.42
1982	3203	4465	-0.28	3075	4465	-0.31
1983	3224	5184	-0.38	3115	5184	-0.40
1984	3447	4991	-0.31	3340	4991	-0.33
1985	3242	4069	-0.20	3113	4069	-0.23
1986	3471	5251	-0.34	3338	5251	-0.36
1987	3921	7290	-0.46	3767	7290	-0.48
1988	4449	7984	-0.44	4272	7984	-0.46
1989	5782	8263	-0.30	5577	8263	-0.33
1990	7197	9888	-0.27	6993	9888	-0.29
1991	7290	9784	-0.25	7043	9784	-0.28
1992	6539	9088	-0.28	6274	9088	-0.31
1993	7811	10747	-0.27	7549	10747	-0.30
1994	12355	15300	-0.19	11975	15300	-0.22
1995	15489	15549	0.00	15031	15549	-0.03
1996	15235	15301	0.00	14704	15301	-0.04
1997	14896	14710	0.01	14395	14710	-0.02
1998	12554	13737	-0.09	12119	13737	-0.12
1999	8161	9932	-0.18	7784	9932	-0.22
2000	10967	9108	0.20	10566	9108	0.16
2001	8094	10465	-0.23	7727	10465	-0.26
2002	10153	10082	0.01	9764	10082	-0.03
2003	13642	13840	-0.01	13200	13840	-0.05
2004	11514	13507	-0.15	11500	13507	-0.15
2005	13795	12299	0.12	13778	12299	0.12

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2f: Prices and NRAs and NRAf for pork (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	1893	5203	-0.64	1745	5203	-0.66
1981	1894	7479	-0.75	1933	7479	-0.74
1982	1895	10041	-0.81	2141	10041	-0.79
1983	1897	9428	-0.80	2372	9428	-0.75
1984	1910	9568	-0.80	2628	9568	-0.73
1985	2542	4041	-0.37	2733	4041	-0.32
1986	2705	6054	-0.55	3002	6054	-0.50
1987	3219	8651	-0.63	3454	8651	-0.60
1988	4685	10042	-0.53	4642	10042	-0.54
1989	5277	8459	-0.38	5304	8459	-0.37
1990	4985	9286	-0.46	5193	9286	-0.44
1991	4857	8587	-0.43	5090	8587	-0.41
1992	5186	10340	-0.50	5348	10340	-0.48
1993	6040	9079	-0.33	6143	9079	-0.32
1994	8430	10601	-0.20	8611	10601	-0.19
1995	11122	12976	-0.14	10654	12976	-0.18
1996	11057	13054	-0.15	9972	13054	-0.24
1997	12827	15335	-0.16	11150	15335	-0.27
1998	9948	14222	-0.30	9678	14222	-0.32
1999	8470	10610	-0.20	7508	10610	-0.29
2000	8689	10795	-0.20	8486	10795	-0.21
2001	9010	10677	-0.16	9138	10677	-0.14
2002	8653	10295	-0.16	8400	10295	-0.18
2003	9636	10079	-0.04	9278	10079	-0.08
2004	12514	12461	0.00	12189	12461	-0.02
2005	11004	12642	-0.13	11440	12642	-0.10

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2g: Prices and NRAs and NRAf for poultry (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	4017	3014	0.33	4125	3014	0.37
1981	4051	3328	0.22	4163	3328	0.25
1982	4087	3116	0.31	4202	3116	0.35
1983	4122	3201	0.29	4241	3201	0.32
1984	4159	3748	0.11	4280	3748	0.14
1985	5145	3954	0.30	5298	3954	0.34
1986	2615	5668	-0.54	2679	5668	-0.53
1987	3266	8829	-0.63	3338	8829	-0.62
1988	5973	11073	-0.46	6132	11073	-0.45
1989	8676	9376	-0.07	8922	9376	-0.05
1990	8882	11402	-0.22	9134	11402	-0.20
1991	8547	12714	-0.33	8795	12714	-0.31
1992	8480	14083	-0.40	8734	14083	-0.38
1993	8675	15747	-0.45	8933	15747	-0.43
1994	8301	18295	-0.55	8545	18295	-0.53
1995	12552	18560	-0.32	12923	18560	-0.30
1996	12830	18011	-0.29	13200	18011	-0.27
1997	11769	15690	-0.25	12114	15690	-0.23
1998	11390	14422	-0.21	11731	14422	-0.19
1999	10712	13834	-0.23	10954	13834	-0.21
2000	9834	12057	-0.18	10126	12057	-0.16
2001	10065	12391	-0.19	10353	12391	-0.16
2002	10351	12839	-0.19	10648	12839	-0.17
2003	10566	13245	-0.20	10872	13245	-0.18
2004	11930	14484	-0.18	12281	14484	-0.15
2005	12174	14788	-0.18	12532	14788	-0.15

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2h: Prices and NRAs and NRAf for vegetable (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	172	203	-0.16	171	203	-0.16
1981	185	277	-0.33	184	277	-0.34
1982	211	278	-0.24	210	278	-0.24
1983	212	400	-0.47	209	400	-0.48
1984	227	441	-0.48	224	441	-0.49
1985	305	509	-0.40	301	509	-0.41
1986	314	713	-0.56	310	713	-0.56
1987	369	1068	-0.65	365	1068	-0.66
1988	483	1257	-0.62	479	1257	-0.62
1989	634	1379	-0.54	629	1379	-0.54
1990	674	1357	-0.50	669	1357	-0.51
1991	667	1413	-0.53	661	1413	-0.53
1992	929	1967	-0.53	922	1967	-0.53
1993	792	2035	-0.61	786	2035	-0.61
1994	1119	2284	-0.51	1112	2284	-0.51
1995	1424	1708	-0.17	1417	1708	-0.17
1996	1330	1816	-0.27	1322	1816	-0.27
1997	1099	1369	-0.20	1091	1369	-0.20
1998	1086	1328	-0.18	1077	1328	-0.19
1999	981	1094	-0.10	973	1094	-0.11
2000	1048	1115	-0.06	1040	1115	-0.07
2001	1063	1284	-0.17	1056	1284	-0.18
2002	1008	1396	-0.28	995	1396	-0.29
2003	1015	1321	-0.23	1005	1321	-0.24
2004	1057	1338	-0.21	1055	1338	-0.21
2005	1138	1393	-0.18	1136	1393	-0.18

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2i: Prices and NRAs and NRAf for fruit (export), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	446	431	0.03	430	431	0.00
1981	439	615	-0.29	433	615	-0.30
1982	472	619	-0.24	465	619	-0.25
1983	516	703	-0.27	509	703	-0.28
1984	697	713	-0.02	688	713	-0.04
1985	794	763	0.04	791	763	0.04
1986	1092	999	0.09	1069	999	0.07
1987	1152	1406	-0.18	1128	1406	-0.20
1988	1583	1561	0.01	1556	1561	0.00
1989	1347	1388	-0.03	1263	1388	-0.09
1990	1438	1561	-0.08	1337	1561	-0.14
1991	1925	1721	0.12	1802	1721	0.05
1992	1605	2534	-0.37	1527	2534	-0.40
1993	1545	2448	-0.37	1450	2448	-0.41
1994	2145	2233	-0.04	2014	2233	-0.10
1995	2565	2487	0.03	2465	2487	-0.01
1996	1959	2575	-0.24	1816	2575	-0.29
1997	1512	2302	-0.34	1428	2302	-0.38
1998	1418	2129	-0.33	1323	2129	-0.38
1999	1213	1955	-0.38	1143	1955	-0.42
2000	1208	1839	-0.34	1138	1839	-0.38
2001	1374	2522	-0.46	1297	2522	-0.49
2002	1316	1948	-0.32	1259	1948	-0.35
2003	1395	1979	-0.30	1348	1979	-0.32
2004	1525	2045	-0.25	1515	2045	-0.26
2005	1678	2131	-0.21	1666	2131	-0.22

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2j: Prices and NRAs and NRAf for milk (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	839	231	2.63	839	231	2.63
1981	846	378	1.24	846	378	1.24
1982	854	403	1.12	854	403	1.12
1983	862	386	1.23	862	386	1.23
1984	870	337	1.58	870	337	1.58
1985	878	325	1.70	878	325	1.70
1986	886	460	0.93	886	460	0.93
1987	894	632	0.41	894	632	0.41
1988	902	887	0.02	902	887	0.02
1989	911	938	-0.03	911	938	-0.03
1990	919	1030	-0.11	919	1030	-0.11
1991	928	752	0.23	928	752	0.23
1992	936	1172	-0.20	936	1172	-0.20
1993	1146	1523	-0.25	1145	1523	-0.25
1994	1539	1569	-0.02	1539	1569	-0.02
1995	1530	1702	-0.10	1530	1702	-0.10
1996	1872	2089	-0.10	1871	2089	-0.10
1997	1981	1833	0.08	1980	1833	0.08
1998	1935	1385	0.40	1934	1385	0.40
1999	1934	1429	0.35	1933	1429	0.35
2000	1860	1314	0.42	1860	1314	0.42
2001	1575	1601	-0.02	1571	1601	-0.02
2002	1938	1873	0.03	1936	1873	0.03
2003	1927	1602	0.20	1926	1602	0.20
2004	1943	1568	0.24	1943	1568	0.24
2005	1944	1552	0.25	1944	1552	0.25

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2k: Prices and NRAs and NRAf for sugar (import), China, 1980 to 2005

	At Farm Gate			At Wholesale		
	Farm gate price plus subsidy	Border price per MT	NRAf = FP/BP-1	Wholesale price per MT	Border price per MT	NRAs = WP/BP-1
	RMB/MT	RMB/MT	Ratio	RMB/MT	RMB/MT	Ratio
1980	617	453	0.36	646	453	0.43
1981	594	483	0.23	622	483	0.29
1982	597	476	0.25	626	476	0.31
1983	637	497	0.28	667	497	0.34
1984	797	480	0.66	835	480	0.74
1985	822	481	0.71	862	481	0.79
1986	844	677	0.25	884	677	0.31
1987	1229	1031	0.19	1288	1031	0.25
1988	1544	1201	0.29	1619	1201	0.35
1989	1621	1017	0.59	1699	1017	0.67
1990	1650	1224	0.35	1730	1224	0.41
1991	1565	1306	0.20	1641	1306	0.26
1992	1414	1609	-0.12	1482	1609	-0.08
1993	1668	1900	-0.12	1748	1900	-0.08
1994	2370	1989	0.19	2484	1989	0.25
1995	3017	2214	0.36	3163	2214	0.43
1996	3057	2282	0.34	3204	2282	0.40
1997	2995	2126	0.41	3138	2126	0.48
1998	2597	2111	0.23	2722	2111	0.29
1999	2058	1474	0.40	2155	1474	0.46
2000	2178	1477	0.47	2282	1477	0.55
2001	2241	1904	0.18	2347	1904	0.23
2002	1986	1474	0.35	2080	1474	0.41
2003	1865	1648	0.13	1954	1648	0.19
2004	2170	1688	0.29	2275	1688	0.35
2005	2837	2310	0.23	2974	2310	0.29

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)

Appendix Table 2l: Prices and NRAp for sugar (import) in China, 1980 to 2005

	wholesale price processed	border price per MT	NRAp=FP/BP-1
	RMB/MT	RMB/MT	Ratio
1980	879	566	0.55
1981	885	604	0.47
1982	877	595	0.47
1983	884	621	0.42
1984	900	599	0.50
1985	907	601	0.51
1986	899	846	0.06
1987	1089	1289	-0.16
1988	1254	1501	-0.16
1989	1480	1272	0.16
1990	1561	1530	0.02
1991	2031	1632	0.24
1992	1890	2012	-0.06
1993	2013	2376	-0.15
1994	3024	2486	0.22
1995	3603	2767	0.30
1996	3332	2852	0.17
1997	3282	2658	0.23
1998	3139	2639	0.19
1999	2648	1842	0.44
2000	2806	1846	0.52
2001	2887	2381	0.21
2002	2559	1842	0.39
2003	2406	2059	0.17
2004	2912	2110	0.38
2005	3389	2887	0.17

Source: Authors' spreadsheet using methodology from Anderson et al. (2006)