Changes in China's Meat Consumption Patterns: Implications for International Grain Trade

Praveen M. Dixit and Shwu-Eng H. Webb

Abstract: A world net trade model is used to study the consequences of changes in meat consumption patterns in China. Results suggest that such changes would considerably depress world grain prices, especially those for maize and rice. The study also shows that grain consumption requirements in China would fall by 8 percent and China would improve its agricultural balance of trade by $2,000 million. The study concludes that while self-sufficiency in grains may improve with consumption realignment, there would be real income losses because of the consumption distortions introduced.

Introduction

To meet its commitment to staple urban food supply and to maintain self-sufficiency, the Chinese government has consistently stressed grain production as a top policy priority, especially after the economic reforms of 1978, which allowed peasants to sell their surpluses after meeting their procurement quota. However, with the increase in freedom that followed reform, Chinese farmers shifted production into cash crops (e.g., fruit and vegetables) and livestock products, and grain production fell short of targeted production. Production stayed below the record 1984 levels for four years so that, in 1989, the government decided to make grain production again a top priority.

Procurement prices of food grains have been raised many times since 1989. The domestic wheat price is now well above the international price. Rice and maize prices have similarly also been raised. The government also adopted many measures to facilitate use of land for grain production. These measures, along with recentralization of production, raised grain production to a record level of 408 Mt in 1989, exceeding the 1984 level of 407 Mt. Available data indicate that 1990 grain production could even have reached 435 Mt.

Despite recent successes in grain production, China continues to have a lingering fear of its ability to feed a growing population and seeks to achieve the maximum possible level of food self-sufficiency. The Chinese Ministry of Finance estimates that grain requirements for the year 2000 could be 500 Mt. Several options are therefore being talked about to remedy the potential grain problem.

Greater market orientation is one such option. Several studies, including Dixit and Webb (1990) and Gunasekera et al. (1991), show that elimination of policies that tax grain producers and subsidize consumers could make China completely self-sufficient in grains. In addition, because more than 15 percent of the government’s budget goes into subsidizing urban consumption of grains and edible oils, unilateral policy reform would also generate budgetary savings of almost $8,000 million.

Another option, which is being increasingly discussed as a means to solve China’s grain problem, is to persuade the population to adjust its meat consumption behaviour. The objective of this option would be to steer consumption away from meats that have high feed-grain requirements to those with low feed-grain requirements. This latter scheme may be especially attractive if it can be achieved with minimal budgetary costs.

Adjusting Chinese meat consumption behaviour has another advantage. Given China’s low per-capita meat consumption levels, any increase in per capita incomes would be likely greatly to increase meat consumption and generate additional demands for grains. Hence, any measure to guide consumption away from meats that use grains intensively could be extremely beneficial.

Either of these options can be expected to have a tremendous effect on Chinese agriculture. And what happens to agriculture in China is of great interest to the world agricultural community. China is the world’s largest producer of grains, accounting for nearly 20 percent of global output in recent years. With 22 percent of the world’s population, China is also the largest consumer of agricultural products. Any change in China’s agricultural...
production and consumption can therefore be expected significantly to affect the world agricultural markets.

**Meat Consumption and Feed-Grain Requirement**

China consumes a considerable amount of pigmeat. Nearly 82 percent of China’s meat consumption (excluding fish products) is pigmeat, and its pigmeat total/meat consumption ratio is nearly twice the world average. Pigmeat, however, has a much higher feed-grain requirement than poultry. While each kg of pigmeat production requires 4.14 kg of grain, the ratio is only 3.2 for poultry (Table 1).

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Meat/Protein Ratio</th>
<th>Feed-Grain/Meat Ratio</th>
<th>Per-Capita Meat Consumption</th>
<th>New Per-Capita Meat Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigmeat</td>
<td>117.00 gm/kg</td>
<td>4.14 kg/kg</td>
<td>14.41 kg/year</td>
<td>6.86 kg/year</td>
</tr>
<tr>
<td>Beef</td>
<td>117.00 gm/kg</td>
<td>6.26 kg/kg</td>
<td>0.67 kg/year</td>
<td>0.34 kg/year</td>
</tr>
<tr>
<td>Sheepmeat</td>
<td>117.00 gm/kg</td>
<td>1.16 kg/kg</td>
<td>0.67 kg/year</td>
<td>0.00 kg/year</td>
</tr>
<tr>
<td>Poultry</td>
<td>156.00 gm/kg</td>
<td>3.20 kg/kg</td>
<td>1.72 kg/year</td>
<td>6.86 kg/year</td>
</tr>
<tr>
<td>Fish</td>
<td>103.00 gm/kg</td>
<td>0.87 kg/kg</td>
<td>5.40 kg/year</td>
<td>7.33 kg/year</td>
</tr>
<tr>
<td>Average</td>
<td>116.63 gm/kg</td>
<td>3.27 kg/kg</td>
<td>22.87 kg/year</td>
<td>21.39 kg/year</td>
</tr>
</tbody>
</table>


The first task in this study was to design meat consumption patterns that minimized feed-grain requirements. A linear programming model was built using the GAMS software to deduce the optimal meat consumption patterns. Because any unconstrained linear programming problem is more than likely to generate a corner solution that may seem rather unrealistic, a number of restrictions were imposed in determining the extent of changes in consumption habits.

First, it was assumed that, despite changes in meat consumption patterns, minimum protein intake from meats as represented by current levels would still be maintained. Second, it was assumed that pigmeat would account for at least 30 percent of Chinese meat consumption (including fish products, which are important in the Chinese diet). The figure of 30 percent was chosen because it reflects the pigmeat/meat consumption ratios in a number of industrial countries, including the USA. Third, because poultry products have low feed-grain requirements relative to other meats but about the same protein conversion ratio, it was assumed that at least 30 percent of meat consumption would be poultry. Fourth, because beef has the highest feed-grain conversion ratio, it was assumed that Chinese beef consumption would be no less than half the current levels. Mathematically, the procedures for calculating grain requirements under the proposed meat consumption patterns can be expressed as:

(1) minimize: \[ FG' = \sum (PC'_i \cdot FC_j) \cdot POP \]

subject to: \[ \sum (PC'_i \cdot PT_j) \cdot POP \geq \sum (PC_i \cdot PT_j) \cdot POP \]

\[ PC'_c \geq 0.30 \cdot \sum PC_i \]

\[ PC'_b \geq 0.50 \cdot PC_b \]

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where:  \( FG_i' \) = feed-grain requirement with change in meat consumption
\( PC_i' \) = per-capita consumption of meat \( i \) after change
\( PC_i \) = per-capita consumption of meat \( i \) before change
\( FC_i' \) = feed-grain/meat conversion ratio
\( PT_i \) = meat/protein conversion ratio
\( POP \) = total population in China in 1986 (1,057,210,000)
\( i \) = meat products, with \( p \) for pigmeat, \( b \) for beef, and \( c \) for poultry

Given the assumptions on behaviour changes but maintaining current levels of protein nutrients in the meat diet, pigmeat consumption would decrease by 52 percent to 6.86 kg per capita, and beef consumption by 50 percent to 0.34 kg per capita, while poultry consumption would increase by 300 percent to 6.86 kg per capita, and fish product consumption by 36 percent to 7.3 kg per capita. With these changes in consumption patterns, the protein content per kg of meat consumed would increase by 7 percent. Consequently, less meat (a decline of 6 percent) is required to maintain the same protein level, and feed-grain requirements would decline by 16 percent per kg of meat production.

Chinese policy makers may view changes in meat consumption patterns as a means to reduce grain use, but changes in meat demand will not in themselves lower China's grain requirements. Associated changes in livestock production have to follow if feed-grain use is to decline; otherwise, China—a net exporter of meat products—would simply produce the same quantity of livestock products but export surpluses to the world market. Because China's objective is to minimize grain use, the targeted consumption patterns were achieved by instituting production controls so as to meet modified domestic demand levels and yet maintain existing levels of meat exports.

The Modelling Framework

The economic implications of consumption reform in China are analysed using the Static World Policy Simulation (SWOPSIM) modelling framework (Roningen, 1986). A SWOPSIM model is a non-spatial price equilibrium model, an intermediate-run static model that represents world agriculture in a given year, and a multi-commodity, multi-region partial equilibrium model. In order to use this static, non-spatial price equilibrium model to describe world agricultural trade, it is assumed that world markets are competitive, that domestic and traded goods are perfect substitutes in consumption, and that a geographic "region," possibly containing many countries, is one market place.

The economic structure of SWOPSIM models includes constant domestic supply and demand equations. Trade is the difference between domestic supply and total demand (absorption). The policy structure is embedded in equations linking domestic and world prices. Policies (PSEs and CSEs) are inserted as subsidy equivalents at the producer, consumer, export, or import levels. Details on the economic and policy structures and the use of summary support measures in the modelling framework are presented in Roningen (1986) and Roningen and Dixit (1989).

The version of SWOPSIM used for this study (CH86) is based on 1986/87 marketing year data. The world is divided into 13 regions—7 of which represent the industrial market economies, 3 characterize developing countries, and 3 describe the centrally planned economies. Twenty-two agricultural commodities representing mainly temperate zone products are included in the model. Fish products, which could be a major source of relief for concern about Chinese grain self-sufficiency, are not included.

This paper presents the results of experiments using the CH86 model in which new equilibrium solutions are obtained by pegging consumption levels as specified earlier. The new solution represents an approximation of the resulting adjustments in production, consumption, trade, and prices of agricultural commodities expected after five years, with the important proviso that all other conditions remain the same as in the base year, 1986/87. This permits
the analysis to isolate and identify the differences between the new solution and the initial or reference solution and to attribute them to the changes in consumption patterns.

Realigning Chinese Consumption Patterns

Using the model and the modified grain requirements described earlier, we studied the economic implications of imposing changes in Chinese meat consumption behaviour. Two issues were of particular interest: how changes in consumption patterns would affect world commodity prices and how these changes would affect Chinese agricultural trade.

Effects on World Prices

Model results indicate that if China were to realign its consumption patterns so as to minimize production of grain-intensive meats but fulfill current protein requirements, world agricultural prices, on average, would fall by 3 percent (Figure 1). The drop in world prices would be large for rice (16 percent) and maize (8 percent), which together account for the majority (73 percent) of total feed use in Chinese agriculture. There would also be some drop in the price of wheat (3 percent) and oilseed products (4 percent). By contrast, world prices for beef, pigmeat, and poultry would change very little because Chinese production and consumption patterns alter such that net trade remains the same.

How do these changes compare with those resulting from unilateral Chinese policy reform (Dixit and Webb, 1990)? Figure 2 indicates that even though, on average, the declines in world prices are very similar, there are at least two major differences. Whereas there is no change in the world pigmeat price under consumption realignment, the increase in price is more than 10 percent under unilateral policy reform. Secondly, the grain price changes, especially for rice (4 percent), are relatively moderate under unilateral reform compared with consumption realignment (16 percent).

Effects on Chinese Trade

Chinese demand for cereals would fall by 8 percent (35 Mt) if consumption and production patterns were realigned along the lines proposed in this study (Figure 3). As a result, Chinese cereal exports would increase by 19 Mt. Maize (11 Mt) and rice (8 Mt) would account for most of the increase. In other words, China would be self-sufficient in cereals and switch from being a net importer to a net exporter cereals. Exports of oilseed products would also increase slightly (2 Mt), while trade in most livestock products would remain unchanged.
These changes in import patterns are somewhat different than those that would be achieved under unilateral agricultural policy reform. Dixit and Webb (1990) show that, with unilateral reform, Chinese cereal exports would remain virtually unchanged while exports of pigmeat would expand by 2.6 Mt. Given that pigmeat is a high-value product, China's agricultural balance of trade would improve by $6,400 million under unilateral policy reform but by only $2,300 million under consumption reform. From a foreign exchange perspective, therefore, the gains in export revenues from trade liberalization are more appealing.

Such differences in trade patterns between the two reform options occur largely because livestock trade is maintained at existing levels under consumption reform, forcing all adjustments vis-à-vis the world grain market. Under unilateral policy reform, on the other hand, both the grain and livestock sectors in China can respond to changes in world market conditions and so the adjustment for any one sector is much less.

**Limitations of Analysis**

The economic implications of changes in Chinese meat consumption behaviour are likely to be different depending on the year under consideration. This study uses the 1986/87 marketing year as the basis of analysis. In many respects, it is probably more reasonable to examine the issue at a future date—the year 2000 or later—when China could be expected to import grains if current population and production trends continue.

This study assumes that modified Chinese consumption patterns are achieved through production and trade control measures. But whether this can be achieved in reality is doubtful; much of what is consumed in China is based on on-farm production and monitoring and maintaining proposed production régimes may be difficult. Rationing or taxing meat consumption could be another means of achieving the desired levels, but whether such rationing could be successful in practice is quite another question. Political unrest over the price of staple foods is a feature of many developing countries that the political hierarchy in China may not wish to import.

Finally, there is also the issue of how one establishes the minimum levels of consumption. In this analysis, it is assumed that at least 30 percent of meat consumption would be pigmeat, based on levels existing in some industrial countries. Realistically, 30 percent could be a rather difficult target to achieve, and minimum levels more reasonable than this may have implications very different than those presented in this paper.

**Conclusion**

One of China's main concerns is to achieve the maximum possible level of grain self-sufficiency. The objective is to ensure that China does not have to rely too heavily on international markets for grains. The results indicate that the self-sufficiency ratio for grains increases from 0.98 to 1.05 with consumption realignment. Under free trade, the ratio rises to 1.
From a self-sufficiency perspective, therefore, there is little doubt that the Chinese government should favour consumption realignment. Consumption realignment, however, is not without costs. Whereas unilateral reform would generate real income gains of $2,500 million to the Chinese economy, consumption realignment would cost $1,600 million. Similarly, increases in export earnings would be nearly $6,000 million under unilateral reform but only $2,000 million under consumption realignment.

Self-sufficiency, however, can be viewed in a number of respects. Traditionally, it is defined as a country's ability to produce that quantity of food necessary for subsistence. Alternatively, it may be defined as a country's ability to acquire enough foreign exchange earnings to purchase necessary food requirements from the world market. The analysis focused on the former definition of self-sufficiency. If the latter approach were adopted, then the emphasis would be to strengthen the sector in which China would appear to have a comparative advantage—the labour-intensive pigmeat industry.

The choice for China is pretty clear. China can either pursue consumption realignment and achieve greater food self-sufficiency or undertake unilateral policy reform and achieve lower levels of self-sufficiency with increased real income (efficiency) gains. The challenge for China is to recognize the benefits of freer agricultural trade and yet not compromise on some of its domestic food concerns.

Note

1US Department of Agriculture.

References


Discussion Opening—Thomas Wahl (Washington State University)

This paper provides an interesting and useful analysis of the effects of changing China’s meat consumption pattern upon international grain markets. The results are a beginning point for discussion. However, the analysis falls short of adequately examining the problem using the SWOPSIM model.

Alternative consumption patterns that are more realistic for China need to be considered. The consumption patterns imposed on the model reflect western biases and, further, they would force tremendous adjustments in China’s livestock infrastructure to meet them.

Fish consumption and production are nearly ignored in the paper, despite the popularity of fish with consumers, the Chinese government’s commitment to increase fish production, and the much greater efficiency of fish production. From Table 1, dividing the meat/protein ratios by the feed-grain/meat ratios should suggest the number of grams of protein produced from 1 kg of feed grain. The ratio is 28.3 gm/kg for pigmeat, 48.8 gm/kg for poultry, and 118.4 gm/kg for fish. These ratios clearly suggest that fish production uses less feed grain to produce protein than does poultry production.

The elasticities and PSEs used in the model are not presented; nor is an analysis of the sensitivity of the results to the assumed elasticities. The relative prices of poultry and pigmeat are not discussed. Currently, the poultry price is as high as that of pigmeat. The relative prices necessary to induce consumers drastically to alter their consumption pattern are not presented.

In summary, the paper is the beginning of a useful analysis of Chinese meat consumption. However, alternative consumption patterns, fish production levels, and elasticities need to be considered.

[Other discussion of this paper appears on the following page.]
General Discussion—Csaba Forgács, Rapporteur (Budapest University of Economic Sciences)

Several issues connected with intersectoral analysis of the agricultural and industrial economies were discussed. It was argued that the conclusions drawn by Koo and Lin indicated no cause and effect relationship between the two sectors of the Chinese economy. Two methodological aspects were mentioned. First, if industrial goods such as fertilizers or chemicals had been chosen for analysis, a stronger correlation might have been observed. Second, if the industrial sector had been divided into two parts, rural industry and the rest of industry, the results would have been different, and the positive impact of the agricultural machinery industry could have been estimated.

The second key point of the discussion was Chinese meat consumption patterns. Although the usefulness of long-term analysis was emphasized, counter arguments, connected with model assumptions applied, related to their consistency and reality. It was also mentioned that the meat consumption level of one country cannot be applied automatically to another country. The questionable model assumptions may lead to results that cannot give a basis for the conclusions taken. Although models always simplify the real world, model assumptions have to be set up carefully, and variables should be defined exactly to obtain reliable results.

Participants in the discussion included He Xiping (Beijing Agricultural University), J.Y. Lin (Development Research Center of the State Council, China), Liu Xiaqiu (Chinese Academy of Agricultural Mechanical Sciences), F.C. Tuan (US Department of Agriculture), Xiao Hui (Beijing Agricultural University), and Zhang Cungen (Chinese Academy of Agricultural Sciences).