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A General Equilibrium Analysis of Macroeconomic and Trade Policy Changes in China

Implications for the Grains Market

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Excess demand in major sectors of the economy, an overvalued domestic currency, a high level of government support to heavy manufacturing industries and implicit taxation of agriculture continue to persist in China despite the economic reforms undertaken since 1978. Given this background, the focus in the paper is on the implications for the Chinese grain market of a reduction in domestic absorption, a devaluation of the official exchange rate and changes in some key trade policies. To analyse these implications a general equilibrium model of the Chinese economy is used. The results indicate that China's ability to earn the foreign exchange that is required for grain imports could be increased by policy reforms such as the devaluation of the already overvalued official exchange rate and the reduction of implicit export taxes imposed on key farm products like rice. Furthermore compared with the trade policy reforms, macroeconomic policy changes such as changes in absorption and in the official exchange rate in China are likely to have greater impacts on the overall economy.

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Introduction

In 1978, China began a program of modernisation and economic reforms. Opening up to the outside world has been a major part of this program. The process of economic reforms undertaken since 1978 has been the major factor behind China's strong economic performance over the past decade. These reforms first began in the agricultural sector and were extended to the rest of the economy in 1984. The main achievements of the reform programs have been to improve economic incentives and to decentralise economic decision making, and consequently to increase the role of markets. Despite the generally favourable overall performance in the Chinese economy following the reforms, several problems continued to persist, including: competition between the planned and the non-planned sectors for resources; a distorted pricing system with major input prices well below world prices; excess demand in major sectors of the economy; high level of government support to inefficient industries, particularly in the capital intensive manufacturing sector; implicit taxation of many agricultural industries; and an overvalued, non-convertible currency (Anderson 1990; Martin and Warr 1990; Webb 1989; World Bank 1990a).

Associated with the process of economic reforms in China in recent years has been a rapid growth in demand in many sectors of the economy (Blejer and Szapary 1990). In 1988, for example, these demand pressures led to an unprecedented surge in inflation, reaching close to 30 per cent by the end of the year. During this period, the agricultural sector performed poorly, with shortages of key inputs and a fall in grain output. By the end of 1988, the Chinese government began implementing measures to contain inflation. These measures included the introduction of contractionary macroeconomic policies and use of administrative measures to restrain demand and stem the diversion of resources from the planned to the non-planned sector where prices were higher. There was a marked slowdown in economic activity in response to the government's contractionary policies. In 1989, the economy grew at only 4 per cent compared with over 11 per cent in 1988. This experience clearly underscores the importance of developing appropriate macroeconomic instruments to govern an economy as it evolves toward a new economic structure. Otherwise, the reform process may be disrupted by 'stop–go' cycles that negate the very benefits that the reforms were designed to bring (Blejer and Szapary 1990).

Despite China's poor overall economic performance in 1989, agricultural production recovered strongly in that year. Although, over time, the agricultural sector in China has progressively declined, it still accounts for just over a third of China's gross domestic product and absorbs 60 per cent of the total labour force. On average, agriculture's share of total exports and imports has been 16 per cent and 10 per cent, respectively, in recent years. At present approximately 50 per cent of gross value of agricultural output in China is derived from grain.

The mix at present in domestic grain output is rice (45 per cent), wheat (14 per cent), coarse grains (30 per cent), tubers (7 per cent) and soybeans (4 per cent). Total grain production in 1989 was 407 Mt, up 3.2 per cent from 1988. China is a net importer of grains. Wheat imports averaged 10.7 Mt a year over the period 1960–88, reaching a record 15 Mt in 1987. Australia, Canada and the United States have been the major suppliers of wheat to China. Since 1972 the United States has in some years shipped over 60 per cent of total Chinese imports. On average, between 1985-86 and 1988-89 wheat exports from Australia to China accounted for nearly 18 per cent (2.4 Mt) of total Australian wheat exports.

Given this background, the objectives in this study are to examine the effects on China's grain sector of reducing domestic absorption (that is, private and public sector expenditure on consumption and investment), depreciating the overvalued Chinese currency and lowering the level of trade distortions in key agricultural and non-agricultural industries in China.

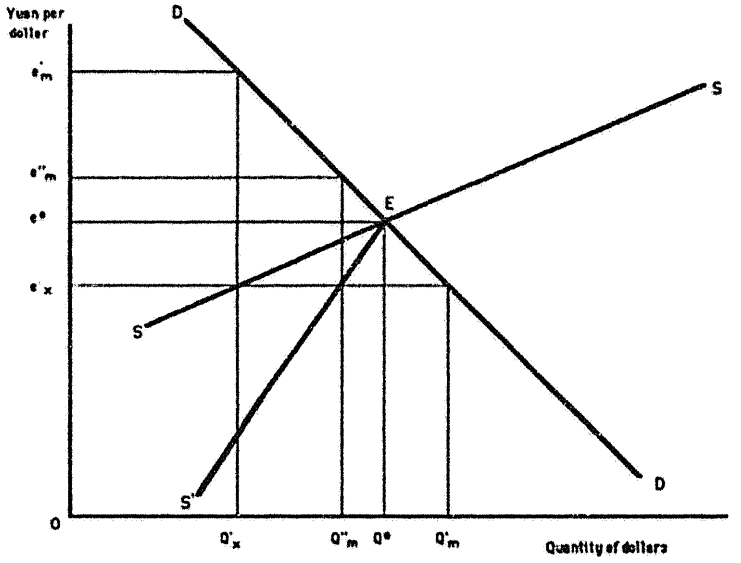
In the next section an overview is provided of the conceptual framework within which domestic absorption, the exchange rate and trade distortions in agriculture and industry in China are examined. The modelling framework used in quantifying and analysing these issues is explained in the third section. In the fourth section the effects on the Chinese grain sector of a reduction in domestic absorption, a devaluation of the official Chinese exchange rate and changes in trade policy are discussed. In the final section some implications are considered, particularly in relation to the capacity of China to import grains.

Conceptual Framework

The approach undertaken in analysing domestic absorption in China involves two steps which could bring about internal and external balance. First, a reduction in absorption and, second, a real devaluation (where the price of non-traded goods would fall relative to the price of traded goods) (Salter 1959; Dornbusch 1980). In China, instruments such as government spending can be used to reduce total absorption (Portes 1979; Reynolds 1983). The relative price changes required to restore external balance could be brought about by holding the general price level in China constant using monetary policy controls and then devaluing the official exchange rate (Chow 1987; Feltenstein and Ziba 1987; Martin 1990a).

When analysing the overvalued currency in China, it is important to focus attention on the foreign exchange system operating in China. Following Desai and Bhagwati (1981) and Martin (1990a) the foreign exchange market operating in China can be described with the use of Figure 1. As illustrated in Figure 1, in equilibrium, Q^* units of foreign exchange is supplied and demanded at an exchange rate e^*, if DD and SS represent the demand and supply curves in

Figure 1: The market for foreign exchange in China



a foreign exchange market respectively. However, when the exchange rate is officially set at an overvalued rate e'_x as in China, the supply of foreign exchange is given by Q'_x. At the official rate, e'_x, the demand for foreign exchange, Q'_m, would exceed the supply, Q'_x. In order to avoid a run down in foreign exchange reserves, the government restricts the availability of foreign currency for would-be users to Q'_x which raises its scarcity value to e'_m. Therefore e'_m represents the 'secondary' market price for foreign exchange.

Under the foreign exchange retention arrangements, in practice, China does allow enterprises or the provincial authorities responsible for enterprises to retain a proportion of their foreign exchange earnings. As indicated by Martin (1990a,b) the impact of this foreign exchange retention scheme is to increase the incentive to export and hence to shift the supply curve of foreign exchange to the right over the portion of the curve for which foreign exchange remains in shortage, that is from SE to $S'E$. This increases the quantity of foreign currency available domestically to Q''_m thereby reducing its scarcity value in the 'secondary' market to e''_m. The higher the retention rate is, the greater is the rightward shift in the foreign exchange supply curve. The recently introduced foreign exchange contract system allows enterprises a higher retention rate for above-plan exports. The implication of these reforms is to force the secondary market exchange rate closer to the equilibrium exchange rate, e^*, as shown in Figure 1. However, in general, the overvaluation of the exchange rate has an adverse impact on the production of exportable goods.

When examining the impact of changes in trade policy in agricultural and non-agricultural industries in China, it is important to recognise that distortions arise from both the foreign trade

system and the foreign exchange system. Within China's foreign trade system, various measures ranging from tariffs to subsidies on tradable commodities are imposed. These trade distortions may vary from commodity to commodity and even from enterprise to enterprise (Martin and Warr 1990). Recent studies (Webb 1989; Anderson 1990) of agricultural policy developments in China suggest that most agricultural industries are implicitly taxed in China and that there is a policy bias toward manufacturing relative to agriculture despite the boost in farm product prices during the past decade. Furthermore, industrial policies in China, as in many other developing economies, have provided the more capital-intensive manufacturing industries with a much higher level of assistance than the more labour-intensive manufacturing industries in which China has a strong comparative advantage. This bias appears to have weakened somewhat during the 1980s (Anderson 1990).

The foreign exchange system in China allows trade taxes to be imposed in addition to the taxes imposed under the commercial policies associated with the foreign trade system. These tax effects reflect the degree of overvaluation of the Chinese currency. In the absence of foreign exchange retention arrangements, it imposes a uniform tax on all trade. Once foreign exchange retention arrangements are introduced, these taxes become non-uniform, varying by region, by type of enterprise and by commodity (Martin and Warr 1990).

Modelling Framework

There is a variety of possible approaches to examining the effect of macroeconomic and trade policy changes on commodity trade, including the use of single commodity partial equilibrium models and general equilibrium models. As Chambers and Just (1979) have demonstrated, to examine the impact of changes in variables such as the exchange rate which affect a wide range of sectors, it is necessary to take account of the interactions between sectors. Therefore, it is more appropriate to use a general equilibrium model rather than a partial equilibrium model to capture the interactions between commodities and between sectors in production and consumption within the economy.

A general equilibrium model is used in this paper to analyse the effects of a reduction in absorption, devaluation of the official exchange rate and a reduction in trade distortions in the agricultural and non-agricultural industries on China's grain sector in general and on the import demand for grain in particular. The model is based on a comparative-static general equilibrium model of the Chinese economy developed by Martin (1990a). This model has been used previously by Martin (1990a) and Martin and Warr (1990) to study the Chinese textile industry and also to address key issues related to agricultural production and trade in China.

Empirical evidence suggests that the changing intersectoral structure and comparative advantages of China during the past four decades are consistent with expectations based on the standard neoclassical trade and development theory (Anderson 1990). There is further evidence that the proportion of output marketed at free market prices for many commodities has increased substantially during the past decade (Sicular 1988). Hence, the general equilibrium model developed by Martin (1990a) provides a useful economywide framework for analysing macroeconomic and trade policy changes in China.

As a detailed description of the model used here is given in Martin (1990a), only a brief overview is provided below. The model is designed to represent the post-reform Chinese economy in which free market prices provide signals to guide resource allocation and consumption decisions. The model employs basic techniques drawn from neoclassical price-responsive general equilibrium models, with modifications for the special features of the Chinese economy.

The model has three primary factors – capital, land and labour. Capital and land inputs are sector specific while labour is mobile. Primary factor inputs are aggregated into a composite input using a constant elasticity of substitution (CES) function. Intermediate inputs are assumed to be used in fixed proportions to industry outputs and the composite primary factor input.

For many goods, there are marked differences between the products produced for the export market and those produced for the domestic market. This product differentiation also extends to domestic and imported products consumed. Hence, following Armington (1969), domestic goods, exports and imported products are regarded as imperfect substitutes in the model. The demand for an export good in the model is determined by the price of China's exports relative to the price of exports from the rest of the world, and the total demand for that particular commodity. The supply of imports is specified as a function of the world price of imports, allowing for the possibility of China being a 'large' or a 'small' trader in particular markets. For example, in the case of grain markets, China is regarded as a 'large' trader in the model.

Although most of the attention is focused on the behaviour of real variables in the model, a simple monetary sector is also incorporated into the model to allow determination of the aggregate price level as a numeraire. The model is solved, not in terms of the levels of the variables, but in a linearised form in which the variables explicitly appearing are percentage changes of the original variables (Johansen 1960).

The basic data for the model were taken from the World Bank (1985) input–output table for China for 1981, the latest currently available. This table has the advantage of having been

prepared using the system of national accounts conventions, rather than the 'material product system' used in China's input–output tables. Some use was also made of the China's input–output tables for 1981 published by the State Planning Commission and State Statistical Bureau (1987). A detailed description of the construction of the complete database used in the model is given in Thompson (1990). Given that the basic database is based largely on official prices, rather than the free market prices which are relevant for resource allocation at the margin, the input-output and price data were adjusted to reflect the free market rather than official prices for material inputs. This price adjustment was made with a set of relativities between official and free-market prices collected in 1985. The adjustment was made on the assumption that the (largely) planned system operating in 1981 in China resulted in the same broad structure of the economy (in terms of sectoral output) as would have resulted from a more market oriented system (see Anderson 1990 for evidence that this is a reasonable assumption). Another feature of the basic database was the high degree of aggregation of several industries including crops.

The modified input–output table for China on which the model is based is presented in appendix A. It contains 27 sectors. Separating out the sectors not explicitly identified in the original input–output table (World Bank 1985) necessitated the use of information from a wide range of sources as detailed by Thompson (1990). In addition to the input–output data described above, the model required several sets of other information. These included consumer demand elasticities, elasticities of substitution between domestic and imported goods, elasticities of transformation between domestic and export goods, elasticities of substitution between Chinese exports and the exports of other countries, elasticities of demand for total world exports, elasticities of supply of imports to China and elasticities of substitution between primary factors. Details of these elasticities and their sources are provided in Martin (1990a). The set of equations making up the model is presented in appendix B together with the definitions of the variables and coefficients. The model is linear in percentage changes and was solved using the GEMPACK program (Codsi and Pearson 1988).

As the emphasis of this study is on China's grain crops, it required more detailed disaggregation of the crops sector than was available in the original Martin (1990a) model. A special purpose version of the model with a more disaggregated crops sector was therefore constructed.

The crops sector in China is modelled here as a multiproduct industry using primary factors and materials to produce four commodities – rice, wheat, coarse grains and other crops. In the model, the output production technology used for the crops sector is a CET (constant elasticity of transformation) specification. While these four crops are produced jointly, the mix of products depends on relative prices. In the absence of any econometrically estimated elasticity of substitution between commodities in the Chinese crops sector, a parameter value of 2 used

for similar commodities in computable general equilibrium models (Higgs 1986) is used here. The potential within the (multiproduct) crops sector for transforming production away from a particular commodity (say wheat) toward the other commodities (say rice, coarse grains and other crops) is reflected in this parameter. On the demand side of the model, the intermediate and final consumption shares of rice, wheat, coarse grains and other crops were derived from the US Department of Agriculture (1989) commodity balance sheets specifically developed for China.

Policy Experiments and Results

The computable general equilibrium model described in the previous section is used to carry out three policy experiments designed to analyse the effects on China's grain sector of a reduction in absorption, devaluation of the official exchange rate and changes in trade policy. These policy experiments are:

- a 1 per cent reduction in aggregate real domestic absorption in China;
- a 10 per cent nominal devaluation of the official exchange rate (yuan per dollar) with the aggregate price of absorption held constant;
- two key trade policy changes:
  - a 10 per cent reduction in implicit tariffs for three highly protected manufacturing industries in China – chemicals, chemical fibres and machinery, which collectively account for nearly 45 per cent of total imports in China;
  - a 25 per cent reduction in the implicit export tax on rice, one of the heavily taxed agricultural industries in China, where the implicit export tax reflects the difference between the world price and what the producers actually receive for the goods exported.

The retention rate for foreign exchange earnings was assumed to remain at 25 per cent for all industries in all the experiments. It is important to recognise that the actual magnitudes of the policy changes undertaken in these experiments are chosen for illustrative purposes. Given that the model is linear in percentage changes, any particular magnitude of a policy change, say a 'k' per cent reduction in absorption will be equal to 'k' times the 1 per cent reduction in absorption undertaken in this study.

Absorption

A change in aggregate real absorption can be expected to have at least two major effects. First, it will lead directly to changes in the demand for particular goods. Second, it will set in train changes in relative prices to bring about the required substitution between traded and non-traded goods. A decrease in total absorption can be expected to reduce the price of non-traded goods relative to the price of traded goods (Salter 1959). To allow a decline in the price of non-traded goods with a fixed aggregate price of absorption (as is assumed in the model used in this analysis) requires a rise in the domestic price of imports, or a nominal exchange rate depreciation. Total exports increase as the lower price of non-traded goods diverts production from non-traded goods to exports. Total imports fall in response to the reduction in total absorption.

The first experiment involves an across the board reduction in all components of aggregate real absorption. This experiment provides a useful benchmark case for evaluating the effects of expenditure reduction programs conducted as part of a macroeconomic stabilisation program. A key feature of the results of this experiment is the sensitivity of both total imports and of grain imports to changes in aggregate absorption levels (Table 1).

A reduction of 1 per cent in aggregate real absorption is estimated to lead to a decline of about 9 per cent in the total volume of imports, with falls of over 7 per cent in wheat imports, 14 per cent in coarse grains imports and almost 17 per cent in imports of other crops. A major factor contributing to these results are the small shares of trade in domestic production and consumption both for the economy as a whole and for the grain sector in particular. Despite a dramatic increase in the exposure of the Chinese economy to international trade since the late 1970s, total exports were only 14 per cent of gross domestic product in 1988 (World Bank 1990b). Wheat imports accounted for only 11 per cent of total wheat supply in China in 1987 (US Department of Agriculture 1989). The implication of the analysis here that import volumes are likely to be very sensitive to changes in aggregate absorption is consistent with the observed volatility of output, exports and imports in general. Both at the aggregate level of trade and for grain trade in particular, import volumes have tended to be considerably more volatile than production.

The exchange rate

In the second experiment, where the official exchange rate in China is devalued (with the money supply and the real absorption assumed to be fixed), an important consequence is the stimulatory effect on the export sector. The growth of the export sector can be attributed to the rise in sectoral efficiencies induced by the official exchange rate adjustment. For example, the 10 per cent fall in the official exchange rate with the aggregate price of absorption held constant brings about an increase in the total volume of exports of nearly 11 per cent (Table 1). This

TABLE 1

Changes in China's Grain Market: Experiments 1 and 2

Variable	1 per cent reduction in absorption (experiment 1)	10 per cent devaluation of official exchange rate (experiment 2)
	%	%
Macro variables		
Real gross domestic product	–0.74	0.88
Real wages	–1.09	0.69
Volume of exports	3.42	10.87
Volume of imports	–9.28	10.53
Price of secondary market exchange rate	7.79	–7.44
Sectoral variables		
Import prices		
Wheat	4.87	–4.75
Coarse grains	6.19	–5.94
Other crops	7.63	–7.28
Export prices		
Rice	1.56	2.93
Volume of imports		
Wheat	–7.30	6.70
Coarse grains	–13.83	12.90
Other crops	–16.64	15.91
Volume of exports		
Rice	10.62	11.63
Domestic production		
Wheat	1.71	–1.96
Coarse grains	–0.21	–0.03
Other crops	–0.06	–0.27
Rice	–0.25	0.12

expansion in exports leads to an increase in the supply of foreign exchange, which contributes to a fall of over 7 per cent in the price of foreign exchange in the secondary market. This leads to a lowering of the cost of imports and results in an expansion in imports, including grain imports to China. For the 10 per cent devaluation of the official exchange rate considered in this experiment, the volume of imports of wheat increase by nearly 7 per cent and imports of coarse grains and other crops each increase by 13 per cent and 16 per cent respectively.

Another potentially important macroeconomic effect of devaluation is its impact on wages. The expansion of relatively labour intensive export-oriented industries such as textiles and apparel would be expected to result in an increased demand for labour following devaluation. This strengthens the aggregate demand for labour sufficiently to raise real wages marginally (Table 1).

Trade policy

Results of the final experiment on key trade policy changes are presented in Table 2. Reduction of trade distortions in chemicals, chemical fibres and machinery leads to a reduction in domestic production and an increase in imports of these goods. For example, the 10 per cent reduction in implicit tariffs on chemicals, chemical fibres and machinery contributes to increases in the volume of imports of these goods of approximately 10 per cent, 2 per cent and 11 per cent respectively. The need for additional foreign exchange to finance the rise in these imports exerts upward pressure on the price of foreign exchange in the secondary markets in China. This implies that other imports will have to compete with the imports of chemicals, chemical fibres and machinery. Although total imports rise, there is a decline in grain imports.

A 25 per cent reduction in the implicit export tax on rice leads to an expansion in the volume of rice exports by about 80 per cent. Consequently, the total volume of export from China also increases marginally. The additional foreign exchange earnings generated by increased exports contribute to a small fall in the secondary market price for foreign exchange in China. This leads to a minor lowering of the import prices of many commodities including grain.

Sensitivity analysis

The question naturally arises as to how sensitive the results are to changes in the values of the various parameters. The emphasis here is on four sets of key parameters relevant to the present study, namely the elasticity of substitution between commodities in the crops sector, elasticities of substitution between domestic and export goods, elasticities of substitution between Chinese exports and the exports of other countries, and elasticities of substitution between domestic and imported goods.

TABLE 2

Changes in China's Grain Market: Experiment 3

Variable	10 per cent reduction in implicit tariffs on chemicals, chemical fibres and machinery	25 per cent reduction in implicit export tax on rice
	%	%
Macro variables		
Real gross domestic product	0.20	0.05
Real wages	0.81	0.34
Volume of exports	2.46	0.61
Volume of imports	2.30	0.65
Price of secondary market exchange rate	2.64	–0.56
Sectoral variables		
Import prices		
Wheat	1.95	–0.54
Coarse grains	2.25	–0.27
Other crops	2.60	–0.40
Chemicals	–7.26	–0.55
Chemical fibre	–7.34	–0.56
Machinery	-7.25	–0.55
Export prices		
Rice	0.78	16.67
Volume of imports		
Wheat	–1.72	0.71
Coarse grains	–3.33	1.40
Other crops	–3.99	1.61
Chemicals	9.71	0.55
Chemical fibre	1.92	0.03
Machinery	10.68	0.66
Volume of exports		
Rice	1.11	80.50
Domestic production		
Wheat	0.54	–0.25
Coarse grains	0.04	–0.03
Other crops	0.07	–0.09
Rice	0.02	0.78
Chemicals	–0.20	–0.03
Chemical fibres	–0.75	–0.09
Machinery	–0.73	–0.08

To test the sensitivity of some important model results to these parameters, a method proposed by Pagan and Shannon (1984) was used. This method involves computing 'sensitivity elasticities' for the key parameters – that is, the percentage changes in the results produced by a 1 per cent change in a parameter value. Pagan and Shannon (1984) suggested that key parameter changes of at least 33 per cent should be considered in a sensitivity analysis of this kind. Model results are considered sensitive if the absolute value of the sensitivity elasticity is greater than one.

In order to test the sensitivity of the model results, the first and the second experiments were repeated, with the elasticity of substitution between commodities in the crops sector in turn reduced by 75 per cent while all the other parameters were held at their 'benchmark' values. Furthermore, the first and the second experiments were repeated again three times, with each of the other key parameters mentioned earlier in turn reduced by 75 per cent (for all of the sectors simultaneously) while all the other parameters were held at their 'benchmark' levels.

The results of the sensitivity analysis are given in Table 3. For example, a 1 per cent reduction in the elasticity of substitution between commodities in the crops sector leads to a 0.02 per cent fall in the price of foreign exchange in the secondary markets in China relative to the

TABLE 3

Sensitivity Elasticities of Some Key Model Variables with Respect to Changes in Key Parameter Values: Experiments 1 and 2

	Parameter			
Variable	Elasticity of substitution between commodities in the crops sector	Elasticity of substitution between domestic and export goods	Elasticity of substitution between Chinese exports and exports of other countries	Elasticity of substitution between domestic and imported goods
Experiment 1				
Price of secondary market exchange rate	-0.02	-0.22	-0.19	-0.68
Total export volume	-0.03	0.61	0.55	-1.55
Total import volume	0.02	-0.31	-0.20	0.54
Volume of wheat imports	0.27	-0.27	-0.24	0.37
Experiment 2				
Price of secondary market exchange rate	-0.01	0.57	0.51	-0.71
Total export volume	0.01	0.61	0.54	0.58
Total import volume	0.02	0.61	0.54	0.56
Volume of wheat imports	0.40	0.57	0.53	0.34

benchmark experiment results. The lower this parameter, the smaller will be the potential within the crops industry for transforming production, for example, away from rice and coarse grains toward wheat. This would enable China to maintain a higher level of rice exports compared with a situation where there is greater potential for transformation of production within the crops sector. Consequently it would generate a higher level of foreign exchange leading to a fall in the secondary market price of foreign exchange.

If the sensitivity of the secondary market price for foreign exchange, and export and import volumes can be taken as a general guide, the results in Table 3 suggest that the results of the experiments are relatively robust around the current values of the key parameters.

Concluding Remarks

According to the results of the macroeconomic policy experiments undertaken in this study even quite small changes in aggregate real absorption in China may have considerable effects on trade volumes, particularly on the volume of grain imports to China. Consequently, any reduction in imports of grain emanating from a cut in absorption in China is likely to have an adverse impact on grain exporting countries such as Australia. Given the foreign exchange system operating in China at present, changes to the nominal value of the official exchange rate may also have important implications for trade with China. Throughout the 1980s the official exchange rate of China has been considerably overvalued. This has been an important constraint on overall trade with China. By discouraging exports and increasing the shortage of foreign exchange, the overvaluation has exerted upward pressure on the secondary market price of foreign exchange in China. According to the results presented in this paper a 10 per cent devaluation of the official exchange rate in China is likely to increase economic welfare in China and to contribute to a considerable fall in the secondary market price for foreign exchange resulting in an expansion in overall trade and a substantial increase in grain imports to China. Such an outcome is likely to have a favourable impact on grain exporting countries like Australia.

As De Wulf and Goldsbrough (1986) have shown, there has been considerable progress in the development of policy instruments for macroeconomic management in post-reform China and the continuation of these reforms is critical to the success of economic reform. The results of this study lend support to the view that China's trading partners also have a particular interest in China's progress in developing effective macroeconomic stabilisation policy instruments.

Furthermore, the trade policy experiments carried out in this study illustrate that a reduction in protection for heavily assisted manufacturing goods such as chemicals, chemical fibres and

machinery could encourage additional imports of these goods, exerting upward pressure on the secondary market price of foreign exchange. Such an outcome is likely to have an adverse impact on other imports including imports of grain to China. On the other hand a reduction in the implicit export tax on a key agricultural exporting commodity such as rice may reduce the price of foreign exchange in the secondary market, encouraging overall imports including grain imports to China. This is likely to have a beneficial effect on grain exporting countries such as Australia.

A comparison of the three experiments undertaken in this study shows that, in all but the first experiment real gross domestic product in China increases. These increases in real gross domestic product measure only the shortrun static gains from improved resource allocation following devaluation and trade policy reform. However, they need to be considered together with the important longer run dynamic gains in income which are likely to result from increased openness of the economy following the policy changes analysed in experiments 2 and 3. Feder (1983) and Chenery (1986) suggest that these longer run gains from improved resource allocation and possible intersectoral externalities may be substantial. These dynamic gains would, in turn, reinforce the effects of the changes on growth of real gross domestic product, exports and imports.

The extent to which China imports grains depends largely on its capacity to pay for these imports. China's labour intensive manufacturing exports are an important source of foreign exchange earnings. Since the mid-1970s, China has continued to increase its exports of labour intensive manufacturing products to major developed countries. China's capacity to continually earn foreign exchange from labour intensive manufacturing exports in the medium term raises the question of whether further increases of these exports would be possible without depressing world prices or generating protectionist responses in developed country markets. According to Anderson (1990), this question need not be a major cause for concern for several reasons. First, China's share of developed country markets for labour intensive manufactures is still very small. Second, other developing country exporters, including the Asian newly industrialising countries, have been able to increase their shares of markets during the past two decades despite increases in trade barriers aimed at limiting their import penetration. Third, expansion in China's labour intensive manufacturing exports is likely to crowd out some exporters in the Asian newly industrialising countries to a certain degree and encourage them to shift their production and trade specialisation toward more skill-intensive manufacturers. Hence, Anderson (1990) argues that China would be able to continue to earn foreign exchange by exporting labour intensive manufacturing goods in order to pay for the products it is likely to choose to import, including grain.

It should be remembered that capital is assumed to be fixed in each sector of the model used in this study. In the absence of any detailed information on longer run investment behaviour in China, it is difficult to relax this assumption. Furthermore, the model is static and therefore cannot trace the time path of changes in economic variables of interest. Also, operation of the model relies on a number of parameter values derived from an extensive literature survey. Yet, it is important to recognise that the results of this study still provide useful insights into the short to medium term pressures for adjustment emerging from key macroeconomic and trade policy changes in China.

In summary, according to the results of this study China's capacity to earn the foreign exchange that is needed for its imports could be enhanced by policy reforms such as the devaluation of the already overvalued official exchange rate and the reduction of implicit export taxes imposed on key agricultural exporting commodities such as rice. Given the actual and potential importance of China in world agricultural markets, any expansion of grain imports, particularly wheat imports, to China which is facilitated by these policy reforms may raise world grain prices. Increases in world grain prices and in the volume of grain imports to China are likely to expand export opportunities for efficient agricultural exporting countries such as Australia. The results of this study also show that macroeconomic policy changes such as a reduction in absorption and devaluation of the official exchange rate are likely to have greater impacts on the overall economy in China than will more specific trade policy changes.

APPENDIX A

Input–Output Table for the People's Republic of China, 1981

(market prices, current billion yuan)

Sectors	Crops	Cotton	Animal husbandry	Wool	Metallurgy	Electricity	Coal	Petroleum mining	Refining	Chemicals	Chemical fibre
Crops	19.21	0	36.00	0	0	0	0.47	0	0	4.73	0
Cotton	0	0	0	0	0	0	0.06	0	0	1.31	0
Animal husbandry	0	0	1.29	0.21	0	0	0	0	0	0.05	0
Wood	0	0	0	0	0	0	0	0	0	0.04	0
Metallurgy	0.29	0.01	0.02	0	17.71	0.11	0.72	0.24	0	1.44	0
Electricity	1.22	0.19	0.29	0.05	2.81	2.87	1.22	0.35	0.17	3.36	0.05
Coal	0.88	0.14	0.21	0.03	3.00	4.34	1.65	0.02	0	2.07	0
Petroleum mining	0	0	0	0	1.24	3.40	0	2.24	33.08	3.00	0
Petroleum refining	7.07	1.15	1.68	0.27	1.68	2.16	0.36	0.54	0.60	7.02	0.16
Chemicals	25.02	3.98	0.02	0	0.60	0.02	0.50	0.80	0.20	31.86	0.02
Chemical fibre	0	0	0	0	0	0	0	0	0	0	0
Machinery	1.89	0.21	0.12	0.02	3.92	0.01	0.98	0.70	0.14	2.10	0.01
Building materials	0.20	0.02	0.06	0.02	0.15	0.02	0.08	0.15	0.02	0.30	0
Wood	0.14	0.02	0.06	0.02	0.38	0.02	0.90	0.02	0.02	0.08	0
Food processing	0.72	0.12	0.45	0.03	0.56	0.01	0.14	0.14	0.01	3.50	0
Textiles	0.24	0.04	0.06	0.01	1.04	0.01	0.50	0.70	0.03	1.47	0.01
Apparel	0.11	0.01	0.03	0	1.01	0	0.30	0.10	0.01	0.24	0
Paper	0.09	0	0.01	0	0.53	0.01	0.02	0.11	0.01	0.70	0.02
Misc. manufacturing	0.12	0.01	0.06	0.01	0.52	0.01	0.26	0.13	0.01	0.59	0.07
Construction	0.66	0.07	0	0	2.61	0	2.32	0	0	1.09	0
Freight transport	0.87	0.14	0.06	0.01	3.20	0.12	0.41	0.41	0.11	1.96	0.14
Passenger transport	0.01	0	0.01	0	0.19	0.03	0.06	0.06	0.03	0.32	0
Commerce	1.06	0.07	0.05	0.01	1.58	0.10	0.40	0.57	0.02	2.90	0.02
Misc. services	0.03	0.01	0.02	0	0.25	0.01	0.04	0.03	0.01	0.20	0
Education and health	0	0	0	0	0	0	0	0	0	0	0.03
Public administration and defence	0	0	0	0	0	0	0	0	0	0	0
Housing	0	0	0	0	0	0	0	0	0	0	0
Intermediate factors	59.82	6.18	40.15	0.69	42.98	13.25	11.38	7.30	34.46	70.32	0.54
Primary factors											
Labour	137.05	8.45	11.97	0.28	3.90	1.09	5.78	0.73	0.10	4.52	0.56
Capital	27.87	1.72	2.43	0.06	26.28	4.48	7.82	43.57	10.29	48.36	2.93
Land	67.36	4.15	5.88	0.14	0	0	0	0	0	0	0
Gross output	292.11	20.51	60.78	1.17	73.16	18.82	24.99	51.61	44.85	123.21	4.02

Appendix A (*continued*)

Sectors	Machinery	Building materials	Wood	Food processing	Textiles	Apparel	Paper	Misc. manufacturing	Construc-tion	Freight transport	Passenger transport
Crops	0.02	2.70	4.50	49.77	0.67	0.71	4.68	3.78	6.30	0	0
Cotton	0	0	0	0	16.62	0.18	0	0.15	0	0	0
Animal husbandry	0.01	0	0	16.96	0.03	0	0.12	0	0	0	0
Wood	0.01	0	0	0	1.74	0	0	0	0	0	0
Metallurgy	39.04	0.64	0.16	0.08	0.02	0.13	0	1.28	10.37	0.80	0
Electricity	1.40	0.71	0.14	0.44	0.94	0.05	0.43	0.65	0.17	0.09	0.02
Coal	0.78	2.49	0.15	0.65	0.70	0.08	0.33	0.45	0.24	0.89	0.14
Petroleum mining	0.64	0.28	0.04	0.16	0.72	0.04	0.04	0.32	0	0	0
Petroleum refining	2.46	0.48	0.27	1.17	2.00	0.12	0.39	0.66	1.35	4.77	3.00
Chemical fibre	5.20	1.00	0.50	5.60	3.58	1.22	3.00	1.20	4.80	0.30	1.2
Machinery	0	0	0	0	11.76	0	0	0	0	0	0
Building materials	41.22	1.12	0.35	0.14	2.41	0.18	0.28	0.42	13.58	1.26	1.44
Wood	0.45	2.27	0.15	0.08	0.07	0	0	0.15	29.18	0	0
Food processing	0.60	0.60	2.07	0.02	0.28	0.03	1.95	0.38	3.75	0	0
Textiles	0.56	0.14	0.07	5.96	0.03	1.06	0.07	0.70	0.14	0.14	0
Apparel	1.00	0.80	0.14	0.21	31.92	35.00	0.40	0.98	0.33	0.04	0
Paper	0.77	0.35	0.07	0.07	0.05	2.33	0	0.27	1.18	0.16	0
Misc. manufacturing	0.55	0.44	0.11	0.15	0.53	0.13	5.58	0.44	0.50	0.22	0
Construction	0.85	0.26	0.09	0.01	1.21	0.23	0.26	3.58	1.82	0	0
Freight transport	2.18	0.87	0	0	0	0	0	0.15	5.80	5.80	0
Passenger transport	4.66	1.22	0.45	1.11	0	0.84	0.54	0.95	2.67	0.54	0.08
Commerce	0.52	0.06	0.06	0.38	0.12	0.06	0.06	0.20	0.06	0.06	0
Misc. services	3.52	2.06	0.24	0.79	2.06	0.24	0.54	1.49	1.77	0.74	0.11
Education and health	0.34	0.04	0.02	0.10	0.10	0.03	0.03	0.03	0.08	0.06	0
Public administration and defence	0	0	0	0	0	0	0	0	0	0	0
Housing	0	0	0	0	0	0	0	0	0	0	0
Intermediate factors	106.77	18.52	9.58	83.85	78.83	42.66	18.70	18.23	84.48	15.87	5.99
Primary factors											
Labour	14.27	4.47	2.68	3.73	4.85	4.06	2.14	2.63	11.09	6.77	1.25
Capital	37.32	11.82	4.22	11.2	23.26	2.25	1.20	4.08	13.58	8.89	1.05
Land	0	0	0	0	0	0	0	0	0	0	0
Gross output	158.37	34.82	16.48	98.78	106.94	48.97	22.04	24.94	108.90	31.50	8.29

Appendix A (*continued*)

Sectors	Commerce	Misc. service	Education and health	Public administration and defence	Housing	Intermediate demand	Housing demand	Govt demand	Fixed investment	Stock investment	Exports	Imports	Gross output
Crops	6.66	0	1.86	0	0	141.68	119.99	1.55	5.40	29.45	3.94	9.90	292.11
Cotton	0	0	0.25	0	0	18.57	0	0	1.11	6.06	0.07	5.30	20.51
Animal husbandry	3	0	0	0	0	22.85	32.25	0	0	4.47	1.20	0	60.77
Wood	0	0	0	0	0	1.79	0	0	0	0	0	0.63	1.16
Metallurgy	0	0	0	0	0	73.06	0	0	0	2.40	2.80	5.10	73.16
Electricity	0.47	0.20	0.30	0	0	18.59	0.35	0.50	0	0	0	0	18.81
Coal	0.32	0.11	0.54	0	0	20.18	4.04	0.41	0	0	0.50	0.14	24.98
Petroleum mining	0	0	0	0	0	45.20	0.08	0	0	0	6.32	0	51.60
Petroleum refining	0	0	0.06	0	0	39.42	0.99	0.87	0	0	3.63	0.06	44.85
Chemicals	3.80	0.20	14.52	0	0.20	109.34	11.94	2.00	0	3.12	5.92	9.12	123.20
Chemical fibre	0	0	0	0	0	11.76	0	0	0	0.35	0	6.47	4.30
Machinery	6.02	0.21	2.24	0	0.21	81.19	21.18	11.77	48.58	3.50	6.08	13.94	158.36
Building materials	0	0	0	0	0.60	33.94	0	0.30	0	0.30	0.29	0.02	34.81
Wood	0	0	0	0	0.38	11.67	4.97	0.75	0	0.30	0.57	1.77	16.48
Food processing	5.60	0.28	2.10	0	0	22.54	72.80	0.90	0	0.63	3.71	1.79	98.78
Textiles	1.56	0.20	2.30	0	0	78.99	20.59	0.52	0	3.74	6.00	2.90	106.94
Apparel	0.14	0.10	1.10	0	0	8.40	34.43	0.48	0	0.76	4.99	0	49.06
Paper	2.20	0.33	5.17	0	0	17.85	2.46	0.67	0	1.21	0.36	0.64	21.92
Misc. manufacturing	0.26	0	4.49	0	0	14.84	4.04	2.60	0	1.82	3.64	2.04	24.90
Construction	0.15	0	0.44	0	1.23	23.35	0	3.05	82.51	0	0	0	108.90
Freight transport	1.49	0.24	1.16	0	0	23.36	3.81	0.16	1.35	1.08	3.31	1.57	31.50
Passenger transport	0.13	0	0	0	0	2.64	3.10	2.56	0	0	0	0	8.29
Commerce	1.14	0.22	1.62	0	0.11	23.43	28.53	0.30	2.20	0.72	3.78	1.61	57.35
Misc. services	0.10	0.10	0.35	0	0	1.99	8.00	2.00	0	0	0	0	11.99
Education amd health	0	0	0	0	0.03	0	3.60	75.28	0	0	0	0	78.91
Public administration and defence	0	0	0	0	0	0	0	12.70	0	0	0	0	12.70
Housing	0	0	0	0	0	0	13.97	0	0	0	0	0	13.97
Intermediate factors	33.03	2.19	38.49	0	2.73								
Primary factors													
Labour	11.67	2.04	18.40	11.91	0.57								
Capital	12.65	7.76	22.02	0.79	10.67								
Land	0	0	0	0	0								
Gross output	57.36	11.99	78.92	12.71	13.97								

APPENDIX B

Structure of the Computable General Equilibrium Model for China

The model is based on the general equilibrium framework developed for China by Martin (1990a). As explained earlier, the original Martin (1990a) version of the model has been modified here in order to disaggregate the crops sector into four commodities – rice, wheat, coarse grains and other crops. The model contains 27 sectors and three factors. The main sources of data used in implementing the model include State Planning Commission and State Statistical Bureau (1987), World Bank (1985), Thompson (1990) and the US Department of Agriculture (1989).

Number of equations

Household consumption demands

(1) $q_i^{(3)} = \varepsilon_i a^* + \sum_k \eta_{ik} p_k^q$ ($k = i$ own-commodity relationship; $k \neq i$ cross-commodity relationship) n

Fixed investment demand

(2) $q_i^{(2)} = a_R$ n

Investment in stocks

(3) $qs_i^{(2)} = a_R$ n

Government demand

(4) $q_i^{(5)} = a_R$ n

Traded good demand–supply

Export demand from China

(5a) $q_i^{(4)} = qw_i^{(4)} - \sigma_i^w (p_{ic}^e - \sum_c ES_{ic} p_{ic}^e)$ ($c = 1$, China) n

World demand

(5b) $qw_i^{(4)} = \beta_i(\Sigma_c ES_{ic} p_{ic}^e)$ (c = 1, China; 2, rest of world) n

Import supply to China

(5c) $q_{is} = E_i p_i^m$ (s = 1, import) n

Intermediate demands

(6) $q_{ij}^{(1)} = x_j$ nm

Domestic absorption of good *i* from all sources

(7) $q_i = \Sigma_j B_{ij}^{(1)} q_{ij}^{(1)} + B_i^{(2)} q_i^{(2)} + BS_i^{(2)} qs_i^{(2)} + B_i^{(3)} q_i^{(3)} + B_i^{(5)} q_i^{(5)}$ n

Domestic/import substitution

(8) $q_{is} = q_i - \sigma_i^m (p_{is} - p_i^q)$ (s = 1, imported; 2, domestic) $2n$

Commodity mix transformation

(9) $q_{ij} = x_j + \sigma_i^t (p_i^x - \sum_i R_{ij} p_i^*)$ nm

Commodity accounting relationship

(10) $x_i = \sum_j D_{ij} q_{ij}$ n

Transformation in production

(11) $x_{id} = x_i + \sigma_i^T (p_{id} - p_i^x)$ (d = 1, export; 2, domestic) $2n$

Primary factor inputs

(12) $q_{vj}^p = x_j - \sigma_i^p \left(p_{vj}^p - \Sigma_v S_{vj}^p p_{vj}^p \right)$ (v = 1, labour; 2, capital; 3, land) $3m$

Product market clearing

Domestic market clearing ($s = d = 2$, domestic)

(13a) $q_{is} = x_{id}$ n

Export market clearing ($d = 1$, export)

(13b) $q_i^{(4)} = x_{id}$ n

Factor market clearing

Labour ($v = 1$)

(14a) $q_1^p = \sum_j L_j q_{vj}^p$ 1

Capital ($v = 2$) in sector j

(14b) $q_{vj}^p = k_j$ m

Land ($v = 3$) in sector j

(14c) $q_{vj}^p = l_j$ m

Zero pure profits at the margin

In production

(15a) $\sum_i R_{ij} p_i^x = \sum_i H_{ij}^{(1)} p_i^q + \sum_v H_{vj}^p p_{vj}^p$ ($v = 1$, labour; 2, capital; 3, land) m

In importing ($s = 2$, import)

(15b) $p_{i2} = (p_i^m + t_i + \phi_2)$ n

In exporting ($s = 1$, export)

(15c) $p_{is} = p_{is}^{e} + v_i + FES_1(RC(rr_i) + \phi_1) + (1 - FES_1(rr_i) + \phi_2)$ n

GDP, absorption and household absorption

(16a) $gdp_R = Aga_R + SXe_R - SMm_R$ 1

(16b) $gdp = Aga + SXe - SMm$ 1

(16c) $a_R = \sum_i SN_{i3} q_i^{(3)} + \sum_i SN_{i5} q_i^{(5)} + \sum_i SN_{i2f} q_i^{(2)} + \sum_i SN_{i2s} qs_i^{(2)}$ 1

(16d) $a = \sum_i SN_{i3} a^* + \sum_i SN_{i5}(p_i^q + q_i^{(5)}) + \sum_i SN_{i2f}(p_i^q + q_i^{(2)}) + \sum_i SN_{i2s}(p_i^q + qs_i^{(2)})$ 1

Balance of trade condition

(17) $\pi = SXe + SMm$ 1

Balance of trade identities

Total export value ($d = 1$, export)

(18a) $e = \sum_i V_i(p_{id} + x_{id})$ 1

Total import value ($d = 2$, domestic)

(18b) $m = \sum_i M_i(p_{id} + q_{id})$ 1

Total export volume ($d = 1$, export)

(18c) $e_R = \sum_i V_i x_{id}$ 1

Total import volume ($s = 1$, import)

(18d) $m_R = \sum_i M_i q_{is}$ 1

Composite price variables

Price level determination

(19a) $p^q = ms - a_R$ 1

Price deflator for GDP

(19b) $p^x = gdp_R - gdp$ 1

Price deflator for total absorption

(19c) $p^q = \sum_i W_i p_i^q$ 1

Price deflator for absorption of good i

(19d) $p_i^q = \sum_s A_{is} p_{is}$ (s = 1, import; 2, domestic) n

Price deflator for output of good i

(19e) $p_i^x = \sum_d J_{id} p_{id}$ (d = 1, export; 2 domestic) n

Total number of equations $19n + 2mn + 6m + 13$

Endogenous variables (percentage change)		No.
a	= Nominal absorption	1
a^*	= Household nominal absorption	1
π	= Balance of trade as a share of GDP	1
e	= Export value	1
e_R	= Export volume	1
gdp_R	= Real GDP	1
gdp	= Nominal GDP	1
m	= Import value	1
m_R	= Import volume	1
p_{is}^e	= Foreign currency price of export i, from source s = 1, China	n
p_{vj}^p	= Return to primary factor v in sector j (v = 1, labour; 2, capital; 3, land)	$2m+1$
p_i^m	= Foreign currency price of import i	n
p^q	= Composite price for absorption	1
p_i^q	= Price for absorption of good i	n
p_{is}	= Price of good i from source s = 1, export; 2, import; 3 domestic	$3n$
p_i^x	= Price for production of good i (composite of domestic and export)	n
p^x	= Aggregate price of output (GDP deflator)	1
q_i	= Total absorption of good i	n
q_{ij}	= Quantity of good i produced by sector j	nm
$q_{ij}^{(1)}$	= Intermediate use of good i by sector j	nm
$q_i^{(2)}, qs_i^{(2)}$	= Stock demand for good i	$2n$
$q_i^{(3)}$	= Household demand for good i	n
$q_i^{(4)}$	= Export demand for good i from China	n
$qw_i^{(4)}$	= World demand for good i	n
$q_i^{(5)}$	= Government demand for good i	n
q_{is}	= Demand for good i from source s = 1, import; 2, domestic	$2n$
q_{vj}^p	= Demand for primary factor v by sector j (v = 1, labour; 2, capital; 3 land)	$3m$
x_i	= Output level of good i	n
x_j	= Output level of sector j	m
x_{id}	= Supply of good i to destination d = 1, export; 2, domestic	$2n$
ϕ_2	= Secondary market exchange rate	1
Total number of endogenous variables		$19n + 2nm + 6m + 13$

Exogenous variables (percentage change)

a_R = Real absorption

k_j = Capital stock in sector j

l_j = Land use by sector j

ms = Money supply

p^e_{ic} = Foreign currency price of good i in country $c = 2$, rest of the world

q^p_1 = Total labour force

rr_i = Foreign exchange retention rate for exports of good i

t_i = Power of the tariff on imports of good i (1 + nominal tariff rate)

v_i = Power of the export tax on exports of good i (1 – nominal export tax)

ϕ_1 = Official exchange rate (yuan/US$)

D_{ij} = Binary variable which equals 1 if good i belongs to good set j, zero otherwise

Value share coefficients

Ag = Total absorption as a share of GDP

A_{is} = Share of absorption of good i derived from source s = 1, import; 2, domestic

$B^{(1)}_{ij}$ = Share of intermediate use in sector j in total absorption of good i

$B^{(2)}_i$ = Share of investment in total absorption of good i

$BS^{(2)}_i$ = Share of stock demand in total absorption of good i

$B^{(3)}_i$ = Share of household consumption in total absorption of good i

$B^{(5)}_i$ = Share of government in total absorption of good i

ES_{ic} = Share of 1, China, and 2, rest of world, in world export markets for good i

FES_1 = Share of export revenue obtained from sales at official exchange rate, $((1-R_0)\phi_1)/(R_0\phi_2+(1-R_0)\phi_1)$ where R_0 = base period retention rate

$H^{(1)}_{ij}$ = Share of intermediate good i in total costs of sector j

H^p_{vj} = Share of primary factor v in total costs of sector j (v = 1, labour; 2, capital; 3, land)

J_{id} = Share of good i production to destination d = 1, export; 2, domestic

L_j = Share of sector j in total employment

M_i = Share of good i in total imports

R_{ij} = Commodity revenue share coefficient of good i in sector j

RC = Conversion factor from proportional change in retention rate (R) to change in $(1-R)$, that is, $(-R_0/(1-R_0))$

S^p_{vj} = Share of primary factor v in primary factor inputs of j

SM = Imports as a share of nominal GDP

SN_{ih} = Share of end-use demand h for good i in final absorption where $h = 1$, intermediate demand; $2f$, fixed investment; $2s$ stock demand; 3, household demand; 4, export demand; 5, government investment.

SX = Exports as a share of nominal GDP

V_i = Share of good i in total exports

W_i = Share of good i in total absorption

Elasticity parameters

β_i = Global elasticity of excess demand for good i

E_i = Elasticity of import supply for good i to China

ε_i = Household expenditure elasticity for good i

η_{ik} = Price elasticity of household demand for good i with respect to price j

σ_i^m = Elasticity of substitution between import and domestic products of good i

σ_i^p = Elasticity of substitution between primary factor inputs i in sector j

σ_i^t = Elasticity of substitution between good i and the output of sector j

σ_i^T = Elasticity of substitution between domestic and export production of good i

σ_i^w = Elasticity of substitution between Chinese and rest of world products in world market for good i

The model distinguishes 27 sectors and within those sectors a total of 30 goods. There are n equations applicable to the goods and m equations applicable to the sectors. In other words the model has 'i' number of goods ranging from 1 to 30, and 'j' number of sectors ranging from 1 to 27.

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