

3. Productivity Growth¹⁴

Introduction

Grain output per head in China (with the exception of corn) has changed little over the last decade. The early gains from reform therefore appear to have been exhausted. But has China really reached a frontier which is limiting the growth of output, either in terms of technology or in terms of the organisation of production? This section reviews recent research into this question. The issue is of great interest to Chinese policymakers, who continue to be concerned about the relative importance of domestic compared to import sources of grain. It is of great interest to the rest of the world, which, given the size of the economy, might expect that events in China might have substantial effects on China's trade and therefore on world markets for grain.

The next part of this section of the report reviews the trends in grain output and notes some of the key shifts in direction. It highlights the developments of the 1990s. We then examine in more detail the context in which farmers are making their output choices, and report work on mechanisms by which events in the rest of the economy affect farm-level decision-making. A number of factors, some subject to change by government policy, which might have effects on trends in output are then discussed.

Trends in grain output

Figure 7 shows the trend in grain output per head in China since 1949. A rising trend in output per head was established in the mid-1960s, but output per head appeared to stagnate around the mid-1970s. The introduction of the reform process in the late 1970s marked a turning point. Grain output per head rose on a new trajectory and reached a peak in 1985. Thereafter, once again output per head appears to have stagnated.

The trends in output relative to population in China vary among types of grain. Figure 8 shows the trend in output per head of wheat over the same period. The growth in output per head accelerated in the reform period, but since 1985 the trend is flat. Rice output per head (Figure 9) shows a similar trend to wheat up to the mid-1980s, but since then rice output per head appears to have fallen, especially over the 1990s.

The exception to these patterns is provided by maize output per head (Figure 10) which in absolute terms has maintained the rate of increase established in the early 1970s. The trend in maize output per head appears to be immune both to the impact of the reform program and to the events driving the flat growth in the other crops since the mid-1980s.¹⁵

The next section provides more information on the context in which farmers are making output choices in China.

The economic context

Growth and structural change

Section 1 notes that the impacts of growth and internationalisation in the rest of the economy have a significant effect on agriculture, including the grain sector. They are powerful contributors to the trends in grain output. Section 1 therefore argues that there is a rising opportunity cost of agricultural output, especially in some regions of China. An agricultural system operating at frontier efficiency levels would still face rising costs of maintaining that level of output. The outcome is then likely to be greater reliance on the world market for grain supply.

¹⁵ These data may even also understate the rate of growth of maize output if that type of grain is being increasingly diverted to animal feed and not counted in the reported output. The likelihood that output is underreported is discussed later.

¹⁴This part was originally prepared as Findlay (1997).

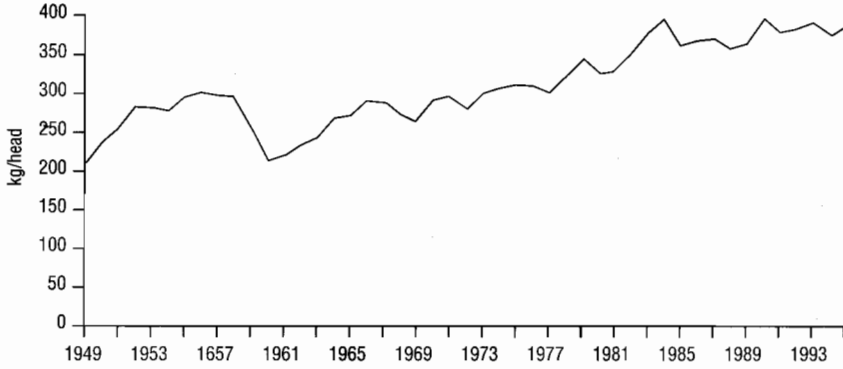


Figure 7. Total grain output per capita, 1949–95.

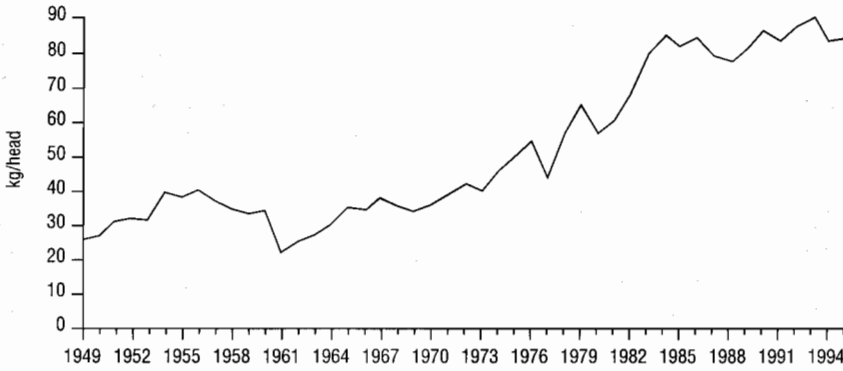


Figure 8. Wheat output per capita, 1949–95.

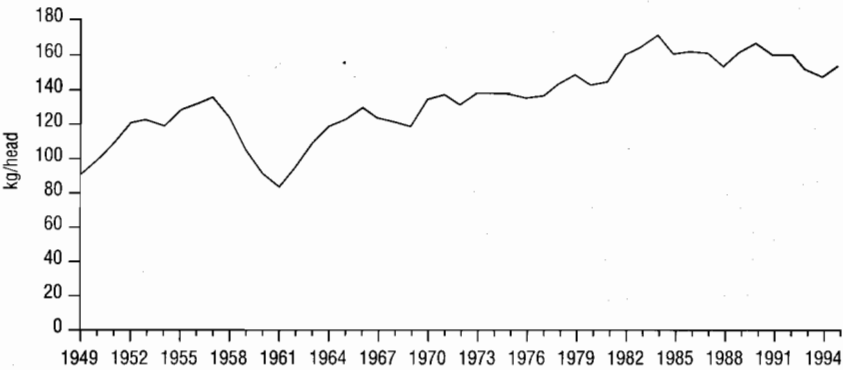


Figure 9. Rice output per capita, 1949–95.

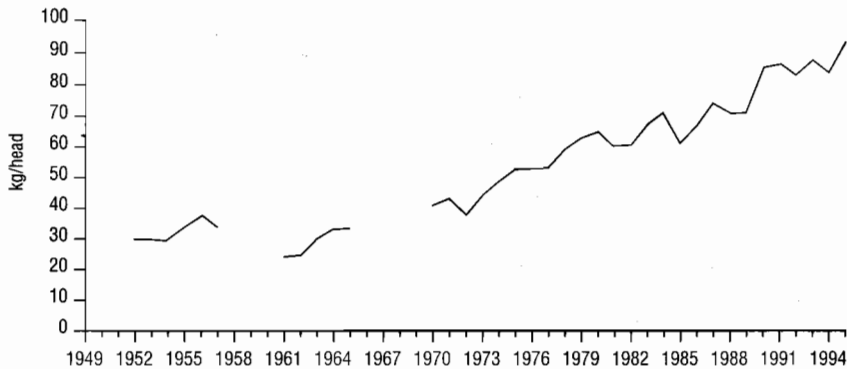


Figure 10. Maize output per capita, 1952–95.

However, there may be scope to increase output at relatively low cost when the agricultural sector, and grain production in particular, lies within the existing set of production possibilities. These circumstances are discussed below.

Impacts of labour mobility

Wu and Meng (1996a,b) note that the rapid creation of jobs in other sectors of the rural economy has led to a concern about the relocation of labour on the output of agricultural products, and of grain in particular. They use household survey data on grain specialist households¹⁶ to examine the effects of labour relocation on grain output.

Wu and Meng (1996a) first examine the contribution of labour to grain output. They find that the return to labour time is relatively low (a doubling of labour input in terms of time would raise grain output by 6%). But the actual labour input is a bundle of worker time combined with farm worker experience and worker education. When these factors are taken into account, the elasticity of grain output with respect to incremental labour input rises to 26%. Farm worker experience is twice as important as worker education in their model. The contribution of education to grain output growth, and to household income growth, is further discussed below.

Wu and Meng argue that an important effect of the relocation of labour is likely to be from the change in

¹⁶ These data were collected as a part of the project whose results we reported here. See Wu (1997) for details. Hereafter these data are referred to as the CERU–MoA household survey data.

the mix of the characteristics in the agricultural labour force in terms of its experience, education and sex. They simulate the effects of the relocation of labour by changing the composition of the agricultural workforce, holding everything else constant. They assume that in its absence of labour mobility the agricultural work force in the household would have the same characteristics as the whole household on average. Generally they find that, according to this method, in the short run the direct effects of the relocation of labour on grain output will not be significant. That result occurs in part because the more important contributors to grain output are experienced and older male workers. The labour that moves tends to be younger workers with more education.

Wu and Meng (1996a) note that the withdrawal of labour from agriculture will also lead in the long run, as the relative cost of labour rises, to the substitution of other inputs for labour, including capital and other purchased inputs. They also argue that current farm sizes in China limit the range of technological options and that larger farm and plot sizes will be required to facilitate the substitution of other inputs for labour. As that happens, they suggest, the education level of farm workers may become a more important determinant of grain output.

Investment

Grain production may also be affected not only by the substitution of purchased inputs for labour but also by the investment that follows the rise in household income which is associated with the relocation of

labour. Wu and Meng (1996b) find that the stock of capital in grain production (in grain specialist households) does rise faster than total household income, but only as all other factors are held constant. They find that as the share of non-agricultural income in total income rises, households tend to invest less in grain production, indicating the lack of profitability of grain production compared to the alternatives. This issue of the distortion of farmer incentives that are a consequence of government intervention in the marketing system is discussed in other work in this project (see e.g. Findlay and Watson, 1996a). Fan (1996a) reports that government investment in agriculture reached a peak in 1978, then nearly halved in real terms by 1987 and rose again in the first half of the 1990s. However, the value in real terms in 1994 was nearly a third lower than in 1987. Nor has the slower rate of farmer investment in agriculture been offset by public projects. The state had for some time been using the pricing system applying to grain in particular to transfer resources out of agriculture. Thus agriculture was not only under pressure from the structural change in the economy, but was also subject to deliberate taxation by the state (Findlay and Watson, 1996a). Fan (1996a) also stresses the fluctuations in investment, the decline in investment in research and development and, during the slump in investment after 1978, the rundown in the capacity of the irrigation and drainage systems.

Current issues in the agricultural research system are discussed in more detail below. Issues in other agricultural infrastructure sectors, such as irrigation, are topics for further work.

Land losses

Concern is often expressed about the loss of agricultural land in China. Various estimates are available of the extent to which land is being transferred to other sectors, which appears to be large in absolute terms. However, the rate at which land is being transferred to other uses appears to be relatively low. Dong (1996) reports data which suggest that between 1958 and 1993, arable land area fell by 12%. Dong's data even suggest that the rate at which arable area is falling has been less since 1978 (0.31% a year) compared to the pre-reform period (0.36% a year). Lindert (1996) also provides a similar estimate of the rate at which land is being transferred to other sectors. At this estimated rate, it would take two decades for Chinese agriculture to lose 10% of its land area.

There are also offsetting forces. Some commentators argue that new arable land areas can be developed (Dong 1996) so that the area of arable land can respond to rising land values. Grain-sown area in China can also follow a different trend to general arable area, not only because of the composition of agricultural output, but also because within the grain sector there is scope to increase the rate of double-cropping. Its growth has contributed to the increase in total output even though the amount of arable area has fallen.

The extent of multiple cropping over time depends on the regional distribution of the loss of arable land — those areas where the multiple cropping rate is high are also losing arable land at a faster rate. The implications of regional variations in the impacts of forces for structural change are discussed in the next section.

Actual land area in China has in the past been underreported. Even so, the changes in the rate of decline of arable areas may still be reliable unless incentives for underreporting have changed over time. The implications of underreporting of land area are discussed below.

Another offsetting factor to the loss of land to other uses is that other inputs can substitute for land in the production process, for example, irrigation and fertiliser. Lindert (1996) raises the related issue of whether the process of the loss of land to other uses has the effect of the lowering the quality on average of the land remaining. One hypothesis is that the best land is converted to urban use. But Lindert argues that industrialisation and urbanisation could have offsetting effects since more effort is put into improving the quality of the land remaining in agriculture. This is a question for further work. Lindert provides some estimates (his Table 8) which suggest the net effect of industrialisation and urbanisation on average soil quality could be positive, particularly in terms of its content of organic matter and nitrogen.¹⁷

Policy reactions

These patterns of structural change are not independent of policy reactions, for example, to the rise in or expected rise in the import penetration of the market for grain. Grain prices in China since later 1994 have been higher than world prices, which is a

¹⁷ Another question is whether agricultural use itself is degrading soil quality. Lindert (1996) finds little supporting evidence for this in China, particularly for those soil characteristics which matter for agricultural production.

consequence of the trends in supply noted in Figures 7–10 compared to the growth in demand, in the context of restrictions on trade. The origins of and risks associated with this position are discussed in more detail in the final section of this report.

A more immediate issue is the change in the management of grain sector policy, particularly the devolution of responsibility to provincial and lower levels of governments. Some implications of this change, in terms of the use of subsidies for grain production and the lack of transparency in grain sector policy, were discussed earlier in Section 1.

Grain sector performance

There has been debate over the effects of the agricultural reforms in China. Watson (1994) has reviewed the literature in general, and Carter (1995) focused on econometric work on the sources of agricultural output growth. Input growth is obviously one contributor to output growth. Studies of the other sources of growth can be divided into different schools. Some put more stress on technological change, others favour the importance of institutional change, such as the household responsibility system (HRS), and others stress the contribution of and continuing importance of market reform and 'getting prices right'.¹⁸ Recent work, particularly papers using the CERU–MoA household survey data, are now reviewed under these three headings.

Technological change

Some of the work on accounting for sources of growth in Chinese agriculture has put more weight on the contribution from technological change, especially after the first-round effects of institutional change have been exhausted (see e.g. Huang, Rosegrant and Rozelle, 1996).

An issue in the assessment of the scope technological change plays in that role is the estimate of the current grain yield in China. Estimation of yields is complicated by errors in the data on land area. Reported land area in China has been understated, at least according to the latest official land survey in China, which revealed a figure significantly higher (20%) than previous estimates of arable areas.

¹⁸ There is also other work, including by Zhong and Carter (1995), which stresses the importance of the weather in patterns of grain production over time, and by Huang and Rozelle (1995a), who highlight the contribution of an increased inability of production to withstand the effects of natural disasters, rising salinity and soil erosion.

Underreporting does therefore appear to have been a problem. Its presence reflects the incentives created at the local level by the land tax system and by the requirements the state imposes on the grain sector to supply grain at lower prices to the state marketing system. Concealing the amount of land available may reduce tax commitments imposed on any one community.

If on the other hand grain output is measured correctly then the estimated yield (output divided by area) will be overstated.¹⁹ Assessments of the scope to increase yields based on comparisons of actual yields in China with those defined to be 'frontier' levels, according to overseas experience, for example, will therefore be biased toward the conclusion that there is little scope for such an increase in yields in China. The correct measurement of yield, however, may lead to a more optimistic view of scope for its improvement. In that case, further technological change has a larger role to play than would be suggested by yield estimates based on underreported land areas.

Yang Hong (1996d), using the CERU–MoA survey data, found that the average land area reported by households is approximately 17% larger than the figure reported by villages. This appears to be another piece of evidence that in previous years reported areas have been understated. Yang Hong also found that the village appears to have reported a figure close to actual yields to higher levels. This result suggests another possibility which is that rather than yields being underreported, it is output, at least at the village level, that is likely to be underreported. Some grain output is therefore concealed from higher levels of government. This output could be diverted into the animal sector and not appear in the marketing system in its raw form. If this diversion has increased over the last decade, as demand for animal products increased and as the marketing system for those products has been reformed, then the official data may also understate the rate of growth of grain output.²⁰

A comparison more relevant than comparing aggregate average yields in China with some assessment of potential based on experience in the rest of the world is the assessment of actual versus

¹⁹ Crook and Hunter Colby (1996) suggest that the State Statistical Bureau overstates yields (which it also measures using sample survey cuttings) in order to compensate for the understatement of land area.

²⁰ This result might also help explain part of the apparent inconsistency between the growth in grain output in China and the growth in meat output. For a discussion of other contributors including the role of grain imports, see Lu Feng (1996a,b).

potential yields in Chinese conditions at farm level. The problem is to find an estimate of potential yield.

Lin and Shen (1994) have undertaken a study of the potential to increase rice yields by comparing actual farm yields with assessments of what is possible provided by agronomists and scientists working in the industry. Lin and Shen distinguish between two yield gaps. The first is the gap between the maximum experimental yield and the best possible farm yield. The second is the gap between the best possible and the actual farm yields. They find a significant combined gap, for example, cases where the maximum yield is three times the actual farm yield. Most of the gap (about 70%) is due to the first type of gap. Lin and Shen argue that there may be high returns to research into how to reduce the factors they identify as contributors to both gaps. Biotechnological research, they suggest, may offer the highest returns.

Other work uses different methodology to evaluate the returns to further investment in research and development in China. As noted above, work on accounting for the growth in grain output in China reveals that in the past technological change has played an important role. A more recent paper tries to find a direct link to research effort, rather than inferring the contribution of technological change from the unexplained part of the trends in output growth. Fan (1996b) includes a research variable in a production function study of the trends in grain output over time. By making assumptions about the lagged structure of the effects of research, Fan is able to estimate returns to agricultural research in the range 44–169%.

Even if there are high returns to agricultural research, would the investments be made? Rozelle (1996) and Fan (1996a,b) have reviewed the reforms, including commercialisation, in the agricultural research and development system in China and the fall in real spending on research. Research in recent years does not appear to be contributing to an increase in the yields of commercially used grain varieties. The number of new varieties has increased but the rate of increase is lower in the first half of the 1990s than in the second half of the 1980s. These results raise some questions about the benefits of the reform process in this sector. Rozelle and others also note that a remaining issue in the reform process in this sector is the strengthening of the property rights regime.

The evaluation of the research sector is an issue. As Rozelle notes, the result that yields of new varieties

are constant could conceal other features. The data used to evaluate research performance refer to varieties in commercial use. Market and profit-oriented farm households may now be selecting varieties which contribute more to household income than to output. The new varieties may require fewer inputs, for example. This question is a topic for further work, and could indicate success in the commercialisation process in the research sector rather than poor performance.

Pray, Rozelle and Huang (1996) also review some of the related issues in the reform of the seed industry in China and stress the returns to easing barriers to entry into the market for seeds to raise to the extent of competition in the market and the returns to removing residual controls on seed prices.

The household survey data available in this project reveal some features of seed use in grain production. Grain for seeding is an important use of grain output. The ratio of seed input to grain output, according to the CERU–MoA survey data, is 3.4% for winter wheat, 0.6% for middle-late indica and 0.9% for maize. Some estimates indicate that there is also a significant loss of seed in the sowing process. Greater efficiency in seed use could make available millions of tonnes of grain for other uses.

Harry Wu, in work in progress on farmer choices about seed use, has identified the following testable hypotheses:

- farmers tend to choose high-yield varieties if they are subject to sales quotas with fixed state prices, that is, they emphasise quantity rather than quality; at the same time, under central government pressure to meet output targets, local governments have strong incentives to develop and promote high-yield varieties;
- the nature of varieties that have been used in the past determines the frequency of change of varieties — hybrid rice varieties often require more frequent changes in seeds;
- farmers' response to the availability of high-yield varieties is subject to their budget constraint, the parameters of which are seed quality, the prices of new seeds/varieties and the cost of associated inputs (many new varieties require higher input of fertiliser and/or labour; in fact, many high-yield varieties are developed to be more responsive to fertiliser and intensive labour input: quality matters, since farmers have to use more seeds or have to reseed if the emergence rate is low).

Preliminary survey findings using the CERU-MoA data include the following points.

- Almost all grain farmers surveyed have changed varieties since the introduction of the HRS, not only for the major crop, but also for other crops, e.g. 95% of rice farmers in Guangdong and 92% of rice farmers in Jiangxi have changed varieties for the same crop since HRS.
- For the major crop, 82% of the households changed varieties at least three times since HRS, 60% at least four times, and 37% at least five times, and 20% of households changed varieties 6–10 times.
- More importantly, most (75%) households changed varieties in 1994–95 when the government re-emphasised quantity control over grain production through the governor responsibility system.
- For their latest change of variety, new varieties increased yield per (sown) mu by 43 kg for wheat, 36 kg for early indica, 45 kg for late indica, 35 kg for japonica and 67 kg for maize.
- The survey also found that seed input (per mu) is positively correlated with yield and negatively correlated with the price of seeds (statistically significant, the two factors can explain 30–40% of the quantity of seeds used).

These results suggest that farmers do consider the effects of seed price and quality on yield. The rate of change to new varieties is also an indicator that farmer decision-making is not necessarily a barrier to the introduction of new technologies at farm level. On the other hand, as reported in Section 2, there appears to be significant variation within the sample in the rate of use of seeds so that, while it is subject to economising behaviour by farmers in general, this input appears to be one in which there is considerable scope for technical efficiency gains. A side effect of greater efficiency in the use of seeds will be an increase in the availability of grain for other uses.

In summary, research and development can clearly play an important role in driving output in the grain sector. The major policy issue is therefore the management and evaluation of research and development programs that apply to grain. Key elements in achieving an efficient outcome will be institutional changes in the research sector and in the seed industry. A more developed seed market may also contribute to improved performance in terms of seed use at farm level. Choices of research effort in China will also be more efficient if they take into account the

cost of China's alternative sources of grain, such as purchases from the rest of the world.

Institutional change

Estimates of productivity gains

Huang and Kalirajan (1996) argue there is scope for yield increases which appear to be higher for maize than for other crops, and higher in Sichuan compared to other provinces in the sample. This argument is based on their assessment of the gap between actual output and an assessment of potential output of between 33% and 50% of current yields.²¹ These estimates are considerably less than those of Lin and Shen (1994) whose type II gaps range between 50% and 65% of actual yields. Perhaps the explanation is the assessment by scientists of 'yields under favourable conditions', which are the source of the Lin and Shen estimates of potential yields, and which exceed the observed best commercial practice in the household survey data.

Huang and Kalirajan find that the gap between actual and the estimated potential performance is smaller for each of rice, wheat and maize:

- if the household average education level is higher;
- if the household head has longer agricultural experience;
- if the total land area being farmed is larger;
- if the proportion of the grain output sold to the market is higher;
- the higher the proportion of days spent working off the farm.

Huang and Kalirajan use these results to stress short-term gains in productivity that might be associated with larger farm sizes, a greater market orientation in grain output (the marketing rate in the sample is still only just over one-third), and the growth of off-farm work. They stress, however, that in the longer run, after the immediate productivity gains are exhausted, some of these changes may not have net positive effects on total output. One example is structural change, including the growth of rural industry, the impact of which is discussed in Section 3.

These results highlight both the role of the extent of use of markets and other institutional changes, for

²¹ Potential output is derived from an estimate of the production frontier which is estimated by including only factors of production in the regression equation. Other contributors to variations in output are considered in the second step of the analysis applied by Huang and Kalirajan.

example, those affecting land area, in the performance of the grain sector. The rest of this section concentrates on input markets, noting not only the output effects but also other consequences of reform. The impacts of output market developments on productivity growth are discussed in the following section.

Plot consolidation

Issues associated with the scale of production are examined by Nguyen, Cheng and Findlay (1996). According to their results, there is a statistically significant positive relationship between plot size and output for all three crops — maize, wheat and rice. However, the positive relationship for rice is obscured by differences in varieties, by the labour-intensive nature of rice production and by the very small plot size in southern China where rice is mainly grown. The elasticity of wheat and maize yields (and all other inputs constant) with respect to plot size is estimated to be 17%.

The generally observed positive relationship between plot size and output for major grain crops in China (Nguyen, Cheng and Findlay argue) suggests that fragmentation involves a significant cost. Further, they stress that they tested for the effects of both farm size (total area) and average plot size (total area divided by the number of plots). Immediate gains are associated with economies in plot size rather than farm size.²²

Given fixed land areas and the pressure of continuing population growth, the already very small plots of land in many areas of China are being fragmented further. The results of Nguyen, Cheng and Findlay indicate this outcome could be expensive in terms of output foregone. The literature on this issue suggests that avoiding this outcome will require a deepening of the reform process. Experiments involving these practices, which are already underway, will have to be promoted actively in other areas of China before problems of falling plot size are resolved.

From an economic perspective, land consolidation in China involves not only gains, but also costs. The possible costs include, first, the exposure of small households to extra risks caused by land consolidation. For example, following land consolidation, the losses of crops in one plot due to floods or other natural

adversities are less likely to be palliated by a good or normal harvest from plots in different locations.

An issue related to these questions of scale, and interest in either consolidating plots, increasing farm size, or both, is the land tenure system. The debate on land tenure in China is reviewed by Zhang, Huang and Rozelle (1996). The collective land of the village is still controlled by the leadership but can be allocated in a variety of ways. The mechanisms involved are characterised by a lack of security of tenure which can weaken the incentive to invest, reduce the ease of access to credit and, in the absence of a market for land-use rights, deny gains from specialisation. The empirical significance of these effects is a topic for further work. A market in land-use rights (even without private ownership) would facilitate both consolidation and the achievement of greater scale if they were profitable. Some models of or experiments with new land tenure arrangements in Zhejiang are examined by Fahlbeck and Huang (1996).

Farmer education

Another variable stressed by Huang and Kalirajan is the impact of education, or the quality of the labour input, on productivity. The impact of formal education is examined by Nguyen and Cheng (1996), who question its importance in the performance of grain-producing households. They report regression results using farm income as the dependent variable which suggest that:

- the returns are statistically significant for the education of household heads but not for the education of farm workers generally;
- the returns are considerably higher for the first three years of education of the household head than for subsequent years.

Wu and Meng (1996a,b) and Cheng (1996) report other regression equations using grain output as the dependent variable in which the education level as well as work experience of household heads is important.

Nguyen and Cheng argue their results confirm that household heads, who are decision-makers within each farm, are handicapped in getting the best of the improved seeds and modern agricultural practices if they cannot read or write.

The problem is to measure accurately the size of the link between education and income. Even if that link is now small, the importance of education is likely to rise. Wu and Meng (1996a) also argue this case.

²² Huang and Kalirajan found that total area was significantly related to productivity, although they did not include a plot size variable in their equation, and there is a correlation between total area and average plot size.

Cheng (1996) observes that with the increased use of chemical fertilisers, new seeds and other modern inputs, grain production becomes increasingly capital-intensive, and hence demand for quality labour inputs rises (that is, more educated labour becomes more productive). More attention should be given, he argues, to further education and training for those household-heads aged in their forties and fifties who are usually the major decision-makers in China's grain production and marketing and who are less likely to move out of grain production completely.

A further question is that, if education is significant, how much is required? At present, returns to education beyond a basic level may be small. That was the main finding of Nguyen and Cheng (1996), whose concern about econometric qualifications to their assessment of the relationship is not likely to affect this conclusion. However, for reasons discussed by Cheng (1996) and others, the returns to longer-term education are likely to rise over time.

Off-farm work

Another interesting issue in household management is the role of off-farm work by household heads. The results are mixed. Huang and Kalirajan (1996) argue that the extent of off-farm work in industry is positively related to productivity in grain production. While families for whom off-farm work is more important may spend less time on farm work, they may work more productively when they are spending time on the farm. Yang Hong (1996c), on the other hand, finds a negative relationship between grain output and the share of non-farm income in total household income (all other inputs constant).²³

Cheng's 1996 study examined a particular form of off-farm work. He found that there is an association between the official position of the household head and grain output. Cheng argues (based on his field work) that there is no systematic relationship between official positions and better quality of land. The positive effects of official position on grain output are more likely to be caused by the collective ownership of some large farm equipment and privileged access to state-subsidised farm inputs, public goods such as irrigated water, and technical information and supporting services.

One interpretation of this outcome is that it represents a form of compensation for undertaking an

official task in the village. Cheng notes the problems associated with this approach. He prefers instead a market solution of both higher prices to grain producers to encourage on-farm productivity, and direct compensation to officials for time spent in that role. One option he suggests would be the creation of one or two full-time positions for village officials and a reduction in the total number of village officials (currently there are about three to five part-time village officials paid from the land-use fees).

Fertiliser

Efficiency of fertiliser use is discussed by Cheng, Nguyen and Findlay (1996). They examine the allocative efficiency in the use of urea (the main component of which is nitrogen) and an aggregate of all other fertilisers (e.g. phosphates) in production. They apply the profit-maximising firm's rule on input use to find that urea is underutilised in all but one of the counties in the sample, while other fertilisers were underutilised in Jiangxi but overutilised in Guangdong.²⁴

Field work by Cheng suggests that a contributor to the allocative inefficiency of rice producers was the risk involved in the adjustment of input use, which was related to the lack of knowledge of the technical relations between input and output for rice production. For example, following an increase in the price of urea, households may not reduce their use of urea accordingly, if they were uncertain about the output effects of such a reduction. They may be concerned, for example, that a small decrease in fertiliser use might lead to a large fall in output. They are therefore conservative and base their input choices on their own limited experience of the technical relationship.

The responsiveness of rice producers to changes in input and output prices in southern China could have been influenced as well by other factors, the range of which includes:

- the lack of price information for small rice producers;
- the exaggeration of price fluctuations associated with the barriers to trade between two provinces and between counties in a province; and
- messages from central and local governments urging farmers to increase rice output following a fall in rice output since late 1993.

²⁴ There are qualifications to these results because of omitted variables problem (related to the exclusion of a soil quality variable and organic fertilisers, data for which were not available) and also because of the aggregation of the fertiliser types. Huang and Kalirajan (1996) also found that overall fertilisers were used relatively inefficiently.

²³ The difference in results could reflect the statistical methods used which treat in different ways the measurement errors likely to be associated with the input variables.

The inefficiency of fertiliser use could also be due to local shortages of fertilisers (particularly urea), or credit to pay for them. Policy implications therefore include the value of more technical information to farmers, but provided in the context of economic decision-making, not output targets. There are also some interesting technical issues in the impact of urea use in southern China, and about the benefits of other methods of fertiliser application compared to those currently in use.

Review

Markets for inputs, including land, labour, and purchased items such as fertiliser matter for productivity growth. Current restrictions on some agricultural input markets reflect the absence of other markets, for example, for dealing with risks in agricultural production. The data suggest that institutional changes in these areas can have a significant effect on productivity. For example, significant benefits would be available, according to this research, from institutional changes which led farmers themselves to consolidate their plots of land. It is stressed, however, that changes in markets other than those for farm land would be required in order for consolidation to be efficient. There may also be high returns to information about the effects of fertilisers in grain production and about methods of application. Longer-term issues include decisions on the extent and funding of farmer education in China.

Market development

The development of the grain marketing system is discussed in more detail by Findlay and Watson (1996b) and Watson (1996). Obviously, changes in relative prices that emerge from market reforms affect trends in grain output. Findlay and Watson (1996b) document examples of the supply response of grain output to relative price changes associated with marketing system reforms.²⁵ In this section, focus is on the way that the development of markets affects the productivity with which resources are used, rather than on volumes of inputs applied to agricultural production.

²⁵ A recent example is the very high grain output expected in 1996, the result not only of good weather in some parts of China but also the increase in sown area. The increase in sown area is likely to be the result of expectations of higher prices for grain based on prices received in 1994 and 1995, and incentives that emerged from the application of the governor responsibility system. The large output and the accumulation of stocks in 1996 is likely to lead to expectations of lower future prices and a reduced sown area next year.

Marketing rate

Huang and Kalirajan (1996) tested the effect of the rate at which households sold their grain on the market on the productivity of the household. They found that more market-oriented households use inputs more productively in the case of all three crops. Huang and Kalirajan also expected that a higher state share in a household's marketed output may not encourage farmers to produce that output efficiently. A relationship in this direction was found in the case of wheat but not for rice and maize.

Other researchers have found a positive relationship between the size of the quota and output, for example Sicular (1995) finds first that quotas do affect the allocation of resources at farm level: quotas are not inframarginal. She finds also that quotas have the significant effect of taxing household income. But quotas in her results appear also to have a positive effect on productivity. One explanation is that other services are provided alongside the quotas, for example, the provision of new techniques, access to fertilisers which might otherwise be constrained, access to credit to buy inputs in an efficient combination, supervision by local officials of on-farm choices, and provision of farm services at lower costs on a collective basis.²⁶

One interpretation of these results is that the quota system is a second-best method of achieving an efficient allocation of the available inputs into the production process among households. The quota system is acting as an assessment of the appropriate degree of specialisation by households in grain production. Available inputs are being allocated accordingly, and access to those inputs has effects on total grain output of the household, not just the quota component. However, these effects are likely to be larger in richer counties which provide subsidies for grain production.

The alternative to this use of the quota system is not only to let households make their own choices of their specialisation in grain production but also to reform input markets so that the market mechanism can achieve the efficient allocation of inputs into grain production. The net effect is likely to be, according to results reported here, higher grain output. Concerns about food supply security, which is one origin of the

²⁶ One explanation for the difference between the results of Sicular (1995) and those of Huang and Kalirajan (1996) about the impact of quotas is that they use different data sets. Sicular uses data from one county in northern China.

quota system, can be met through the development of a more market-oriented production process.

Barriers to market integration

Another marketing issue is the set of barriers to inter-regional trade in China. These barriers could be due to the presence of bottlenecks in the transport infrastructure or to deliberate policy choices such as the governor responsibility system (see Cheng, Findlay and Watson, 1996), to cause each region to be more self-reliant. If those barriers were significant, then the consequence is a lack of specialisation by region within the grain sector. The failure to pursue specialisation means that some output is foregone. When regions specialise they concentrate on grains with lower opportunity costs in terms of other types of grain foregone. When regions differ in their opportunity costs of production of various types of grain, as is the case in China, then the output foregone in one region can be more than offset by increments to output in other regions. The grain output of the whole economy is increased as a consequence.

Of course the same issues arise with respect to choices between grain and other goods and services. In particular, there is the question of whether the prices to which Chinese farmers are responding are divorced from world prices, and therefore from the point of view of the whole economy whether an inefficient volume of grain is being produced, compared to its real cost of procurement from the rest of the world.

Barriers to market integration have a second important consequence from the point of view of output decisions. While demand for grain is relatively stable within any one region, the supply within a region can fluctuate significantly as a result of changes in weather, in relative prices of other crops which affect supply decisions, or in local policy. The consequence is likely to be a greater degree of price instability. In more integrated markets there is also a lower degree of correlation between prices and yields in any one region. Market development also lowers the costs of making transactions.

Park (1995) models the effects of these dimensions of market development on household behaviour in the presence of yield and price uncertainty. Market development involves a number of offsetting effects. Park finds that the effects on grain storage on the farm and on grain sown area are ambiguous. Complications arise from the dual role of households as both consumers and producers, in which

roles price fluctuations have different implications. There is scope for further work to identify the empirical importance of the various effects in order to model more accurately grain producer output and storage decision-making.

Conclusion

Research reviewed here indicates that it is possible to raise the productivity of inputs used in grain production in China, but the condition required for this change is an even greater role for markets in the management of grain production. Contributors include:

- plot consolidation, facilitated by the development of land use markets;
- development of markets for other purchased agricultural inputs;
- deregulation of the seed market.

The greater degree of integration of domestic grain markets would also have significant effects on aggregate output, through opportunities for specialisation and trade and the effects on technical efficiency at farm level. Pressures for structural change that vary between regions will at the same time be changing the mix of grain output that China can expect. These pressures will determine the patterns of trade in grain in China through an integrated national market.

Despite the likely gains in economic terms, there are constraints to the deepening of the role of markets in the grain sector in China. Market development inevitably leads to substantial redistributive effects, involving growers of grain, trading intermediaries, input suppliers and consumers. The sensitivity of the progress of and path of market development to the political reactions to these redistributive effects has been documented by Findlay and Watson (1996a). As they explain, a particularly important issue is the role of the grain bureaus.

It is also possible to shift out the position of the grain production frontier. Substantial increases in yields even beyond those at the frontiers under current technologies appear to be possible. The issue in that case is the management and evaluation of research and development programs that apply to grain. Institutional changes in the research sector and in the seed industry, as noted above, are key objectives. In addition to market reforms, therefore, important issues include:

- the extent of public investment in agricultural infrastructure and in research and development;
- the design of the extension system; and
- the long-run development of farmer education policy.

China can change its trend in grain output per head reported earlier. The question to be answered is what it will cost, to change the trend. There are reforms, including the development of input markets and the integration of output markets, that may be undertaken through regulatory reform at relatively low cost. Further output growth could involve more substantial investment and therefore lead to challenges to policy makers to make careful judgments about costs and benefits. Using the resources available in the rest of the world to supply grain to China is another option to be considered. Integration of the domestic and international markets for grain will facilitate the assessment of all those options by exposing decision makers to world prices.

4. Grain Trade Prospects²⁷

Review of projections

There is a variety of scenarios for China's international trade in grain over the next two decades (see Table 10).

Outlooks differ significantly. Some are pessimistic about production growth: 500 mt is the upper limit in all projections for the year 2000. Brown (1994, 1995) forecasts a dramatic decline in output, mainly due to arable land loss associated with salinisation and erosion. Projections differ in the outlook for output beyond the year 2000. Some are optimistic about production growth relative to consumption growth, e.g. the IFPRI group and Mei (1995), but not the OECF.

These scenario differences are reflected in their ratios of imports to consumption. These range from less than 3% for Mei (1995) by the year 2020 to more than 20% for OECF (at 2010), and around 50% in 2030, Brown. Mei argues that imported grains 'can only play a role in adjusting the production' (p. 3).

None of these projections allow for the impact of events in the non-agricultural sector. As Anderson and Peng (1996) point out, this means these projections do not take into account constraints on the use of resources in other sectors or constraints on China's international transactions. They report the results of an application of a multisectoral model to this problem. One scenario is based on growth of GDP in China of 7.8% a year through to the year 2005.²⁸ The result is that China is projected to import 33 mt of grain in

2005 and have a domestic grain self-sufficiency rate of 96% (import dependence of 4%).

Anderson and Peng note that these results are relatively low compared to others in Table 10, in part because of the projected growth in imports of livestock and other food products.²⁹ A tighter set of trade restrictions on those items would raise the level of grain import dependency above 4%.

In the early 1990s, the bulk of China's grain imports was wheat. But the studies reviewed above suggest a change in the import mix toward feed grain. This switch is associated with growth in demand for meat, egg and aquatic products, while the direct consumption of grain is expected to fall.

The OECF study suggests that the bulk of import grain will be feed grain at the end of the projection period. China will maintain its self-sufficiency in rice, according to the OECF projections, and remain a net importer of wheat while maize imports boom.

The IFPRI study notes that the rise in meat and other product consumption will raise the share of feed grain in total consumption from 20% in 1991 to nearly 40% in 2020. In its projections, feed grain demand rises from 76 mt in 1991 to 108 mt in the year 2000 and 232 mt in 2020. The study also reports that that by 2020 'wheat will still account for most imports'.

Garnaut and Ma (1992) concluded that the outcome would depend on Chinese trade policy. In 1992, the Chinese grain market was closed off from the world market to a considerable extent, and domestic prices were below what were then low world prices (see Figure 1). They anticipated that either the relationship between domestic and international prices or the closed nature of the grain economy would

²⁷ This part is based on an extract from Wu and Findlay (1996).

²⁸ In this scenario, other economies in the rest of the world are also growing, at similar rates to China in the rest of East Asia and at slower rates in the developed economies. The Uruguay Round (UR) outcome of multilateral trade negotiations is also implemented, which removes export subsidies for farm products, thereby boosting world trade in farm products and also prices of those products. This price is not however sufficient to offset the long-term structural decline in food prices which is built into the model. The UR also removes quotas on exports of textile and clothing products which also boosts the trade in those products but lowers their prices. For details, see Anderson and others, 1996.

²⁹ China pays for these imports by expanding net exports of manufactures, even though China is denied full access to the benefits of the UR outcome because of lack of WTO membership. China's export growth is concentrated in light manufactures not including the textiles and clothing category in this scenario.

Table 10. Review of projections of China's grain trade to 2030

Source and year	Period of projection	Consumption at end point (B) (year)	Production at end point	Net imports (unit) at end point (A)	A/B %
Tyers and Anderson 1992	1990–2000	510 mt in 2000	420mt in 2000	90 mt in 2000	18
Garnaut and Ma 1992	1990–2000	Normal growth (6% p.a. income growth): 547.2 mt in 2000 High growth (7.2% p.a. income growth): 593 mt in 2000	Upper limit of 500 mt	Normal growth (6% p.a. income growth): 50 mt in 2000 High growth (7.2% p.a. income growth): 90 mt in 2000	9.1 15.2
Brown 1994	1990–2030	No rise in consumption p.c.: 479 mt in 2030 Rise in consumption p.c. and rise in population: 641 mt in 2030	272 mt in 2030	No rise in consumption p.c.: 207 mt in 2030 Rise in consumption p.c. and rise in population: 369mt in 2030	43 58
Huang, Rozelle and Rosegrant (IFPRI) 1995	Early 1990s to 2000, 2010 and 2020	450 mt in 2000 600 mt in 2020	410 mt in 2000 550 mt in 2020	40 mt in 2000, <i>but not likely to be greater than</i> 50 mt in 2020	8.8 8.3
OECD 1995	1993 to 2000, 2005 and 2010	508 mt in 2000 571 mt in 2005 645 mt in 2010	484 mt in 2000 502 mt in 2005 509 mt in 2010	24 mt in 2000, 69 mt in 2005 136 mt in 2010	4.7 12.1 21.0
Mei 1995	1993 to 2000, 2010 and 2020	511 mt in 2000 593 mt in 2010 695 mt in 2020	500 mt in 2000 578 mt in 2010 675 mt in 2020	11 mt in 2000 15 mt in 2010 20 mt in 2020	2.2 2.5 2.9

change rapidly with continued rapid economic growth through the 1990s. China would soon face a choice between Northeast Asian-style grain protectionism (the earlier choice for food grains in Japan, Taiwan and Korea), and the linking of domestic into international markets.

It was technically possible, they argued, for China to remain self-sufficient in grain with Northeast Asian-style protectionism. If this were the choice, domestic grain prices would rise well above the then current world prices. High prices would encourage grain production and hold back consumption. Chinese economic growth would be held back, and the people's standard of living would not rise as much as the country's economic performance would otherwise be able to support.

Alternatively, China could choose to open its agricultural economy to foreign trade, while maintaining the liberalisation of domestic grain markets that had recently been implemented.

In these circumstances, continued rapid growth in incomes would lead to strong expansion of grain use, especially for animal feed and industrial purposes. Two approaches to estimation of demand were utilised by Garnaut and Ma — one based on published

estimates of income elasticity of demand, and one on the Taiwan experience at a similar stage of its economic development. The two approaches suggested broadly similar outcomes: use of 550 mt with normal economic growth, and 590 mt with high growth. Garnaut and Ma (1992) noted that the starting point for the quantitative analyses preceded, and therefore abstracted from, the major upward adjustments in China's grain prices in 1991 and 1992, and therefore may have overestimated net imports in 2000 by an amount that could not be calculated on data then available. Garnaut and Ma (1996, p. 61) later adjusted their expectations of net imports under free trade and stable world prices (1990 levels) to 30–70 mt to take account of this factor.

On the supply side, Garnaut and Ma (1992) undertook less detailed analysis. They concluded that, while there was biological potential for much larger increases, it was unlikely that grain production would grow more rapidly than population, that is, that it was unlikely that production would exceed 500 mt with free trade and world relative prices remaining near the levels of 1990. They noted that higher levels of production would be induced at higher prices.

Garnaut and Ma also discussed in detail the likely change in the mix of grain demand in China. In their high growth scenario, the share of feed grain in total grain consumption rises from 25% in 1990 to 33% in the year 2000 (30% in the lower growth scenario) (see their Table 42, p. 98). They note that the mix of grain output is highly sensitive to shifts in relative prices, but expect the growth in imports would be concentrated in feed grains and to a lesser extent in wheat and barley (p. 118).

Food grain self-sufficiency

This section highlights the significance of the demand projections reported in Section 2 by comparing them with a simple supply scenario.

Supply assumptions

A simple but important assumption used in supply projections is annual grain output growth. The assumption may be based on a simple extrapolation of grain output in previous periods, or on the experience of other countries at similar development stages, or may be estimated by a sophisticated econometric approach taking all possible factors affecting grain supply. Some

supply assumptions consider only technical potential, while others take economic factors as well.

Based on the experiences of other countries, Brown (1994) assumes that China's grain supply will decline by at least 0.5% a year from now to 2030, compared with 1% decline for Japan since 1960, 1.2% decline for Taiwan since 1977 and 1.9% decline for South Korea since 1977. Carter and Zhong (1988) project zero growth, while all other estimates of grain output are positive. Garnaut and Ma (1992) assume 1% for the slow-growth scenario, and 1.7% for a rapid-growth scenario. The OECF projection assumes that grain land area and yield per unit of land will continue to grow annually at 0.05% and 1.75%, respectively, as they did in the period 1984–93 (OECF 1995, Appendix II, Tables 2 and 3). Some projections assume a declining growth rate but one which is still positive, such as OECF (from 0.8 in 1993–2000 to 0.6 in 2000–2010), while some assume an increasing growth rate, such as Lin, Huang and Rozelle (from 0.7% in 1991–2000 to 1.4% in 2000–2010 and 1.6% in 2010–2020), which is less likely, considering rising opportunity cost of labour and land.

Table 11. Trade implications of the projected demand for food and feed grains for China under various scenarios to 2020.

	Food grain (mt)				Feed grain (mt)				Total grain (mt)			
	1995	2000	2010	2020	1995	2000	2010	2020	1995	2000	2010	2020
Demand												
1. Low feeding efficiency scenario												
Income growth by 8% a year	286 ^a	284	239	177	194 ^a	239	346	466	480	523	585	643
Income growth by 10% a year	286 ^a	280	221	151	194 ^a	249	385	548	480	529	606	699
2. High feeding efficiency scenario												
Income growth by 8% a year	286 ^a	284	239	177	157 ^a	193	279	377	443	477	518	554
Income growth by 10% a year	286 ^a	280	221	151	157 ^a	201	311	443	443	481	532	594
Supply												
Assumed output growth since the end of the last period (% p.a.)												
	n.a.	0.0 ^d	-1.7 ^d	-3.0 ^d	n.a.	3.0	3.0	3.0	n.a.	1.1	0.5	0.6
End-period supply												
	286 ^b	284	239	177	181 ^c	210	282	378	467 ^e	494	521	555
Balance												
1. Low feeding efficiency scenario												
Income growth by 8% a year	0	0	0	0	-13	-29	-64	-88	-13	-29	-64	-88
Income growth by 10% a year	0	4	18	26	-13	-39	-103	-170	-13	-35	-85	-144
2. High feeding efficiency scenario												
Income growth by 8% a year	0	0	0	0	24	17	3	1	24	17	3	1
Income growth by 10% a year	0	4	18	26	24	9	-29	-65	24	13	-11	-39

Source: Based on Table 9 and supply assumptions.

Note:

a Data are estimated actual demand in 1995 from Table 9, used as a starting point.

b Assuming food grain supply met demand in 1995.

c Estimated feed grain supply by subtracting food grain from total grain output in 1995 (467 mt).

d Rates are set assuming China will meet its food grain demand as demand declines, at least in net terms.

e Actual grain output in 1995.

These assumptions vary greatly. Data constraints are one important reason for the variation but also, in a rapidly growing economy, there are offsetting forces, the relative importance of which is difficult to judge without more detailed modelling work. The previous section of this report identified a number of policy changes which could make a contribution to productivity. A more detailed assessment of their impact is also a topic for further work.

While there is no agreement on reasonable supply growth assumption, a simple supply projection provides a background against which to judge the sensitivity of the trade projections to the variations in demand parameters stressed.

Here we assume that in 1995 demand for food grain was met in net terms by local supply and that China will be able to meet its (declining) demand for food grain from 2000 onwards at least in net terms — China will show food grain self-sufficiency.³⁰

We assume that the annual growth rate of feed-grain production is assumed to be 3% throughout the projection period, based on the growth of maize output in the past 10 years.

Under these assumptions, China's total grain supply in the year 2000 will be 494 mt as projected in Table 11, very close to the government's 500 mt target (see Luo 1995, 1996). The implied annual total grain output growth will be about 1.1% over this period, slightly higher than the growth rate of 0.9% achieved since the reform. This rate falls to about 0.5–0.6% from 2000 to 2020, a decline from the previous trend, which may be reasonable, given the very likely rise of opportunity cost of increasing grain production in China. As projected, China will be producing 521 mt a year by 2010 and 555 mt a year by 2020.

The trade implications in quantity terms will rely on the choice of economic growth and feeding efficiency scenarios.³¹ If the 8% income growth rate is

chosen, under the low feed efficiency scenario, China needs feed grain imports of 29 mt a year by 2000, 64 mt a year by 2010, and 88 mt a year by 2020.

Under the high feed efficiency scenario China will still enjoy a surplus by 2000 and balance by 2020, which is unlikely to be possible. If the results under low efficiency are scaled down by 25% to reflect some improvement in feeding efficiency, China will still need feed imports of 22 mt a year by 2000, 48 mt a year by 2010 and 66 mt a year by 2020.

These projections for total grain are summarised in Figure 11 which illustrates the sensitivity of the projections to assumptions about feeding efficiently and about income growth.

Comments on the projections

We concentrate here on the outlook for China's feed grain imports and demonstrate the sensitivity of the projections to changes in income growth, and to the efficiency of feed use. The projections also incorporate a more accurate assessment of population growth compared to other studies, and also take into account the impact of changes in the structure of the population. Feed grain imports could be nearly 90 mt by 2020 under the low feed efficiency scenario. However, the pattern of feed grain trade is highly sensitive to developments in the efficiency with which feed is used.

There is a number of other factors to consider when assessing the outlook for China's grain trade, and trade in products like meat based on grain, and which suggest a number of topics for further work, such as:

- the choice of trade policy regime;
- the substitutability between food and feed grain;
- the substitutability between grain imports and meat imports.

One issue is the choice of policy regime. The projections reported here are based on the assumptions that the trade policy regime permits the growth in demand for feed grain driven by income increases to be met by import growth, while the outcome in the food grain market is self-sufficiency. This highlights the sensitivity of the projections to key parameters in the feed grain markets.

We have assumed that China is self-sufficient in food grain production. The choice of trade policy regime for the grain sector will also have implications for the size of the grain-consuming meat industry and therefore the pattern of trade in meat. A protected

³⁰ Food grain output could decline faster than the rate required for self-sufficiency in a free trade scenario, depending on the pressures for structural change in foodgrain-producing regions of China and the offsetting effects of new technologies. In that case our assumption of food grain self-sufficiency could be met only by subsidies to production and/or protection, the welfare costs of which may be substantial. A number of the CGE studies of China's grain trade have also produced estimates of these sorts of costs.

³¹ The projections in Table 10 are described more accurately as the gap between projected production and consumption. There is not necessarily a direct relationship to international transactions because of changes in stocks and also because of the mechanisms for the management for international transactions. The institutional arrangements for those transactions and their implications for observed trade patterns are beyond our scope here.

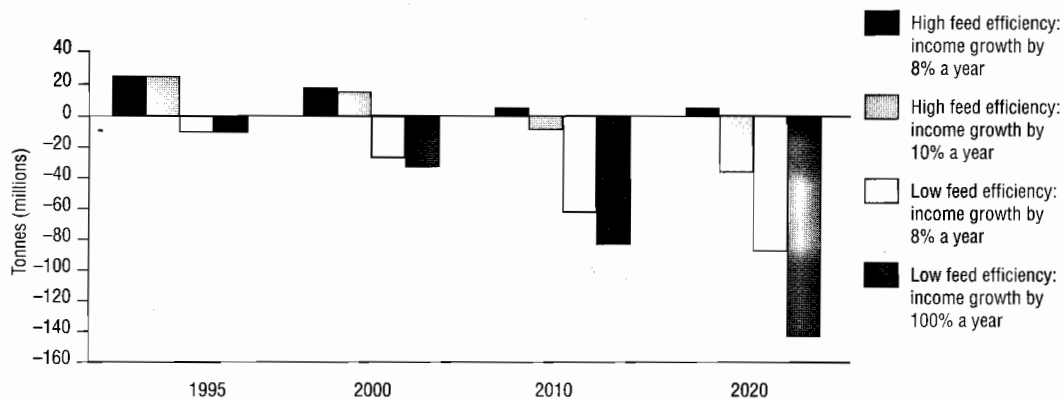


Figure 11. Grain trade scenarios: net exports to 2020.

grain sector, for example, and a less restrictive meat sector policy will lead to a larger volume of meat imports.³²

We have also assumed there is no substitutability between feed and food grain, whereas a feature of China is a degree of substitutability between the grains. In that case, a higher feed efficiency which makes available more grain for food use reduces the rate of growth of food grain output required for self-sufficiency. Alternatively, more rapid food grain output growth (a consequence of technological change, perhaps) makes it easier to meet domestic demand for feed grain, even in the low feed efficiency scenario. These interactions could also be examined in a more sophisticated modelling framework.

³² Using the grain-meat conversion ratios of 6:1 (kg) for red meat and 3.5:1 (kg) for poultry meat (average levels of low and high grain-meat ratios) and applying a degree of improvement in feed use efficiency, then feed grain imports could be replaced by 3.7 mt of red meat or 6.3 mt of poultry a year by 2000, 8 mt of red meat or 13.7 mt of poultry a year by 2010, and 11 mt of red meat or 18.9 mt of poultry a year by 2020, or apparently any combinations of the red and poultry meats.

5. Policy Outlook

Factors influencing the outlook for grain policy

From the producers' point of view, the growth in purchase prices after the market crisis of 1993 represented only a necessary recovery of the increases in production costs in recent years. But producers are faced with a government which tries to enforce deliveries to the state at administratively determined prices, and a grain bureau system that is subsidised but attempts to maximise its trading profits. Not surprisingly, therefore, producers are beginning to look toward higher prices from market traders, holding on to stocks to affect market prices, and trying to process more output for themselves in order to capture the value added.

From the household consumer point of view, growth in incomes and the shift to quality foods have made basic grain prices less significant. But consumers are concerned about inflationary expectations and have growing real incomes. While current overall output may be close to total demand (Zhu Xinwu, 1995), the regional distribution and output mix is not. Quality grains and grains in short supply are thus likely to increase in price, while poor quality grains will have a poor market. There is already a broad perception that the grains people want to eat are only available at higher prices on the free market, and that the state-supply of grain is not welcome. Furthermore, as grain prices rise, the prices of processed foods and meat also rise, though often at rates substantially above those of raw grain. Particularly sensitive consumers such as students, the unemployed, people on low and fixed incomes and the army are also likely to exert political pressures. These dilemmas invite government administrative intervention, even though that intervention may not solve the underlying problem.

To grain bureaus, the state-owned organisations in the grain distribution system, the underlying problems

of the 1990s remain clear. These are being asked to become more efficient and more profitable, yet at the same time are expected to carry out policy roles which need subsidies and may not reflect market pressures. They are thus in a position to trade between plan and market roles to maximise profits, and to find their commercial aims conflict with the policy role. They may seek to increase prices in order to improve profits, when they are being asked to sell grain cheaply in order to bring down costs. They may prefer to use capital for higher-value trading than in building and holding stocks of grain for market stabilisation policies. Their position is thus a confused one. It also faces different pressures at the purchasing end (where prices may have to rise in order to obtain any stocks at all) and the selling end (where government pricing measures, consumer demand and market supplies may exert contradictory pressures).

Finally, the problems of the relationship between production and consumption regions and central and local government continue to play a role. The production regions tend to have lower incomes and smaller budgets. They want to maximise their profits and revenues from grain. The consumption regions are anxious to maximise any subsidies for grain supplies and to minimise any costs of purchase. And the central and local governments dispute the relative shares of subsidies and costs of maintaining the managed part of the grain system.

Overall, therefore, China's grain system reform is still constrained by the fundamental issues of the government's concerns for urban consumers, the pressures to maintain stability in supplies and prices, and constraints on involvement in world trade stemming from the self-sufficiency goal.

Reactions to these forces of political economy have led to considerable debate in China on grain sector policy and to a variety of positions on trade and

other aspects of grain marketing policy. Elements of these positions include the following:

- *Trade can only be used to fix the grain mix*

The role of trade is to adjust the mix of grain types available in China, e.g. by exporting maize and rice while importing wheat, while overall a high degree of self-sufficiency is maintained, China, because of its size, cannot rely on the world market.

- *Domestic market integration is the key issue*

A greater degree of self-sufficiency will be possible, and the role of imports reduced, if the government withdraws from regulation of the domestic market and encourages the integration of the market within China.

- *There has been too little investment in research and development*

There are significant returns to further investment in research and development that will raise the degree of self-sufficiency by raising yields of both grain output per unit of land area and of meat and other products per unit of feed.

- *Output would increase if the production system was reorganised*

The most important domestic reform is the redesign of agricultural production systems so as to yield greater scale economies.

- *Grain market issues are macro-policy issues*

The link between macroeconomic performance of the Chinese economy and movements of grain prices is the current key issue.

Mei's 1995 set of projections provides an example of one view of policy makers in China on prospects for the grain trade. The share of imports in consumption remains tiny. While consumption continues to grow rapidly, there is substantial scope, in Mei's view, to increase grain output. Luo (1995) makes a similar set of observations concerning the scope for output growth. Contributors in Mei's case include mainly return to research and development. Investment in research and development also plays a key role in promoting output growth in the IFPRI projection.

Guo (1995b) provides an example of the view that stresses gains from domestic market reform. He argues for a liberalisation of the state purchase price, the extension of subsidies to producers for inputs, the development of a national grain market and separation within the market of administrative and commercial functions, a 'balanced' trade in grain (exports and imports offsetting), and special provision for low-

income households to have access to grain. People supporting this position stress the role of government as managing some sort of reserve scheme or stabilisation mechanism (see Tang Renjian, 1995).

The analysis by Brown (1994) summarised above reinforced the position of those who are concerned about China's reliance on world markets for grain. World grain trade is currently of the order of 200 mt. Brown was forecasting imports by China of at least that (by 2030) and possibly of twice as much. This perspective has been challenged. China may well be a relatively large trader but what matters is: (a) the comparison of its consumption with world consumption, and (b) the supply response from the rest of the world following the growth in China's imports. A protectionist policy is actually more likely to be destabilising in the domestic market than is a strategy of combining domestic supply with the larger supply from the world market.

Some commentators in Beijing now accept, however, that imports will increase — the OECF 1995 report, conducted in conjunction with MoA officials, appears to have had some impact. The debate in this case moves on from outright rejection of use of the world market. The issues instead are the ability of China to export other products to earn the foreign exchange required to pay for grain imports, and the composition of the imports of grain, in particular, the choice between food and feed imports.

The link between grain prices and inflation has been a topic for debate in China and the issue has had some influence on policy.

One view being argued in Beijing is that the price of grain is a key component of movements in the general price level. Rising grain prices in other words lead to higher inflation rates. The policy implication drawn from this model is that grain prices should continue to be capped, or caps should be applied when appropriate. Price caps, however, can only be enforced alongside the reconstruction of the a marketing system in which state intervention and coercion play key roles.

This argument is assessed by Johnson and Song (1995) who argue that the more important relationship operates in the opposite direction. They argue that changes in the general price level can affect the relative prices of some commodities. The mechanism is that when households expect the rate of inflation to be high or increasing, they increase their grain stocks. Supply of grain in the market is reduced when stocks

increase and the price of grain rises (in both nominal and real terms). Grain stocks are held as a hedge against inflation in the absence of well-developed alternative forms of holding wealth. The use of grain for this purpose does affect grain prices in China: however, this effect would not be observed if domestic and international prices were more closely connected. Guo Shutian (1995b) also argues that the source of inflation is the level of investment in fixed assets, and that grain price rises merely reflect the response to this situation.

The implication of the Johnson and Song model is that intervention to cap grain prices will actually make worse the situation that the intervention is trying to control. Intervention of this type reinforces the expectation of higher future inflation rates. Grain stocks are further increased and the price of grain in the market place rises yet again.³³

The analytical aspects of these positions and the forces from the interest groups reviewed above are boiled down in the political process to produce a grain sector strategy. In their review of the emphasis in policy shifts over time, Garnaut, Fang and Huang (1996) identify what they call a turning in the Chinese policy debate on grain marketing arrangements.

Turning point?

Garnaut, Fang and Huang argue that previous policies which discriminated against agriculture are coming to an end. They go further to argue that there is a possibility that the Chinese will follow other high-income Northeast Asian economies into a regime which provides subsidies to producers. This policy could be operated by raising border prices of importable agricultural inputs, by the imposition of tariffs and quotas, rather than by paying explicit fiscal subsidies.

A change in policy in the direction of protection is a common one (see Anderson and Hayami, 1986). There is a strong positive correlation across a very large number of economies between the rate of change in discrimination in favour of farmers in agricultural pricing policy and (a), the growth of the level of incomes and (b), the loss of agricultural comparative

advantage. Contributors to this outcome are the differences in the costs of collective action by various interest groups in the policy-making process.

At the early stages of development, farmers face relatively high costs compared to urban employers and their workers. The result is a food pricing policy biased in favour of consumers. But as development occurs, these relative costs change and the policy regime shifts.

Garnaut, Fang and Huang observe data which show domestic prices of maize crossing over world prices (see Figure 1). They note in other East Asian economies the pattern of policy development, which is characterised by rapid increases in the rate of agriculture sector protection, and argue that in real terms China's income per head is now at levels similar to those at which the East Asian economies started to accelerate the protection of agriculture. So they say 'this is suggestive at least that this may be a time when China might face pressures to turn from taxing to subsidising agriculture'.

A fundamental factor associated with this tendency is the loss of comparative advantage in agriculture which occurs as a result of the growth in incomes, and the accumulation of factors of production used intensively in other activities such as manufacturing. The implications of this process for grain output were noted earlier. Shifts in output mix are also reinforced by reforms in the non-agricultural sectors; again, the development of markets for industrial products is an example. Others are the freeing-up of the foreign exchange market, the demonopolisation of the trading system, and the reduction in the use of quantitative restrictions on imports and exports, as well as the general reduction in the schedule of tariff rates. The benefits to producers of border protection for their products also depend inversely on the extent to which similar policies are applied to industries that produce agricultural inputs. For example, highly protective arrangements for other sectors such as energy or steel would reduce the gains to producers from agricultural protection.

Events in the world market also matter — for example, the removal of the multifibre arrangement, and China's eventual accession to the WTO, would also strengthen China's comparative advantage in manufacturing. WTO accession would also have implications for the protection which China could apply to the agricultural sector.

An important part of the political equation — the loss of agricultural comparative advantage — is

³³ Of course, the relationships could operate in both directions. Cheng Yuk-shing (1995) has argued that an upward spiral in the general price level can be triggered by an increase in the foodgrain price, in consequence of a wage indexation mechanism built into a model which he has constructed. This model also highlights the relationship between changes in grain prices and farmers' stockholding decisions.

certainly present in the Chinese case. There are, however, some substantial regional variations in the rate at which agriculture is losing its comparative advantage. The implication is that political pressure for a reversal of pricing policy is likely to vary between provinces.

A further qualification to this analysis is the extent to which China can increase yields (per unit of land area) in grain production (see Section 3). The various projections differ in their assessments of the scope to increase output, despite the pressure to reallocate arable land areas to other uses. Greater scope to raise yields will reduce the urgency with which other strategies designed to achieve a greater degree of self-sufficiency are pursued.

Garnaut, Fang and Huang also note some qualifications to the possibility of rising agricultural protectionism. China has relatively much larger endowments per capita of agricultural inputs than those of other East Asian economies. Agriculture's share of the Chinese economy is much higher than it was in other East Asian economies when protection accelerated. The share of the agricultural labour force in the total is also relatively high. These characteristics are offsetting factors in the political economy processes, which stress the ability of producers to organise to form an effective lobby and in which the burden on consumers of the transfers involved is a key parameter. Consumer willingness to pay the taxes on agricultural products depends on their significance in consumer budgets. The shifts in consumption bundles and the falling food share in income combine to reduce the significance of agricultural output taxes in consumer incomes.

A vision of Chinese food security³⁴

China over the period of economic reform has enjoyed large benefits from movements part of the way toward the use of markets for the allocation of resources and distribution of commodities in the agricultural sector. It has enjoyed an increase in the value of agricultural output from greater specialisation in each locality or region (Lin 1996). Production has also increased from more efficient allocation of scarce inputs across and within agricultural activities.

China's people have enjoyed an expansion in consumption possibilities across regional and seasonal specialities, through growth of wholesale markets and

long-distance trade (Xu 1996; Watson 1996). Market exchange and long-distance trade have contributed to stabilisation of the availability of food in each area, balancing with less cost and risk the inevitable variation in agricultural production. Also, the internationalisation of agricultural markets, despite being limited in extent, has given China a taste of the advantages that would come from going further: the role that larger grain imports took in dampening domestic price increases in 1995 and the contribution that large variations in cotton imports and exports have played in balancing fluctuations in domestic supply.

Each of these benefits has been limited by the highly constrained and cyclical nature of the movement towards a market economy. Local governments have placed myriad barriers against inter-regional trade within China, now reinforced by a return to emphasis on a high degree of regional self-sufficiency in grain. The price movements, which are central to the role of markets in equilibrating supply and demand for agriculture commodities, have been constrained from time to time by the re-imposition of controls and state purchase requirements. Officials have observed the rising or falling prices of markets at work, encouraging or discouraging production and consumption, and concluded that markets are not working. The role of markets in allocating agricultural inputs has been limited. Also, integration into international markets is greatly limited by central controls and the policy roles of state trading enterprises.

How would the completion of the process of market reform and integration into the international economy affect Chinese agriculture? How would a thoroughly market-oriented Chinese agriculture come to look? What additional improvements would be achieved in Chinese economic performance? What problems could be expected to arise?

To pose these questions is not to presume that the completion of market reforms would be easily, smoothly or cheaply achieved. Indeed, the stops and starts, the periodic retreats and the incomplete movements forward in the reforms are testimony to the difficulties experienced to date. Vested interests in central and local bureaucracies and interest groups which stand to lose from changes that bring benefits to the country as a whole have demonstrated that they have important roles in decision-making. Nevertheless, to answer the questions about the effect

³⁴ This section is an edited version of parts of Garnaut (1996).

of full movement to market exchange in the agricultural sector is to provide for the Chinese who hold responsibilities for the national interest a guide to the gains to be had from overcoming pressures from sectional interests.

A Chinese agricultural economy in which allocation and distribution were regulated by internationally open domestic markets would produce more economic value (with inputs and outputs appropriately measured in international prices). Some land that is still locked by regulatory arrangements into grain production would shift into higher-value cash crops of various kinds. Fertiliser production would expand until further increases were no longer justified by factory profitability at market prices; fertiliser use would expand until no further increase would raise farm profitability at market prices; and the market would allocate fertiliser to those activities that could use it profitably at market prices (Zhang and Zuo, 1996). Inter-regional specialisation and exchange would increase: in each locality, production of some items would expand and some contract.

Such an agricultural economy would be able to handle at lower cost, and with less price instability and less political tension, the fluctuations in demand that are inevitably associated with the cycle of weaker and stronger incomes growth, and the variation in supply deriving from flood, drought and other movements in seasonal conditions. The stocks held in one region would be varied in response to expectations of price movements in others, or in the country as a whole. There would be some balancing of excess demand for some product in one region with excess supply in others, diminishing the extent of equilibrating price movements in both.

In a Chinese agricultural economy the parts of which were linked to each other and to the rest of the world through markets, there would be large regional variations in prices of agricultural products, reflecting differences in economic conditions and high costs of transport and exchange. Some regions would have large surpluses of grain above the requirements of domestic production, with lower food prices, and strong advantages as locations for processing industries. Prices would be higher in provinces with poorer per capita endowments of agricultural land — in some cases perhaps above international levels. Prices in the major coastal cities would be closely linked to international levels, influencing prices throughout China only when domestic conditions

tended to move local prices away from international levels to an extent beyond the bounds of China's high internal transport costs.

Internationally, specialisation and trade would also increase, with production in China tending to fall and net imports to rise of commodities that use land relatively intensively. Production would tend to rise and net imports to fall at least for a number of years, for relatively labour-intensive agricultural products. It would probably be the case that net imports of grain would rise and net exports of at least some other foods rise at the same time.

The internationalisation would ease price instability associated with fluctuations in demand and supply within China of particular commodities or of total agricultural output.

China would share in the changes in prices, consumption and incentives for production that would follow from a large surge in demand or shock to supply anywhere in the world. Because the adjustment was spread so widely, some shocks would cancel out each other. The residual effect of any shock would generate proportionately smaller economic fluctuations in each part of the international system than it would in the region of primary impact if that region were closed to the rest of the world.

In a Chinese agricultural economy linked to the rest of the world through markets there would be important national international roles for government.

It is a mistake to think of an efficient market economy having none or a minimal level of government intervention, in agriculture at least as much as in other areas of economic activity. An efficient, market-oriented agricultural economy would assign a larger role to government in China than exists at present in some activities, and a smaller role in others. A larger role is required in setting and enforcing the commercial laws of commodity exchange, in the retail, wholesale, futures and other markets (Xu 1996). A larger and more effective role for government is required in agricultural research, extension, and provision of infrastructure including irrigation services. The role of government would diminish in setting and controlling prices, levels of foreign trade, and the amount of commodity composition of production.

Government roles, too, would be important in establishing conditions for efficient international cooperation. The arrangements between states that govern international trade would need to promote

confidence in secure supply. The role of government in research to extend the technological frontiers of agricultural production is often efficiently performed internationally, as there are large international spillovers from research activity. The international systemic benefits of China's opting for free trade in agriculture also justify some special efforts of international cooperation that increase incentives for China to move in this direction.

Detailed empirical research is required to define in more detail the shape of a market-oriented Chinese agricultural economy. In the nature of things, there would be surprises, although there is no reason to expect the surprises to be more bad than good. Nevertheless, uncertainty about outcomes generates concern about adverse development, and caution in reform.

In 1987, in the course of a long interview subsequently published in full over successive editions of the *World Economic Herald* in Shanghai, Ross Garnaut responded to questions about the future of Chinese reform with examples from agricultural policy.

'If China retains its current level of self-sufficiency in food and other agricultural products', he was accurately recorded as having said, 'China's people will have to accept a standard of living that is in some important respects low, even when the economy is productive in other ways. Much better results for the Chinese people would be possible if domestic price reform for agricultural products were accompanied by much closer links between domestic and international markets. With this solution, workers could enjoy the higher overall standard of living that they will expect to accompany successful modernisation in China'.

These and related comments gave rise to discussion among senior members of the Chinese Government. Garnaut (1996) refers to the views of Mr Du Runsheng who (in 1987) was Director of the influential Research Centre for Rural Development, following a long and distinguished role in agricultural policy, including in relation to the reforms starting in 1978. According to Garnaut, Mr Du identified two concerns. First, would an open Chinese agricultural policy generate net imports of grain that were so large that they led to a substantial increase in world prices, reducing radically the gains from trade for China, and creating problems for poor grain-importing developing countries elsewhere? Second, would the

additional foreign exchange requirements of an open agricultural policy be larger than China could expect to be able to meet securely by expansion of labour-intensive manufactured goods?

The answer to the first question required answers to several others. How would Chinese demand and production expand in the course of future reform and economic growth? How would these developments be affected by changes in prices? What prices would need to be offered in international markets to induce the expansion of production that would be necessary to meet the requirements of an open Chinese agricultural policy?

The answer to the second question required assessment of China's capacity to supply manufactured goods competitively onto world markets, and of the rest of the world's capacity and willingness to absorb the required additional amounts of Chinese manufactured goods.

The consequences of integrating Chinese and international markets for agricultural products have been discussed a great deal in China and abroad since those early conversations. Three other major concerns about deep integration into international markets have been frequently raised in China. Would the incomes of farmers and the rural population generally be lower within an open agricultural policy? Would high levels of food imports make China vulnerable to decisions by supplying countries to restrict trade for political reasons? And would food prices be more unstable if there were deeper integration into the international agricultural economy? Generally concern has focused on the grain situation, and especially on good grain, rather than food generally, reflecting China's long history of concern for security and price stability in grain supply.

Du Runsheng was deeply concerned for farmers' incomes, and in 1987 was mindful of several ways in which the opening of the Chinese agricultural economy to international trade would be favourable for income distribution. There was considerable scope for raising farmer incomes through greater internal specialisation within a domestic market economy, and through greater export specialisation in some labour-intensive agricultural products that were likely to expand in an open economy. Further, in 1987, domestic grain prices were well below international levels, so that internationalisation was likely to lead to higher farm prices.

Grain and other agricultural products

Lu Feng (1996a) has broken new ground in analysing the relationship between changes in the net exports of grain and of other agricultural products in the process of thorough-going market reform and integration into the international economy. Lu's analysis leads him to the view that an open trade policy in China, supporting specialisation in line with comparative advantage, is likely to lead to China becoming a large net importer of grain, but not a large net importer of food. Net imports of grain would be balanced to a considerable extent by net exports of their foodstuffs. Free trade is unlikely to generate a monotonic decline in the 'self-sufficiency' ratio for all food, 'let alone the alarming scenario of China starving the world'.

Lu presents data that demonstrate that China's comparative advantage is much stronger in fruit and vegetables, aquatic products and meat than in grain. China has a very low per capita endowment of arable land compared with the rest of the world, with about 22% of global population and only about 7% of global arable land. The relatively high proportion of China's work force still in farm employment makes the relative scarcity of land even more acute. At the same time, China has a relatively low per capita endowment of capital, with a long history of urban bias making the relative scarcity of capital even more acute in rural areas. Vegetable, fruit, meat and aquatic products are much more labour-intensive than grain. Fruit and vegetables utilise almost five times as much labour per acre of land as grain. Meat and freshwater fish utilise much labour and little arable land. In addition, demand for labour in grain is highly seasonal, and the other food production can be organised to increase demand for labour in off-peak times. Moreover, some of the other foods can utilise land that is unsuitable or marginal for grain production.

Lu observes that for all of these reasons, China's comparative advantage is, as the currently relevant margin, generally much stronger in fruit, vegetables, meat and aquatic products than in grain. The value of farm production, valued at international prices, would be greater to the extent that resources were shifted from grain production to other foods.

Lu demonstrates that his propositions have an empirical and not merely a theoretical basis by examining Taiwan's participation in international food trade in the course of its rapid industrialisation from the 1960s. Taiwan, like the Chinese mainland, only more so, began its rapid economic growth with

relative abundance of labour and relative scarcity of arable land. As industrialisation absorbed labour from the countryside, farm labour per unit of land became less abundant, and is now much lower than the mainland, while remaining considerably higher than in other advanced economies. As is now expected for mainland China, Taiwan's net imports of grain increased rapidly with industrialisation and integration into the international economy, despite increasing rates of protection for rice production. From a small net exporter of cereals in 1965, annual net imports of grain were around \$US one billion in the early 1990s and \$US 1.2 billion in 1995. Net imports of dairy products also rose to about \$US 250 million.

Over this same period, net exports of fruit, vegetables, aquatic products and meat rose rapidly. Taiwan's overall food self-sufficiency in calorific terms declined from well over 100% in the 1960s to about 40% in 1990. Remarkably, in *value* terms Taiwan remained a net exporter of food, albeit by declining amounts, until the 1990s. Net export revenue from fruit and vegetables peaked in 1980 and aquatic products at around \$US one billion in 1990. Net exports of meat continued to rise through the 1990s to \$US 1.35 billion in 1995.

Overall, Taiwan's net exports of food have declined late in its industrialisation process as real labour costs have increased. Taiwan now would have considerable comparative disadvantage relative to the mainland in many food products of which it remains a net exporter.

Lu notes that the partial internationalisation of China's food economy is already generating patterns of trade that resemble Taiwan's at an earlier stage in its own rapid growth. Grain and sugar imports have reached new peaks in the mid-1990s, with the highest level of net grain imports in 1995 at 20 mt. At the same time, net exports of all food have increased from near zero early in the reform period to \$US 2.3 billion in 1985 and \$US 3.8 billion in 1995. As in Taiwan, net exports of meat, fruit, vegetables and aquatic products have grown especially rapidly.

Lu acknowledges that more research is required to define the likely pattern of overall food trade in the process of rapid growth and internationalisation of the Chinese economy. He nevertheless is able to conclude that Chinese specialisation in line with comparative advantage is likely to generate high levels of other food exports alongside grain imports, easing the process of adjustment to internationalisation in the Chinese countryside.

Food security: self-sufficiency or international cooperation

We conclude by returning to the question raised by Du Runsheng and others, about the effects of integration into the world economy. Should increases or instability in world prices, shortages of foreign exchange, vulnerability to political blackmail, or concern about farmers' incomes inhibit movement toward greater use of markets in domestic or international trade? Would greater use of markets, including the world market, lead to more or less food security?

None of the recent work on the Chinese grain economy raises doubts about the presumption that the removal of barriers to internal and external trade will increase average output and incomes in China. The economic growth, to which trade liberalisation would contribute, strengthens food security by deepening the margins between consumption and subsistence.

Recent work has tended to raise expectations of gains in economic efficiency and output from greater regional and national specialisation within the grain sector.

Is there a danger of greater specialisation in international grain trade lifting world prices to levels that negate the gains? That depends on likely levels of net imports (and therefore of production and consumption) at various grain prices, and on the international supply and demand responses to variations in world prices.

On Chinese grain supply, earlier expectations that grain production would be highly sensitive to price increases have been borne out in the experience of the mid-1990s. Research reviewed above has indicated considerable technical capacity substantially to raise yields with current frontier technology, but has not yet thrown much light on the economic costs of unlocking this capacity. The evidence suggests that considerable public investment is warranted in research related to extending the technological frontier, in adapting to Chinese conditions innovations from abroad, and in extension to assist farmers to move closer to the technological frontier. Some combination of increased public and private investment in locality-specific research to define best practice is justified. What would these measures do to total supply? The measures appear necessary to raise total output in line with population over the next decade.

Total demand growth for grain has been interrupted and obscured by massive changes in

relative prices in the first half of the 1990s. Relative prices could continue to increase, slowing consumption growth, if China continues down the path of Northeast Asian protectionism, or if world prices remain well above the levels of the early 1990s and continue to rise. Otherwise, strong demand growth along the lines of mainland China in the 1980s or Taiwan from the mid-1960s to mid-1970s can be expected.

Virtually all analysts now expect high and rising levels of net imports under 'free trade' assumptions, from the considerable (well above last year's 20 mt) to the startlingly large. The serious modelling and informed eclectic analysis suggest that the international economy can meet the range of possibilities without increases in world prices that are so large as to seriously diminish Chinese gains from trade. The large and rapid global grain supply response to the temporarily high prices of the mid-1990s underlines the point.

Short-term world price instability is perhaps a greater concern. However, inspection of the data reveals that in recent years of high world price instability, Chinese domestic prices have varied even more widely. World grain markets will become more stable as more large grain economies, China most important of all, are integrated into them. Nothing in recent analysis or experience weakens the economists' presumption that a wider, global market is likely to be more stable than an efficient domestic market.

Foreign exchange concerns are less important in Chinese grain policy discussion now than in the 1980s. Chinese labour-intensive industry has sustained strong export growth over long periods. International markets have revealed a considerable capacity for adjustment, and the regional and international trade environment looks more favourable for the accommodation of increased Chinese exports than at any time in the reform period.

The modelling, empirical examination of Chinese comparative advantage and the experience of comparable economies suggest that farm incomes are likely to be higher with free trade than with 'self-sufficiency'. Lu Feng's work suggests gains for farm incomes beyond those previously anticipated, through respecialisation in labour-intensive activities. It should be noted as well that grain protectionism would diminish opportunities for potentially large exports of grain-intensive on-farm and processing activities that utilise farm and other rural labour.

The concern about political conditions being attached to grain trade has deep roots in China's history of the past half-century. It is worth examining carefully the experience of food sanctions in the post-war period, and analysing the realities of China's vulnerability. The United States of America, during the height of the Cold War, was unable to stem the flow of grain from its alliance partners (variously Australia, Canada and the countries of Western Europe) to China (the early 1960s) or the former Soviet Union (the late 1970s). There is currently considerable diversification of the sources of grain supply into the world economy, and this will continue with reform in South Asia, Latin America, Eastern Europe and the former Soviet Union. All the serious economic analysis suggests that, under free trade, Chinese domestic grain production would be well above the requirements of subsistence, and a smoothly functioning domestic market would facilitate adjustment to the highly unlikely restriction of supply.

If there is continued concern about the political reliability of international grain supply, various steps could be taken to reduce the risk. The mutual interest with supplying countries could be expected to generate cooperative approaches. One option might be

to establish supply security provisions in multilateral and bilateral trade agreements. A first step could be to examine whether rules on export embargoes that now apply in the WTO³⁵ would be sufficient to meet China's concerns or whether a strengthening is required. Another step is to establish and agree to a set of non-binding principles relevant to food supply security in the APEC process. Perhaps even more convincingly for China, supplying countries could be asked to make a proportion of sales to China from locally held stocks, which would come under Chinese control in the event of irreconcilable breakdown in political relations.

The mutual interest in Chinese grain trade liberalisation suggests other international cooperation. Internationalisation of grain markets would be more productive for China if world markets especially for labour-intensive foodstuffs were opening-up at the same time. The effective coverage of agriculture in the APEC free trade commitments of Japan, Taiwan and Korea is of special importance.

Finally, in the context of mutually beneficial Chinese grain trade liberalisation, it would be reasonable for China and its partners to expand cooperation in international public-good research in agriculture. The ACIAR programs in China are one mode.

³⁵ Article XI of the GATT rules out quantitative restrictions on exports, with some exceptions, and Article XIII rules out discriminatory application of such restrictions.

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