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Agricultural Trade Reform and Rural Prosperity Lessons from China

Jikun Huang, Yu Liu, Will Martin, and Scott Rozelle

China's agriculture has grown rapidly in recent years, despite radical reductions in agricultural tariffs (Huang and Chen 1999; Huang, Rozelle, and Chang 2004). China's agriculture has moved from a focus on self-sufficiency and industry-first growth, through the Open Door Policy of the 1980s, to a much more market-oriented regime. Accession to the World Trade Organization (WTO) was allowed only after China promised major institutional reforms and a virtually unprecedented degree of tariff reduction, the abolition of export subsidies, and introduction of constraints on domestic support (Lardy 2001; Bhattasali, Li, and Martin 2004).

In response to the commitment to reform trade as well as domestic markets, there were fears that such sharp liberalization would have dire consequences for the rural population. In poor countries, government officials know that agricultural price shifts can have important effects on domestic food production, farm household incomes, national poverty rates, and overall rural stability. Many voices focused on the cuts in agricultural tariffs and warned that poverty in China would be exacerbated and rural incomes would fall if the nation were to follow through with their ambitious domestic market and trade liberalization policies (Carter and Estrin 2001; Li, Zhai, and Wang 1999; Schmidhuber 2001; Ni 2007). Even in light of these concerns, policymakers have pushed ahead.

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By the mid-2000s, the concerns about rural incomes of critics of trade policies had not been realized. Even scholars who have long worried about poor income growth in the rural areas are admitting the incomes and rural welfare are rising as never before. Although the gap in incomes between urban and rural people remains large, conventional measures of this gap are overstated by neglecting the lower costs of living in rural areas and by the exclusion of rural migrants living in urban areas when calculating average urban incomes (Sicular et al. 2006; Chen and Ravallion 2007; National Bureau of Statistics of China [NBSC] 2007).

Although there has long been an interest in the agricultural economy (e.g., Lardy 1983; Sicular 1988a; Lin 1992; Rosen, Huang, and Rozelle 2004), it is quite surprising to many that the agricultural sector of China actually has a very impressive record. Growth rates of gross domestic product (GDP), agricultural value added, and food per capita increased dramatically between the early 1980s and the mid-2000s. Indeed, China's performance in agriculture over the past two decades was more impressive than any other country in Asia. Markets have boomed. The structure of agriculture has fundamentally shifted. Despite having the largest population in the world and high income growth (which has radically changed consumption patterns), China has remained a net exporter of agricultural products until very recently, with a recent switch to net import status due largely to increased cotton imports needed for burgeoning exports of textiles and clothing. A report by the National Bureau of Statistics of China (NBSC 2006) demonstrates that rural incomes grew robustly between 2002 and 2005 and did so in all income deciles and all provinces (see table 10.2).

The overall goal of this paper is to address these questions using two specific approaches. The first is to present estimates of indicators of direct and indirect interventions of China's government in agriculture from 1981, when it first became possible to assess the stance of trade policies, to 2005, when almost all of China's WTO commitments had been phased in. To achieve this objective, we examine the differences in prices between international prices and domestic prices at the border (Nominal Rates of Assistance [NRA] at the market level and NRA_f at the farm level). Because input-related policies were relatively small over most of our sample period, we focus on the transfers associated with changes in commodity prices, although we include the effects of input measures in our estimates of support to farmers. In the most general terms, we find that China shifted from an economy that was highly distorted with a generally taxed agricultural sector, to one that was highly integrated with the world economy.

In the second part of the paper, we seek to understand what allowed the rural economy to do as well as it has in the face of falling prices for some products. To do so, we examine four factors: investments in agricultural technology; the policy responses aimed at deregulating agricultural markets and promoting structural adjustment; the new set of programs that

has redirected resources toward rural infrastructure and services as well as relatively nondistorting transfer programs and tax cuts; and policies aimed at facilitating the movement of labor from agriculture to industry and from rural to urban.

The wide scope of our goals and objectives necessitate certain limitations. First, the absence of data precludes our examining the entire agricultural sector. Instead, we examine commodities that account for two-thirds or more of gross output value over our study period. Second, although we are able to judge from the price trends and our understanding of domestic marketing and trade policy reforms the broad sources of the shifts in the distortions of the agricultural economy, we cannot identify the exact source of changes and must rely on earlier work by the authors and others examining these causal linkages in more detail (Huang and Rozelle 1996; de Brauw, Huang, and Rozelle 2004). Third, because of the complexity of agricultural trade instruments during the period—including state trading, quotas, licenses, tariffs, and exchange rate distortions—we were forced to use price comparison approaches even though exchange rates were distorted by a two-tier exchange rate system up to 1994. During this period, we used an exchange rate adjusted for the two-tier exchange rate system to compare international prices with prices in China's domestic economy, an approach used in (Huang, Liu, et al. 2009).

Before showing these results in the following section, we discuss our quantitative approach and sources of data. The results of the distortion analysis are presented and discussed in the next section. The following section discusses three policy responses that are likely part of the reason for the robust performance of China's rural sector. The final section concludes.

10.1 Methodology and Data Sources

In this paper, we have utilized the approach specified in Anderson et al. (2008). The approach is primarily based on comparisons between domestic and international prices. During the reform era, these price comparisons provide indicators of the incentives for production, consumption and trade, and of the income transfers associated with interventions.

Our approach essentially creates two main measures of distortions for each commodity. The basic measure in our analysis is the NRA, used to compare the prices of commodities in the domestic economy (at the port) with the international prices of commodities at the border (that is, cost, insurance, and freight [c.i.f.] in the port for importables; free on board [f.o.b.] in the port for exportables).

Because of barriers within the domestic economy, the extent of protection (or disprotection) provided by trade policies may not be the same as the 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 s). NRA_f s are calculated after allowing for quality adjustment; taxes or subsidies; and transport, storage, and handling costs in moving commodities from the farm to the wholesale level. Differences between NRAs and NRA_f s can arise from subsidy or transfer payments that cause the prices received by farmers to differ from what they would receive under competitive internal market conditions.¹

10.1.1 The Data

In compiling our data, we necessarily had to make choices on commodity coverage. We included eleven commodities: rice, wheat, maize, soybeans, cotton, pork, milk, poultry, fruit (using apples as a representative product), vegetables (using tomatoes as a representative product), and sugar (both sugarbeet and sugarcane). Over the study period, these commodities accounted for roughly 75 percent (in the late 1980s) and 60 percent (during the early 2000s) of the value of agricultural output in China. Because production and consumption decisions were only gradually being allowed to respond to domestic prices, and because we do not have access to reliable data on secondary market exchange rates prior to 1981, we focus on the period from 1981.

Much of the data on margins, transportation costs, and other transaction costs are from an extensive set of surveys by Huang and Rozelle during the 1990s and the early 2000s, surveys which also served to establish which commodity price series provided appropriate bases for price comparisons. Some of this was previously reported in Rozelle et al. (2000) and Huang, Rozelle, and Chang (2004), which provided information on substantial quality differences between some imported and domestic commodities and resulting methodologies for ensuring valid price comparisons. For more recent years, survey teams from the Center for Chinese Agricultural Policy interviewed traders in ten cities around China in 2006. The complete data series are in the appendixes of Huang et al. (2007).

When calculating the rate of support to farmers, we took into account direct support measures using data from the Price Department of the National Development and Reform Commission. These measures included three applying since 2002—direct grain supports, the seed subsidy program, and agricultural machinery subsidies. We also took into account the negative assistance imposed by agricultural taxes on production of specific commodities. We did not take into account the input subsidy program that pays subsidies to state-owned enterprises (SOEs) producing fertilizers and mulching film on the grounds that all or part of this may be a subsidy to the

1. While NRAs only measure differences in output prices, there may also be distortions on the input side; our NRA_f measures include a number of budget support and tax measures. The assumption and methods that were used to generate our exchange rate series are in Martin, Huang, and Rozelle (2006).

SOEs, rather than to the farmers. Nor did we include the “grain for green” payments made to convert fragile agricultural land to forest or pasture (see OECD [2008] for details of both of these measures).

10.2 Results

10.2.1 The Role of Domestic Price and Marketing Policy

Before examining the role of distortions at the border, it is useful (and necessary) to examine the relationship between the available domestic price series for farm and retail prices for two major grain crops (figure 10.1, panels A and B). The importance (and role) of China’s domestic price and marketing policy for rice and wheat (the two largest crops in China—one an exportable and the other an importable) can be seen by comparing the state-set urban retail price and the state-set farm-gate procurement price with the rural retail price, a free market price. Until 1992, the urban retail price for rice was generally well below the free market price in rural areas, despite the costs associated with transferring rice to urban areas. Only urban residents could buy rice at these low prices and only with ration coupons that were available in limited quantities.

The relatively low selling price of grain at the farm gate by farmers shows that China’s food system in the 1980s was set up to transfer income from rural to urban people (figure 10.1, panels A and B). The amount that farmers received for their mandatory deliveries was far below the free market price although, in the case of rice, it was above the urban retail price, suggesting urban prices were held down by a subsidy as well as by taxation of farmers. However, there is some question about the effects of the depressed rural prices on farmers’ incentives given the inframarginal nature of many of these transfers (Sicular 1988b). This is because from the mid-1980s, farmers were able to sell additional amounts at higher market prices once they had met their obligation to deliver a quota at the low purchasing price. As shown by Sicular (1988b), the higher out-of-quota price is the relevant incentive for production at the margin. However, as shown by Wang, Rozelle, and Huang (1999), even such policies may not be fully decoupled from incentives, with seemingly inframarginal transfers giving rural household members an incentive to move out of agriculture.

After 1992, however, changes to China’s domestic marketing and procurement system appear to have eliminated this additional layer of taxation and regulation for producers of rice and wheat (figure 10.1, panels A and B). 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. 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).

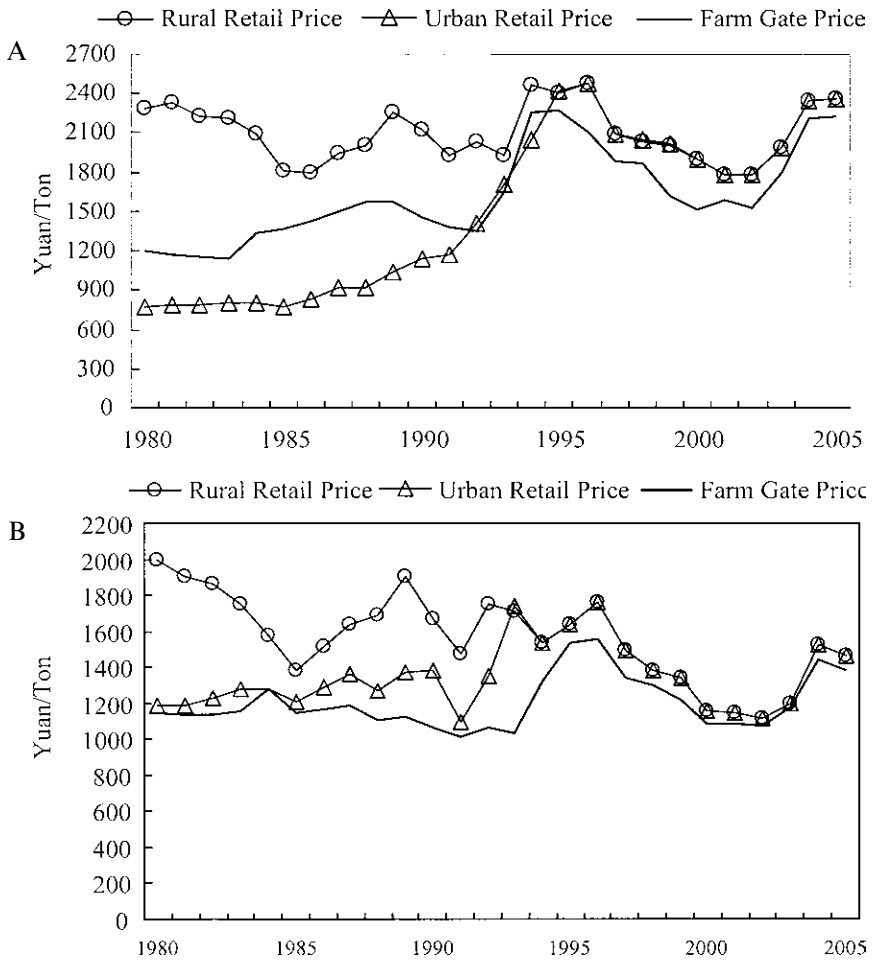


Fig. 10.1 Rural retail price (free market price), urban retail price, and farm-gate sales price in China, 1980–2005 (real 2005 yuan): *A*, Rice; *B*, Wheat

Source: NDRC (2005).

10.2.2 Nominal Rates of Assistance for China’s Main Agricultural Commodities

In this section, we focus on the distortions faced by farmers in China between 1981 and 2005. To do so, we examine plots of NRAs and $NRA_{j,s}$ over time for an illustrative subsample of our eleven commodities. A more comprehensive analysis is contained in Huang, Rozelle, et al. (2009).

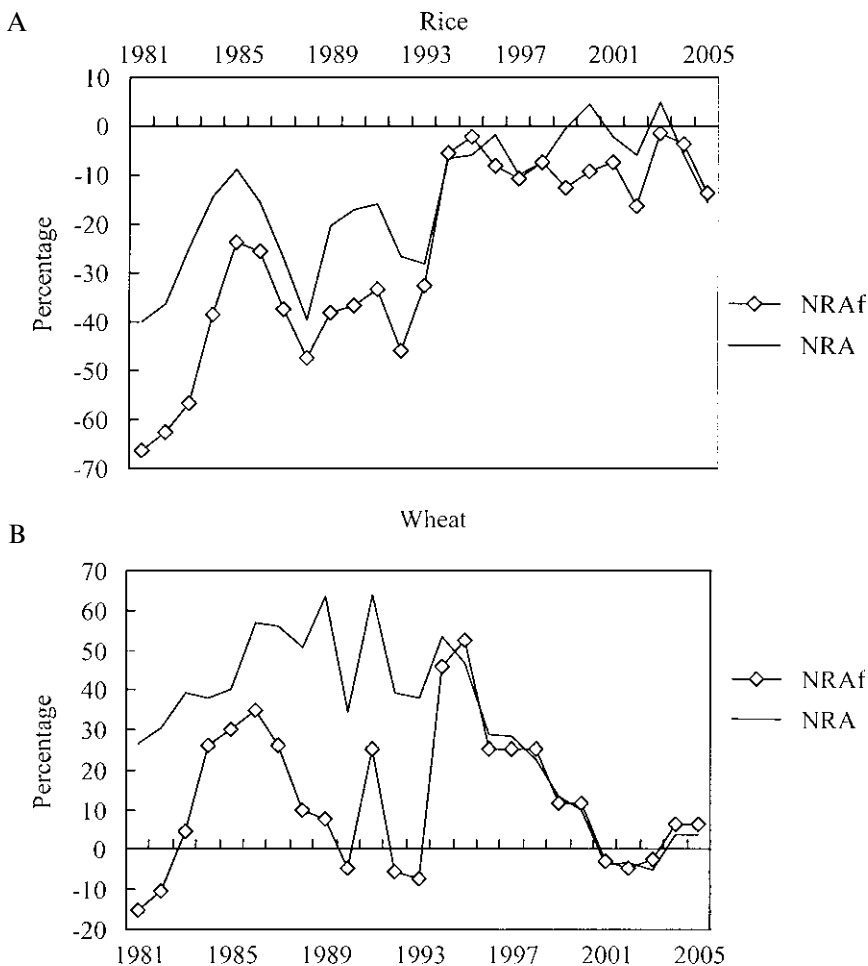


Fig. 10.2 Nominal rates of assistance (NRAs) and nominal rates of assistance for farmers (NRAs) for rice and wheat in China, 1981–2005: *A*, Rice; *B*, Wheat

Source: Huang et al. (2007).

Distortions to the Grain Economy before 1995

The distortions to the rice economy of China in the 1980s and early 1990s are characterized by two important features (figure 10.2, panel A). 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 show that China was highly competitive in international rice markets during these years. Trade policy, and particularly the state trading monopoly, kept

exporters from shipping large quantities of rice onto world markets and kept market prices of rice in China's port cities below world 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 10.2, panel A). 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 NRA_f s. Because of this, the total tax on rice ranged from -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.

Unlike rice, the NRA measures show that trade policy offered high rates of protection for wheat in China between 1981 and the mid-1990s (figure 10.2, panel B). In most years after 1980, the free market price of wheat in China's port cities was about 60 percent above international prices (cost, insurance, and freight [cif], China's port cities). Unlike rice farmers, wheat producers—who have been shown to produce at a higher cost than producers in many other countries (Huang and Ma 2000)—benefited from high market prices for their marginal output. By keeping out imports and keeping domestic prices high, trade policy appears to have been focused on food self-sufficiency, rather than on providing inexpensive food to urban consumers.

The differences between rice and wheat illustrate that trade liberalization in China should not have been expected to hurt everyone and emphasize the importance of looking at distortions on a commodity by commodity basis. Trade liberalization clearly had the potential to help rice producers, in particular. By contrast, the removal of the high protection rates for wheat observed in the 1980s and early 1990s would have had the potential to hurt wheat producers. Our analysis of why trade policy reform has been accompanied by rural income rises seems most relevant for the case of crops, such as wheat, that were receiving positive protection in the 1980s and 1990s.

Domestic marketing policies, however, were working in the opposite direction. The trends in NRA_f s show how the forced deliveries under wheat quotas largely insulated farmers from much of the benefit of protection (figure 10.2, panel B). Although there was still positive protection for wheat in most years between 1980 and 1995, the average rates were lower (all below 50 percent except for in 1994 and 1995) and were zero and even slightly negative in five of the sixteen years (1981, 1982, 1990, 1992, and 1993). These figures suggest that policy for wheat was trying to increase production through the higher market prices, but to transfer income from producers to consumers through the inframarginal transfers captured in the NRA_f . Huang et al. (2007) show that the story for maize is similar to that of wheat.

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 10.2, right-hand sides of panels A and B). That China's reformers were able to eliminate the procurement policies that had been taxing rice and wheat (and maize) farmers is apparent from the way the differences between NRAs and NRAs narrow and disappear. In other work, Huang, Rozelle, and Chang (2004) show that elimination of the procurement quota system contributed significantly to a reduction in the tax burden on farmers. In part, then, procurement policy reform itself was important in increasing rural incomes to farmers during the 1990s.

The liberalization of domestic policies in the mid-1990s was accompanied by liberalization of trade policy, at least in the case of China's major food grains. After 1995, the taxation and subsidization of rice and wheat were 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 these crops was eliminated. Since 2001, the NRAs for both rice and wheat have been almost zero.

Edible Oils, Milk and Sugar

Outside the grain economy, marketing and trade reform, as in the case of wheat, removed positive protection from a number of key commodities. The biggest difference between the analysis of distortions for grain crops and cash crops (in our case, for soybeans) is that domestic marketing policy has historically played less of a role for cash crops. Although some counties had procurement delivery quotas for soybean producers, this was not as widespread as for grain, and the implicit taxes on soybeans in counties with quotas were generally lower than for staple grains. There was, as a consequence, little difference between the graphs for NRAs and NRAs. The same applies for the remaining commodities (livestock, horticulture, and milk and sugar) because there was no state-mandated procurement for these commodities. As a result, the discussion in the rest of this section focuses on trade policy.

Before 1995, our analysis shows that soybeans fluctuated between being taxed and protected (figure 10.3). Although the average level of protection was roughly zero, it varied from -20 percent up to 30 percent. A paper by Rozelle and Huang (2004) shows that much of this fluctuation was due to domestic policy cycles that switched between encouraging and discouraging production while allowing little trade.

The trends in NRAs after 1995 show the strong commitment to trade liberalization for soybeans (figure 10.3, right-hand side of the graph). Begin-

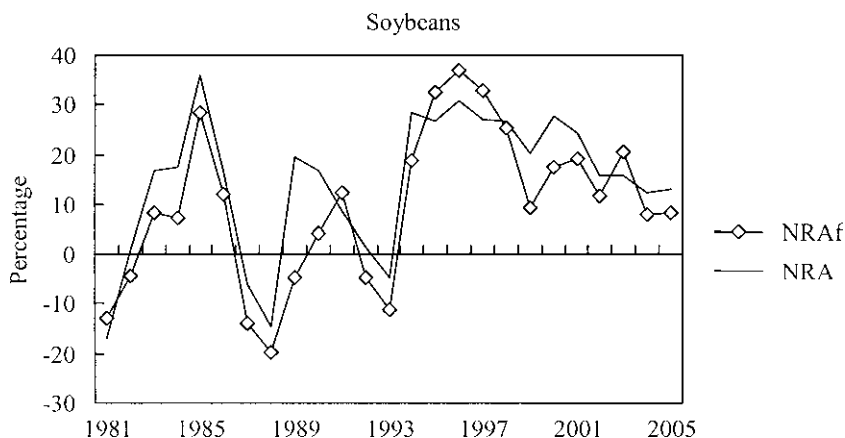


Fig. 10.3 Nominal rates of assistance (NRAs) and nominal rates of assistance for farmers (NRAs) for soybean in China, 1981–2005

Source: Huang et al. (2007).

ning in the late 1990s and continuing through 2005, 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 after 1995 parallels that of wheat. In fact, because of the high level of imports, the case of soybean producers often raised in discussions about the adverse effects of trade policies on farmers (see Rozelle and Huang [2004] for a complete description). In fact, Rozelle and Huang (2004) empirically show using CAPSiM (an agricultural simulation model developed by the authors) that soybean prices and the incomes of soybean producers would have been higher in the absence of trade reform. Therefore, in the case of soybeans, the government carried through with its commitment to trade reform.

Protection of milk and sugar began earlier and remained higher than for soybeans. During the 1980s, the NRAs for milk and sugar were large and positive (figure 10.4, panels A and B), with milk ranging between 50 and over 200 percent between 1980 and 1987, and sugar above 40 percent through the late 1990s. The NRAs for milk fell dramatically in the late 1980s and subsequently fluctuated between zero and 50 percent. Protection for sugar also fell in the late 1980s, but subsequently rose, with the average NRA fluctuating around 40 percent.

Livestock and Horticultural Commodities

The case of livestock (figure 10.5 for pork) and horticulture (not shown here—see Huang et al. 2007) show that trade liberalization directly helped

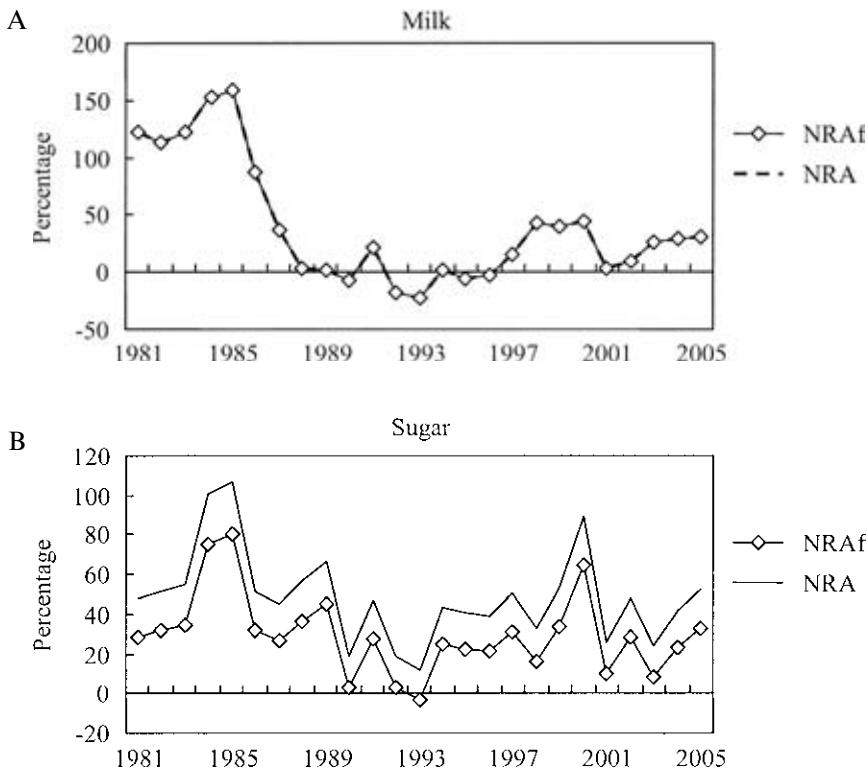


Fig. 10.4 Nominal rates of assistance (NRAs) and nominal rates of assistance for farmers (NRAs) for industrial processed goods (milk and sugar production) in China, 1981–2005: *A*, Protection measures for milk; *B*, Protection measures for sugar

Source: Huang et al. (2007).

raise farm incomes in certain regions and sectors. During the early reform era there was heavy implicit taxation of livestock and horticultural commodities. Although China can competitively produce labor-intensive livestock and horticultural products, producers were not encouraged to produce or export these commodities on a large scale. Part of the resistance to exports was from China's own barriers, such as quotas on exports to Hong Kong. Another part of the price gap shown in these figures reflects trade barriers facing China in export markets. While there quite possibly were grounds for some of these barriers (for example, foot and mouth disease is widespread in China), even blatantly false claims could not be contested because China was not a WTO member. As a consequence, China's livestock and horticultural producers produced commodities far below the world market price yet were unable to increase exports into global markets.

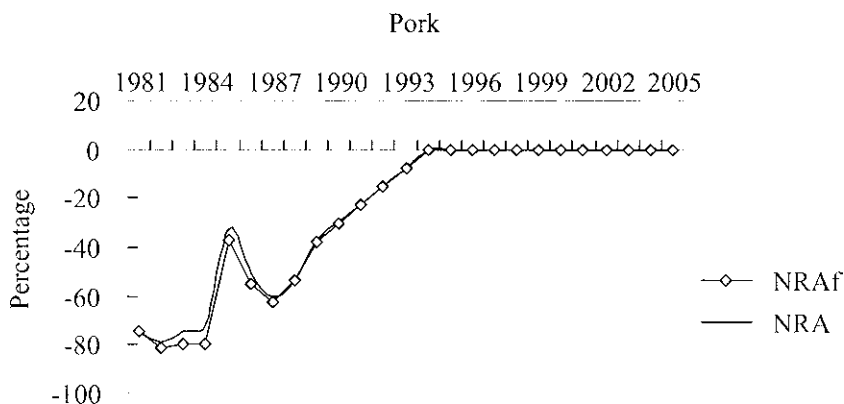


Fig. 10.5 Nominal rates of assistance (NRAs) and nominal rates of assistance for farmers (NRAs_f) for pork in China, 1981–2005

Source: Huang et al. (2007).

Notes: These measures are calculated in the same way as NRAs and NRAs_f reported for other commodities. However, the true NRAs for these commodities become zero after 1994 because China has no policies holding their prices below world levels.

Aggregate Impacts

We separated the commodities in our study into importable and exportable groups and used production weights at undistorted prices to aggregate them. Assuming that our study commodities largely reflect the distortions to all commodities, there is a striking pattern (figure 10.6, left-hand side of figure) that reinforces the positive relationship between trade liberalization and rural incomes. In the 1980s and through the mid-1990s, importables (such as wheat, soybeans, milk and sugar) were protected. On average, their protection rates were between 15 and 35 percent. The same was true for exportables, except the distortions show that commodities such as rice, livestock commodities, and horticultural commodities were taxed at rates ranged from 40 to 50 percent. With exportable agricultural products accounting for a larger share of output than importables, China's average agricultural distortions were negative. 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 evident from the right-hand side of figure 10.6. After 1995, the NRAs of importables fell from around 20 percent to less than 10 percent. During this period, the NRAs of exportables rose, or the implicit taxes on them fell, from about 40 percent to around 15 percent. When taken together, the distortions in China's agriculture fell to less than 10 percent. In many years, overall protection was between 0 and –5 percent. The combination of domestic marketing reforms and international

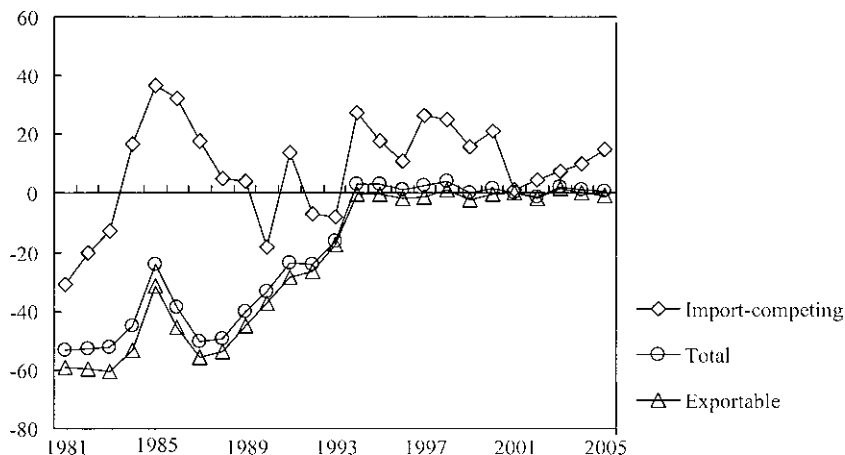


Fig. 10.6 Rates of assistance (including subsidy/taxes on inputs) for farmers that produce importable commodities, exportable commodities and for all of agriculture (11 commodities) in China, 1981–2005

Source: Authors' spreadsheet using methodology from Anderson et al. (2008) and Huang et al. (2007).

trade liberalization has created an economy that is one of the least distorted in the world. It also helped China enjoy rising incomes (in the aggregate) at the same time that it was reforming trade policies. One key to this was the removal of agricultural taxation. Another was allowing farmers to produce the goods that would generate the greatest benefit at international prices.

When considering the impact of trade reform on the agricultural sector, it is not sufficient to consider only the instruments directly affecting the sector. The pathbreaking study of distortions to agricultural incentives in developing countries (Krueger, Schiff, and Valdés 1991) showed that the indirect taxation of agriculture resulting from protection to other sectors was generally more important than direct agricultural distortions.

In the case of China, this question requires particular attention because there have been enormous reductions in nonagricultural barriers, including tariffs, exchange rate overvaluation, quotas, and licensing. We have combined estimates of these distortions into a composite measure of nonagricultural distortions depicted as an NRA for nonagricultural tradeables in figure 10.7. In a simplified two-sector model, what matters is the relative rate of assistance (RRA) also shown in this figure. This figure shows that the agricultural sector benefited from a rapid reduction in both direct and indirect taxation between the early 1980s and 1995. In the period since 1995, the RRA has become positive and continued to rise, albeit at a much slower rate than in the 1981 to 1995 period. The reduction in taxation of the agri-

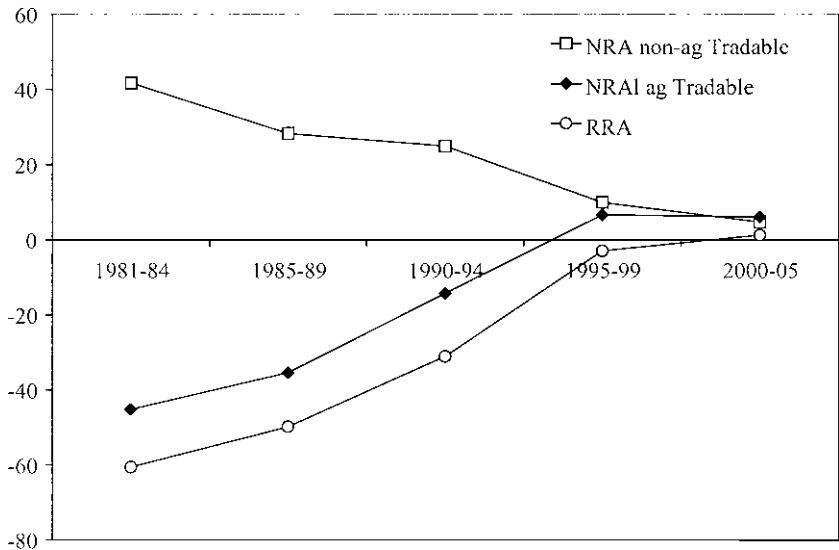


Fig. 10.7 Agricultural and nonagricultural protection and the relative rate of assistance to agriculture

Source: Huang et al. (2007).

cultural sector evident in this diagram is consistent with the improvement in the terms of trade for agriculture relative to nonagriculture within China observed by Zhu and Hong (2007) using data on relative prices for agricultural and nonagricultural goods.

Distinguishing the Impacts of WTO Accession

One final issue that needs to be recognized when considering the impacts of reforms associated with WTO accession is the nature of commitments in the WTO. China's main WTO accession commitments on agriculture were commitments that tariffs would not rise above the bound levels agreed in China's WTO accession schedule. These commitments were negotiated through an intensive process that took into account the market access interests of existing members and the previously prevailing applied tariff rates. Given the nature of China's trade regime, however, the relationship between these tariff rates and China's actual protection was weak. For many products, the relationship between domestic and world prices was determined more by state trading, quotas and licenses than by tariffs.

Table 10.1 shows the relationship estimated by Ianchovichina and Martin (2004) between applied protection prior to accession, the applied tariff, and the bound tariff associated with WTO accession. From table 10.1, it is clear that the applied tariffs for many commodities were strikingly above

Table 10.1 Actual protection, applied tariffs, and out-of-quota tariff bindings (%)

	Actual protection 1995	Applied tariff	Out-of-quota tariff bindings
Rice	-5	114	65
Wheat	25	114	65
Corn	20	114	65
Soybean	30	22	3
Sugar	44	114	50
Cotton	20	30	40

the protection actually provided. For rice, the applied tariff of 114 percent was quite irrelevant, with the actual protection applied being negative. Similarly, the applied rates of protection on wheat and maize were far below the applied rates of 114 percent. For only a few commodities, such as soybeans, did the bound rate agreed at the WTO require reductions in the protection previously applied. This distinction between reductions in applied rates and reductions in actual agricultural protection is extremely important. Much of the concern about potential adverse impacts of WTO commitments expressed either in prospect by authors such as Schmidhuber (2001) or Carter and Estrin (2001) or retrospectively by authors such as Ni (2007) is based on the reductions in tariff rates required by WTO accession.

10.3 Policies to Support Market and Trade Liberalization

Our analysis that documents reductions in the distortions to China's agriculture helps us meet our first objective. China's policymakers have successfully carried out their promises to liberalize markets and trade. In some sense, the analysis also helps explain the second puzzle. Because of the rising share of livestock and horticulture in China's agricultural economy, and because trade liberalization actually eliminated negative protection in these sectors, the average level of protection (combining the net effects of commodities that were having their positive protection removed and the commodities that were being less taxed) moved toward zero. In this way, trade policy was helping to increase farm incomes. In the period since 1995, liberalization elsewhere in the economy reduced the taxation of the agricultural sector leading to the rise in the relative rate of assistance noted in figure 10.7. In this way, trade policy changes can contribute, in part, to the explanation of how rural China avoided declining during trade liberalizations.

However, the story needs more explanation. In part, the additional explanation is needed because rural incomes not only rose on average, but rose *in all provinces* (table 10.2). The rise in income occurred in all provinces, including those in northern, northeastern, and northwestern China. In

Table 10.2 Real per capita net income of rural households, by province in China, 2000–2005 (in real 2005 yuan)

	2000	2005	Growth in 2005 over 2000 (%)	Annual growth rate (%)
Beijing	4,790	7,346	53.36	8.93
Tianjin	3,830	5,580	45.68	7.82
Hebei	2,711	3,482	28.41	5.13
Shanxi	2,127	2,891	35.90	6.33
Inner Mongolia	2,318	2,989	28.97	5.22
Liaoning	2,671	3,690	38.18	6.68
Jilin	2,215	3,264	47.37	8.06
Heilongjiang	2,339	3,221	37.75	6.61
Shanghai	5,809	8,248	41.97	7.26
Jiangsu	3,960	5,276	33.25	5.91
Zhejiang	4,603	6,660	44.70	7.67
Anhui	2,095	2,641	26.08	4.74
Fujian	3,467	4,450	28.36	5.12
Jiangxi	2,255	3,129	38.77	6.77
Shandong	2,960	3,931	32.80	5.84
Henan	2,195	2,871	30.80	5.52
Hubei	2,526	3,099	22.68	4.17
Hunan	2,452	3,118	27.17	4.92
Guangdong	3,838	4,690	22.22	4.10
Guangxi	1,991	2,495	25.32	4.62
Hainan	2,346	3,004	28.06	5.07
Chongqing	2,015	2,809	39.39	6.87
Sichuan	2,109	2,803	32.90	5.85
Guizhou	1,513	1,877	24.02	4.40
Yunnan	1,615	2,042	26.40	4.80
Tibet	1,414	2,078	46.99	8.01
Shanxi	1,620	2,053	26.68	4.84
Gansu	1,656	1,980	19.53	3.63
Qinghai	1,729	2,151	24.40	4.46
Ningxia	1,891	2,509	32.64	5.81
Xinjiang	1,796	2,482	38.24	6.69
National average	2,462	3,255	32.21	5.74

Source: NBSC, Statistical Yearbook of China, 2001–2006.

Note: Values are in real 2005 yuan using rural consumer price index by province.

these regions of China, farmers produce many crops (wheat, maize, soybeans, and cotton) that were still receiving positive protection during the late 1990s and early 2000s. With this set of crops accounting for a large share of the crop area in northern, northeastern, and northwestern China, there remains a puzzle to explain. Why did incomes rise in those areas even though we know that incomes of some producers would have suffered from trade liberalization-induced cuts in protection. Part of the explanation is presumably the reduction in the cost structure resulting from rapid liberalization in the rest of the economy. In the rest of this section, we discuss several key

policy reforms that we believe contributed to rural incomes rising even while agricultural protection fell.

10.3.1 Development and Dissemination of Agricultural Technology

The importance of agricultural research and extension in increasing agricultural productivity in developing countries is now widely recognized. Successful development has been shown to be tied closely to productivity growth in the agricultural sector (World Bank 2008). In a country like China, where agriculture is dominated by small, poor farms, it is even more important.

During the reform era, it was not always clear whether China would be able to maintain the pace of technological advance needed to maintain farm incomes in a dynamic economy. While decollectivization played the key role in boosting productivity (Lin 1992) in the early stages of reform, this provided only a one-off boost to productivity. After 1985, the evidence suggests that technological advance has been the main engine of productivity growth (Huang and Rozelle 1996). China was one of the first countries to develop and extend Green Revolution technology in the 1960s, 1970s, and 1980s. Hybrid rice was developed by China's scientists in the late 1970s and, until the mid-1990s, it was the only country in the world to have commercialized this new technology.

Despite these and other successes, China's system of agricultural research faced great challenges by the late 1980s (Pray, Rozelle, and Huang 1997). Research investment, almost totally publicly funded, was declining. Incentives were poor, and funding was being allocated in ways that did not always reward excellence. The system was not responding to many demands for new technologies and the extension system was in shambles.

A nationwide reform in research was launched in the mid-1980s (Pray, Rozelle, and Huang 1997). The reforms attempted to increase research productivity by shifting funding from institutional support to competitive grants, supporting research useful for economic development, and encouraging applied research institutes to support themselves by selling the technology they produced. In addition, in the late 1980s and early 1990s, new horticultural seeds, improved breeding livestock (Rae et al. 2006), and new technologies for dairy were all imported (Ma et al. 2006).

After declining between the early 1980s and the mid-1990s (Pray, Rozelle, and Huang 1997), investment in research and development (R&D) also began to rise. Funding was greatly increased for plant biotechnology, although only Bt cotton has been commercialized in a major way to date (Huang et al. 2002). China now ranks among the global leaders in agricultural biotechnology. In the late 1990s, China invested more in agricultural biotechnology research than all other developing countries combined. Its public spending on agricultural biotechnology was second only to the United States and, according to some projections, it will soon outspend the U.S. government on plant biotechnology research. Investment in government-sponsored R&D

Table 10.3 Annual growth rate of yield and total cost of main grain crop in China, 1985–2004 (%)

Crop	1985–1994		1995–2004	
	Output (1)	Input (2)	Output (3)	Input (4)
Early indica	0.05	1.72	0.08	–2.31
Late indica	1.37	2.12	0.80	–1.16
Japonica	1.79	3.99	0.17	–1.99
Wheat	2.84	2.58	1.38	–0.22
Maize	3.66	1.87	1.04	–0.63
Soybean	0.71	2.24	1.06	–1.36

Source: Jin et al. 2007.

increased by 5.5 percent annually between 1995 and 2000 and by over 15 percent per year after 2000 (Hu et al. 2007). During the past decade, the increase in investment in rural research and development has been the most rapid of any large nation.

The investment in R&D has been paying off. During China's early reform period, the yields of major food crops rose steadily (table 10.3, column [1]). Although some of that yield increase came from greater efficiency in input use, technological improvements appear to have accounted for some of this growth because indexes of aggregated inputs (that is, measures of land, labor, and material inputs) for rice, wheat, and maize actually fell for all the crops during the early 1980s (column [2]).

Although there was concern about the effect of the slowdown in R&D spending during the 1980s and early 1990s, the analysis shows that the growth of output continued to outpace that for inputs (table 10.2, columns [3] and [4]). And, productivity trends continued to rise (table 10.4, column [2]). During this time—and during the early reform period—China's total factor productivity (TFP) has been rising at the healthy rate of about 2 percent per year. Such rises, which occurred in all provinces and with all crops, could not have helped but increase incomes—of all farmers—regardless of whether the crop was being protected or taxed.

10.3.2 Policies to Encourage Market Integration and Efficiency

Price and marketing reforms have been key components of China's transition strategy from a centrally planned to a market-oriented economy. These policies were implemented in a gradual way (Sicular 1995). In the initial years, there was little effort to move the economy to one in which most all resources and factors were allocated according market price signals. Over time, the government's position on market reform has gradually evolved. As officials in charge of the overall economic reforms began to be committed to use markets as the primary means to allocate resources for the economy,

Table 10.4 Annual growth rate of main grain crop's total factor productivity (TFP) and decomposition into technical efficiency (TE) and technical change (TC) in China, 1985–2004 (%)

Crop	1985–1994			1995–2004		
	TFP (1)	TE (2)	TC (3)	TFP (4)	TE (5)	TC (6)
Early indica	1.84	-0.03	1.88	2.82	0	2.82
Late indica	1.85	0.26	1.59	2.92	0.21	2.71
Japonica	-0.12	-0.37	0.26	2.52	0.15	2.37
Wheat	0.25	1.08	-0.83	2.16	1.06	1.10
Maize	1.03	0.61	0.42	1.70	-0.23	1.94
Soybean	0.11	0.19	-0.09	2.27	-0.08	2.35

Source: Jin et al. 2007.

the commitment to allowing markets in agriculture also deepened (Sicular 1995).

As markets began to emerge, China's leaders took steps to encourage the efficiency of markets and, perhaps more important, stepped aside and allowed them to expand in an environment with minimal distortions. Above all, national and regional governments invested in the hardware—roads, landline telephones, and cellular technology—that reduced transaction costs and accelerated the flow of information and goods (Park et al. 2002). Many regional and local governments invested in marketing sites and tried to attract commercial interests to set up businesses. Finally, except for a short period in the late 1990s, government officials have stepped back and allowed the entry of private traders and private transport and have done little to interfere with markets. Licensing fees and taxes are low or nonexistent. Markets were encouraged for both agricultural outputs and inputs.

In assessing the health of the rural economy, it is important to understand how China's markets are functioning. 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. With better markets, producers can begin to specialize, become more efficient, and increase their incomes.

According to price data from private reporting stations and information firms, it appears that China's markets function relatively well. For example, maize prices in for different cities in Northeast China track each other closely (Rozelle and Huang 2003). Soybean prices in markets in different regions of the country move almost in perfect concert with one another (Rozelle and Huang 2004). Rice markets also have been shown to function as well as or better than those in the United States in terms of the efficiency of moving commodities around and between China's producing and con-

suming regions (Huang, Rozelle, and Chang 2004). Horticultural, dairy, and livestock markets are all dominated by millions of small traders who are operating in extremely competitive environments (Wang et al. 2007; Wu, Huang, and Rozelle 2007; Bi, Huang, and Rozelle 2007).

The improvement in markets has allowed individual producers to specialize as never before. According to one national survey, the number of villages that have become specialized producers of a single commodity rose from less than 20 percent in 1995 to nearly 40 percent in 2004 (Rosen, Huang, and Rozelle 2004). Such integration has allowed relatively small and poor farmers to participate in emerging markets and to accrue the substantial income gains associated with moving from subsistence to a market orientation (Wang et al. 2007; Bi, Huang, and Rozelle 2007; Balat and Porto 2006). In fact, in a recent survey of the greater metropolitan Beijing area, it was found that poor farmers living in poor villages were the main beneficiaries of new demands for horticultural commodities.

Most important, according to de Brauw, Huang, and Rozelle (2004), when markets in China have begun to become more competitive and efficient, they have led to rising productivity and efficiency. The link between improved markets and rising incomes is important because it is consistent with our puzzle. Even where market and trade liberalization has reduced protection and necessarily adversely affected income, the rising productivity and efficiency effects have at least partly offset these negative impacts. This interpretation is supported by the modeling work in Huang et al. (2005), which finds when trade policy positively affects some prices (e.g., horticultural crops) but negatively affects others (e.g., wheat), farmers mitigate the downside effects by transferring production into the commodities with rising prices.

10.3.3 Public Investment, Services, and Subsidies

Any visitor to most parts of rural China is struck by one thing: agriculture is still being carried out in many environments that can only be described as backward. Except in a few suburban and coastal regions, the infrastructure in rural China is extremely poor. Roads and bridges, irrigation and drainage, drinking water, schools, and health facilities are far from modern and decades behind the infrastructure in China's cities. Yet development economists know that for a country to modernize, its infrastructure has to be able to support the production and marketing activities of a complex economy.

Although the stock of infrastructure is poor, there have been improvements in recent years. Research has shown that, on average, each village in China had about one infrastructure project during the late 1990s (Luo et al. 2007). This is far higher than in most other developing nations in Asia. In recent years, the level of investment activity has risen sharply (to almost one project per year). Most of these projects are public goods (and not activities, such as orchards, in which governments frequently invested during the 1980s). In addition, research suggests that this investment is being targeted

fairly well, with increasing amounts going to poor, minority, and remote parts of China.

Although the level of public goods investment per capita has risen from about 40 to 100 U.S. dollars (in purchasing power parity [PPP] terms), it is still far below the levels that were enjoyed by rural residents in Japan during the 1950s and South Korea during the 1970s (Luo et al. 2007). Quality, while rising, is still low in many villages (Liu et al. 2009). China is just beginning the process of narrowing the gap between rural and urban infrastructure, and it will take an enormous and sustained effort to transform the rural economy.

10.3.4 Education and Health Programs

Rural services—in particular education and health—are perhaps the weakest part of the rural economy, despite the recognition by development economists of their importance. Rural education by any metric is abysmal. Fees—until recently—were high, even for elementary school. Buildings and equipment are outdated and poor. Teaching quality is poor. Because of poor education, there is evidence that even as the nation accelerates its drive toward industrialization and urbanization—and agriculture is becoming more complex and demanding—retention rates for farm children remain very low beyond the compulsory nine years of schooling. Partly because tuition and associated fees are so high—an estimated one-quarter of total expenditure for many poor households—participation rates in high school (grades 10–12) are less than 15 percent for the rural population. A national survey found that nearly half of rural residents believe education has not improved in recent years (Liu et al. 2007).

There has been a new surge of interest by the government in improving rural education and reducing the cost of education—especially in poor, rural areas. In 2005, fees for elementary schools were eliminated in poor areas. In 2006, this was expanded to the entire rural economy. By 2007, all compulsory education (grades 1–9) was supposed to be free. The income effects of such policies are potentially enormous. Huang, Rozelle, and Chang (2004) show that the elimination of government tuition fees provided a benefit more than twice as large as the losses resulting from tariff reductions for China's protected crops.

The national and regional governments have also begun to build a rural health care program. In its initial years, while funding was scarce, it is in high demand. By 2007, the government was investing up to thirty yuan per capita into the program.

10.3.5 Farm Subsidies and Taxes

The government launched a massive program of direct subsidies in 2004, and this program is projected to expand further in the coming years. Designed in part to boost production of grain (for national food self-sufficiency) and

in part as a rural income transfer, the national Grain Subsidy and the national new technology program have in a very short time become fixtures in the rural economy. Nearly 80 percent of farm households receive subsidies. Participation in the program is as high in poor areas as it is in higher-income areas (Tan et al. 2006). Although they were relatively small in the first year of the program, by the second year, between the two programs, many farmers were receiving about ten to fifteen yuan per mu, which is more than seventy yuan per acre.

While farmers were obviously predisposed to favoring the program (who does not like direct subsidies?), there are several issues that China must weigh in considering the long-term benefit and sustainability of the program. First is whether payments under the Grain Subsidies should be counted toward the nation's aggregate measure of support (AMS) at the WTO. In its accession to WTO, China agreed to keep its distorting payments in agriculture below 8.5 percent of agricultural GDP. Obviously, if these payments were counted against the AMS, China could rapidly approach its maximum level of payments. But there is a question about whether these payments are "distorting or not." In 2004, a survey by the Research Center for the Rural Economy (RCRE) found that more than 70 percent of the payments were decoupled, with farmers receiving the payment whether they planted grain or any other crop. If this were the case, then such payments arguably could be counted as pure, unlinked transfers and not be counted. However, during the second year of the program, there was more of an effort to target households that produced grain. If the payment is linked to the type of crop planted, it is likely to be classified as a distorting subsidy with careful accounting needed to ensure it does not violate the restriction on distorting subsidies under China's WTO commitments.

In addition to subsidies, the national government has eliminated almost all taxes and fees in rural villages. In 2001 and 2002, all fees were converted to a single agricultural tax that was not to exceed 8.5 percent of a household's (village's) gross value of agricultural output. However, no sooner had this been implemented than the tax was eliminated altogether. By 2007, surveys showed that farmers were paying almost no taxes.

When added together, the recent policy innovations in rural infrastructure, free rural school tuition, grain and other agricultural subsidies, tax reductions, and health insurance subsidies are substantial. These government programs have likely injected enough funds to contribute importantly to the observed improvements in household incomes in rural areas.

10.3.6 Improving Mobility of Labor out of Agriculture

China began the period under study with around half of its workforce in agriculture and will reduce this fraction to just a few percent by the time she reaches high income status. The rate of migration out of agriculture

consistent with China's growth path is one of the most rapid ever observed. In almost all rapidly growing economies, the resistance to this adjustment, particularly due to sector- and region-specific investments in human capital, is frequently seen as the source of a "farm problem" in which farm incomes fall below incomes in the rest of the economy.

The usual resistances to labor out-migration are compounded by a number of China-specific factors. One is the *hukou* residence permit system, which has restricted mobility of labor into urban areas (see Sicular and Zhao 2004). Another is the land tenure system, where households leaving the agricultural sector completely must relinquish their land without compensation (Zhao 1999). Other China-specific resistances have come from factors such as the low quality of educational opportunities in rural areas discussed in the preceding. Unless these structural rigidities to mobility of labor out of agriculture are reduced, the effectiveness of other reforms, such as tax cuts or price supports, is likely to be diminished greatly, as excess labor remains bottled up in agriculture, earning low returns. Where out-migration is feasible, de Brauw and Giles (2008) show that it increases the living standards of the family members remaining, and tends to increase their land holdings, although not necessarily their investment in other assets.

During the period we consider, the *hukou* system has been relaxed considerably, to the point where it is regarded by some, but not all, labor economists as a relatively minor source of resistance to overall labor mobility out of agriculture. Relatively little appears, so far, to have been done to change the land tenure system to reduce this barrier to mobility. The improvements in rural education discussed in the preceding seem likely to play a key role in enhancing mobility, both by increasing returns from work outside agriculture and by lowering the costs of adjusting (Fan, Hertel, and Wang 2004).

10.4 Conclusions and Implications

The main finding of this paper is that the nature of policy intervention in China's agriculture has changed dramatically over the past twenty-five years, transforming the agricultural sector from one characterized by high and variable distortions to one that is relatively liberal. In the 1980s and early 1990s (or the *early reform period*), there were distortions in both external and domestic policies that isolated domestic producers and consumers from international markets.

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. In the case of rice and other exportable commodities, heavy border distortions that reduced domestic prices were compounded by a domestic procurement system that depressed farm prices and the prices paid by urban consumers.

Similar dynamics characterized importable commodities such as wheat and soybeans where, despite fairly high rates of protection from trade policies, producer prices were relatively low.

In contrast, since the late 1980s and early 1990s (the *late reform period*), the liberalization of domestic markets has reduced the distortions from domestic policies (as the market gradually has replaced the state as the primary mechanism for allocating resources and has become the basis for farmers' production and marketing decisions). At the same time, especially in the case of importable commodities, trade policy has been 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 increased farm prices for many commodities. Reductions in protection to nonagricultural tradables—a major element of the WTO accession negotiations—also appear to have reduced the costs imposed on the agricultural sector.

The main question, once the trade liberalization is established, then, shifts gears, and the focus of our analysis begins to try to understand how it could be—when there are many places in China that have experienced large falls in protection to the agricultural tariffs that they produce—that rural incomes still rose almost nationwide. In trying to explain this puzzle, we examine three sources of income increases that might help offset the fall in income brought on by trade liberalization. We explored the role of agricultural technology, the rise of markets, and the emergence of new subsidy and support policies.

In our analysis, we find that at the same time that trade liberalization policy was reducing returns to some products that had been receiving positive protection, a number of other elements were working to offset these effects. One was the reductions in taxation of other important commodities, such as rice. At the same time, investments in R&D, the fostering of markets and the new investment, and subsidy programs appear to have generated wide-ranging, positive income effects in rural China.

The implications of these findings are that, although trade policies may have had negative effects on incomes in certain parts of the agricultural community, the magnitude of these adverse impacts appears to have been widely overstated. This is partly because the usual way of assessing the impact of WTO commitments—comparisons of bound tariffs with prior applied tariffs—widely overstates the extent of liberalization required in China. Another reason that these adverse impacts have frequently been overstated is that the agricultural sector as a whole was negatively protected at the beginning of the period, and most of this taxation has been eliminated. Another important source of gains was the reduction in protection to some

less-efficient import-competing sectors, which allowed farmers to increase the value of their output. There were also important dynamic benefits as new export activities emerged, and the cost to burden on agriculture of protection to nonagricultural sectors was reduced.

The reforms undertaken in China have included both trade policy reforms and complementary domestic reforms that have helped to create greater opportunities for rural people—a combination of policies widely seen as necessary if the greatest benefits are to be achieved. China's experience over the past quarter century appears to provide some important lessons both for the future and for policymakers grappling with similar challenges in other countries.

References

- Anderson, K., M. Kurzweil, W. Martin, D. Sandri, and E. Valenzuela. 2008. Measuring distortions to agricultural incentives, revisited. *World Trade Review* 7 (4): 675–704.
- Balat, J., and G. Porto. 2006. The WTO Doha Round, cotton sector dynamics, and poverty trends in Zambia. In *Poverty and the WTO: Impacts of the Doha Development Agenda*, ed. T. Hertel and L. A. Winters, 155–83. Basingstoke, UK: Palgrave Macmillan.
- Bhattasali, D., S. Li, and W. Martin, eds. 2004. *China and the WTO: Accession, policy reform and poverty reduction strategies*. Washington, DC: World Bank and Oxford University Press.
- Bi, X., J. Huang, and S. Rozelle. 2007. Modern supply chains, expansion of demand and the poor in China: The case of livestock. Working Paper, Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.
- Carter, C. A., and A. Estrin. 2001. China's trade integration and impacts on factor markets. University of California, Davis, Working Paper.
- Chen, S., and M. Ravallion. 2007. China's (uneven) progress against poverty. *Journal of Development Economics* 82:1–42.
- de Brauw, A., and J. Giles. 2008. Migrant labor markets and the welfare of rural households in the developing world: Evidence from China. World Bank. Mimeo-graph.
- de Brauw, A., J. Huang, and S. Rozelle. 2004. The sequencing of reforms in China's agricultural transition. *Economics of Transition* 12 (3): 427–66.
- Fan, Z., T. Hertel, and Z. Wang. 2004. Implications of WTO accession for poverty in rural China. In *China and the WTO: Accession, policy reform, and poverty reduction strategies*, ed. D. Bhattasali, S. Li, and W. Martin. Washington, DC: World Bank and Oxford University Press.
- Hu, R., K. Shi, Y. Cui, and J. Huang. 2007. Changes in China's agricultural research investment and its international comparison. *China's Soft Science* 194 (February): 53–58, 65.
- Huang, J., and C. Chen. 1999. *Effects of trade liberalization on agriculture in China: Commodity and local agricultural studies*. United Nations, ESCAP CGPRT Centre, Bogor, Indonesia.

- Huang, J., Y. Jun, Z. Xu, S. Rozelle, and N. Li. 2007. Agricultural trade liberalization and poverty in China. *China Economic Review* 18:244–65.
- Huang, J., Y. Liu, W. Martin, and S. Rozelle. 2009. Changes in trade and domestic distortions affecting China's agriculture. *Food Policy* 34:407–16
- Huang, J., and H. Ma. 2000. International comparison of agricultural prices. *International Trade* 10:20–24.
- Huang, J., and S. Rozelle. 1996. Technological change: Rediscovering the engine of productivity growth in China's agricultural economy. *Journal of Development Economics* 49:337–69.
- Huang, J., S. Rozelle, and M. Chang. 2004. The nature of distortions to agricultural incentives in China and implications of WTO accession. *World Bank Economic Review* 18 (1): 59–84.
- Huang, J., S. Rozelle, W. Martin, and Y. Liu. 2009. Distortions to agricultural incentives in China. In *Distortions to Agricultural Incentives in Asia*, ed. K. Anderson and W. Martin. Washington, DC: World Bank. See www.worldbank.org/agdistortions.
- Huang, J., S. Rozelle, C. Pray, and Q. Wang. 2002. Plant biotechnology in China. *Science* 295 (25): 674–77.
- Ianchovichina, E., and W. Martin. 2004. Economic impacts of China's accession to the World Trade Organization. *World Bank Economic Review* 18 (1): 3–28.
- Jin, S., H. Ma, J. Huang, R. Hu, and S. Rozelle. 2007. Productivity, efficiency and technical change: Measuring the performance of China's transforming agriculture. Paper presented at conference, Trends and Forces in International Agricultural Productivity Growth, Washington, DC.
- Krueger, A., M. Schiff, and A. Valdés. 1991. *The political economy of agricultural pricing policy*. Baltimore: Johns Hopkins Press.
- Lardy, N. 1983. *Agriculture in China's modern economic development*. Cambridge, UK: Cambridge University Press.
- Lardy, N. 2001. *Integrating China into the global economy*. Washington, DC: Brookings Institution.
- Li, S., F. Zhai, and Z. Wang. 1999. The global and domestic impact of China joining the World Trade Organization. Project Report, Development Research Center, the State Council, China. Beijing.
- Lin, J. 1992. Rural reforms and agricultural growth in China. *American Economic Review* 82:34–51.
- Liu, C., L. Zhang, R. Luo, and S. Rozelle. 2009. Infrastructure investment in rural China: Is quality being compromised during quantity expansion? *The China Journal* 61:105–29.
- Luo, R., L. Zhang, J. Huang, and S. Rozelle. 2007a. Investing in rural China: Tracking China's commitment to modernization. Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences, Working Paper.
- Ma, H., A. Rae, J. Huang, and S. Rozelle. 2006. Enhancing productivity on suburban dairy farms in China. Stanford University, Freeman Spogli Institute for International Studies, Working Paper.
- Martin, W., J. Huang, and S. Rozelle. 2006. Exchange rates and agricultural distortions in China's agriculture, 1981 to 2004. Working Paper. Washington, DC: World Bank.
- National Development and Reform Commission (NDRC). 1995–2005. *China's price yearbook*. Beijing: NDRC.
- National Statistical Bureau of China (NBSC). 1981–2006. *Statistical yearbook of China*. Beijing: China Statistics Press.
- . Various Years. *China yearbook of agricultural price survey*. Beijing: China Statistics Press.

- Ni, H. 2007. Why are special products and the special safeguard mechanism essential to China? *Bridges* 11 (3): 3–5.
- Park, A., H. Jin, S. Rozelle, and J. Huang. 2002. Market emergence and transition: Arbitrage, transition costs, and autarky in China's grain market. *American Journal of Agricultural Economics* 84 (1): 67–82.
- Pray, C. E., S. Rozelle, and J. Huang. 1997. Can China's agricultural research system feed China? Rutgers University, Department of Agricultural Economics, Working Paper.
- Rae, A. N., H. Ma, J. Huang, and S. Rozelle. 2006. Livestock in China: Commodity-specific total factor productivity decomposition using new panel data. *American Journal of Agricultural Economics* 88 (3): 680–95.
- Rosen, D., J. Huang, and S. Rozelle. 2004. *Roots of competitiveness: China's evolving agriculture interests*. Policy Analysis in International Economics, vol. 72. Washington, DC: Institute for International Economics.
- Rozelle, S., and J. Huang. 2003. China's maize economy: Supply, demand and trade. Report for the U.S. Grains Council. Beijing:
- . 2004. China's soybean economy: Supply, demand and trade. Report for the American Soybean Association. Beijing:
- Rozelle, S., A. Park, J. Huang, and H. Jin. 2000. Bureaucrat to entrepreneur: The changing role of the state in China's transitional commodity economy. *Economic Development and Cultural Change* 48 (2): 227–52.
- Schmidhuber, J. 2001. Changes in China's agricultural trade policy regime: Impacts on agricultural production, consumption, prices, and trade. In *China's agriculture in the international trading system*, 21–51. Paris: Organization for Economic Cooperation and Development.
- Sicular, T. 1988a. Agricultural planning and pricing in the post-Mao period. *China Quarterly* 116:671–703.
- . 1988b. Plan and market in China's agricultural commerce. *Journal of Political Economy* 96 (2): 283–307.
- . 1995. Redefining state, plan, and market: China's reforms in agricultural commerce. *China Quarterly* 144:1020–46.
- Sicular, T., Y. Ximing, B. Gustafsson, and S. Li. 2006. The urban-rural income gap and inequality in China. WIDER Research Paper no. 2006/135. Helsinki, Finland: World Institute for Development Economics Research.
- Sicular, T., and Y. Zhao. 2004. Earnings and labor mobility in rural China: Implications for China's accession to the WTO. In *China and the WTO: Accession, policy reform, and poverty reduction strategies*, ed. D. Bhatasali, S. Li, and W. Martin. Washington, DC: World Bank and Oxford University Press.
- Wang, H., X. Dong, J. Huang, T. Reardon, and S. Rozelle. 2007. Small traders and small farmers: The evolution of China's horticulture economy. Center for Chinese Agricultural Policy, Working Paper.
- Wu, Y., J. Huang, and S. Rozelle. 2007. Modern supply chains, expansion of demand and the poor in China: The case of livestock. Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences, Working Paper.
- Zhao, Y. 1999. Leaving the countryside: Rural-to-urban migration decisions in China. *American Economic Review* 89 (2): 281–86.
- Zhu, J., and W. Hong. 2007. Trade openness, domestic terms of trade, and welfare of agricultural producers in China. Paper presented to the summer symposium of the International Agricultural Trade Research Consortium, Beijing. <http://aede.osu.edu/programs/Anderson/trade/37JingZhu.pdf>.