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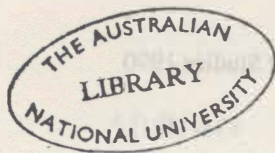
BOUND SHEET

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Modelling the post-reform Chinese economy

Will Martin

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Abstract

The system of dual-tier pricing developed in post-reform China includes an important role for secondary market prices in guiding resource allocation and stimulating adjustment. This paper draws on recent theoretical literature on dual-tier pricing systems to specify a computable general equilibrium model of the Chinese economy. Particular attention is paid to the foreign exchange system where the interaction of an overvalued official exchange rate, the foreign exchange retention scheme and secondary markets for foreign exchange affect the performance of the entire economy. Key results of an illustrative simulation experiment for devaluation of the official exchange rate are presented.

Modelling the post-reform Chinese economy**

1. Introduction

Policy reforms over the past decade have greatly improved the performance of the Chinese economy. However, important problems remain, particularly in foreign trade, where exchange rate overvaluation and current account deficits have presented recurring difficulties.

The computable general equilibrium model of the post-reform Chinese economy developed in this paper draws on the recent theoretical analyses of the dual-tier price system in China (Sicular 1988; Byrd 1987, 1989; Wu and Zhao 1987) and earlier work on foreign exchange mechanisms in centrally planned economies (Desai and Bhagwati 1979). The model is based primarily on a World Bank (1985a:55-6) input-output table extended to production, consumption and trade for 27 sectors. Given the importance of foreign trade for the development and modernization of China, particular emphasis is placed on the foreign exchange and foreign trade systems.

The model allows analysis of the effects of both macroeconomic and sectoral policies on the Chinese economy. A simple analysis of exchange rate devaluation illustrates some of the likely responses of the economy to this particularly important policy instrument. Analyses of the effects of many other policy measures can also be undertaken.

A central issue is the extent to which prices affect the allocation of resources in China's 'planned commodity economy'. The relative importance of plan and market in the economy and in the foreign trade sector in particular are discussed in Section 2.

The nature of the foreign exchange system and its implications for the economy are analysed in Section 3. Then, in Section 4, a general equilibrium model is developed and applied to an analysis of exchange rate policy changes. Section 5 contains a summary and conclusions.

**This paper has benefitted from comments by participants of seminars at the Australian National University, Chinese Academy of Social Sciences, Flinders and Adelaide Universities, and the University of Melbourne. Responsibility for any remaining errors remains with the author.

2. Plan and market in the Chinese economy

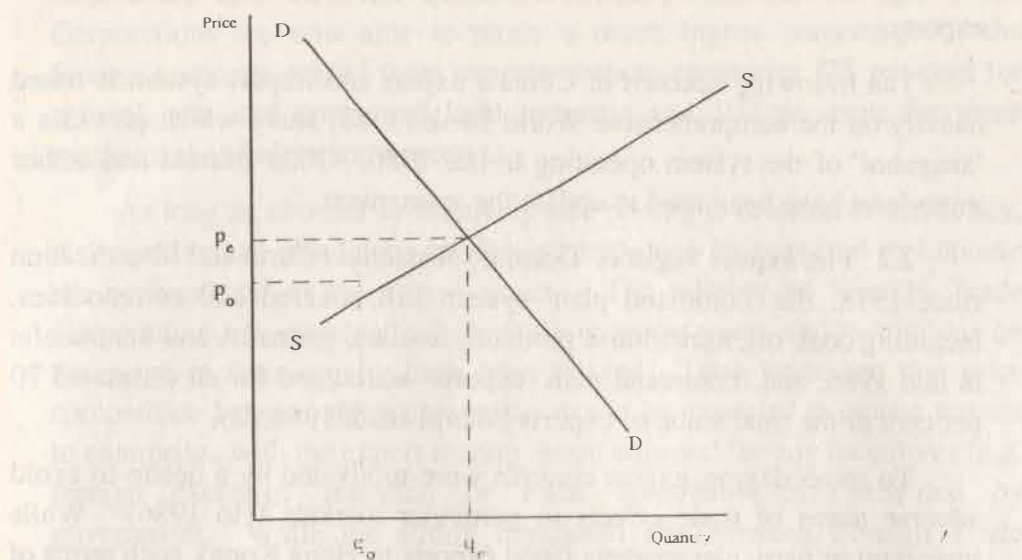
A major thrust of the reforms in China's economy since 1978 has been to decentralize economic decision-making away from central planning and towards provincial governments and producing enterprises. This process has involved increased use of markets as a means of allocating resources, although planning by central and provincial authorities remains very important (Naughton 1985; Wong 1985), particularly in determining the distribution of gains and losses.

The extent to which decision-making has been decentralized depends upon the sector of the economy. It appears, for instance, that decision-making has been substantially decentralized in the agricultural sector (Sicular 1988; Lardy 1983). Progress has been viewed as having been somewhat less rapid in the industrial sector (Naughton 1985; Wong 1985); Chinese Economic System Reform Research Institute (CESRRI 1987), although recent work suggests that secondary market prices now have an important influence on industrial sector decisions (Byrd 1987; Wu and Zhao 1987). The foreign trade system has also been substantially decentralized, although significant elements of central planning remain (World Bank 1988).

The introduction of dual tier (or multi-tier) pricing has been an important development. Part of total production takes place under a planning system in which specific quantities of output are supplied at specified official prices, and part of consumption demand is met by allocations or rationing at state-determined prices. Enterprises are frequently able to produce additional output at market, rather than official, prices and consumers are able to buy or sell additional amounts at market prices.

As Byrd (1987) and Sicular (1988) have argued, in principle, only the prices prevailing at the margin have any effect on short-run output levels under a system of legal secondary markets such as those developed under the dual-tier pricing system. In fact, the existence of these legal markets greatly simplifies the analysis relative to the case of illegal parallel markets considered by Roemer (1986). This point can be readily illustrated as in Figure 1 for an individual market where suppliers are contracted to supply a quantity q_0 at official price p_0 . For simplicity, it is assumed that consumers do not face any corresponding fixed price, although the argument can readily be generalized to incorporate fixed consumer prices associated with rationing or allocation systems (Srinivasan 1987).

Figure 1 Effects of dual tier pricing in an individual market



As long as q_o and the official price, p_o , do not affect the price obtained for output at the margin, they will not affect the position of the short-run supply curve SS in Figure 1. Thus the total level of output q_e and the secondary market price p_e will be shown by the same intersection of SS and DD that would represent the price and quantity outcomes in the absence of intervention.

While the existence of a quota delivery amount q_o , or a corresponding contract to deliver a fixed amount of revenue, has no impact on resource allocation, output or free-market prices in this market, it does generate a revenue transfer. In the case depicted in Figure 1, the transfer from the supplying enterprises is shown by the area $(p_e - p_o) \cdot q_o$. In principle, such transfers are perfectly non-distorting taxes whose only effect on resource allocation results from their effects on the distribution of income and hence on demand. In practice, however, pursuit of these economic rents is likely to lead to significant rent-seeking costs. Further, the potentially large profits available to those able to reallocate products from the official to the free market create powerful incentives for illicit reclassification of commodities. These inefficiencies are likely to reduce the level of output, as noted by Chow (1988), although it should remain responsive to relative price signals at the margin.

2.1 Foreign trade. Prior to 1978, the Chinese economy was relatively closed, with decisions on exports made within the planning process, in accordance with an assessment of the level of imports required for particular purposes. All foreign trade was channelled through centralized Foreign Trade Corporations, with minimal opportunities for

direct interaction between producing enterprises and importers of Chinese exports.

The following account of China's export and import system is based heavily on the comprehensive World Bank (1988) study which provides a 'snapshot' of the system operating in late 1986. Other sources and author interviews have been used to update the assessment.

2.2 The export regime. Despite substantial reform and liberalization since 1978, the 'command plan' system still covered 120 commodities, including coal, oil, agricultural products, textiles, garments and handicrafts in late 1986, and 'command plan' exports accounted for an estimated 70 per cent of the total value of exports (World Bank 1988:22).

To some degree, export controls were motivated by a desire to avoid adverse terms of trade effects in particular markets (Ho 1986). While important in particular markets (food exports to Hong Kong), such terms of trade effects can easily be over-emphasized. Lin and Yang (1987) point out that, despite rapid expansion of its exports over the last decade, China's share of world trade in its main export markets remains quite low, even for its major labour-intensive exports, such as textiles and clothing. For instance, it is estimated that China's share of the total clothing market in the United States, Japan and the European Community (in 1985) was less than 1 per cent (Lin and Yang 1987).

In 1984, a report on reform of the trade system by the Ministry of Foreign Economic Relations and Trade (MOFERT) recommended a number of reforms, some of which have begun to be implemented. The major recommendations included (World Bank 1988:21):

- direct participation by large producing enterprises in foreign trade;
- eliminating the state's responsibility for profits and losses in foreign trade; and
- adoption of an agency system for Foreign Trade Corporations.

Direct participation by selected producing enterprises in foreign trade was strongly endorsed by the World Bank (1988). The 'airlock' imposed by forcing enterprises to deal through separate Foreign Trade Corporations prevented producing enterprises from obtaining necessary information from buyers about production techniques and product quality. Some larger producing enterprises are now allowed to engage in foreign trade on their own account.

A move towards achieving the second objective was made through the introduction of an experimental system for exports from several major sectors in early 1988. Under this system, subsidies for exports were eliminated for exports of apparel, light industry, arts and crafts, and

mechanical and electrical (Chan 1989:15). Instead, Foreign Trade Corporations are now able to retain a much higher percentage of the foreign exchange earned from exports in these categories (75 per cent for apparel, arts and crafts and light industry, and 100 per cent for some mechanical and electrical exports).

As long as two-tier or relatively free pricing is retained domestically, the experimental provisions for foreign trade can be expected to improve the performance of the export sector. The number of Foreign Trade Corporations has increased substantially in recent years, and restrictions on the scope of their activity have been relaxed. Thus, price and non-price competition between these enterprises would be expected to equate returns to enterprises with the export market return adjusted for any incentives (e.g. foreign exchange retention or trade taxes/subsidies) provided by government. While the strong traditional ties between Foreign Trade Corporations and producing enterprises may limit the extent of price competition, the system for these major export sectors seems likely to be relatively responsive to the price incentives provided by the system.

2.3 The import regime. The import regime appears to have undergone relatively little change in recent years. The key features of the system are:

- . command plan imports of seven key raw materials - steel, chemical fertilizer, rubber, timber, tobacco, grain, polyester and other synthetic fibres (World Bank 1988:111);
- . central allocation of foreign exchange for imports on priority investment projects;
- . allocations of foreign exchange for other priority imports of raw materials, spare parts and equipment; and
- . non-centrally funded imports or imports subject to import licensing.

The World Bank estimated command plan imports to be around 40 per cent and non-centrally funded imports to be 30 to 40 per cent of total imports in 1986. From interviews by the author in June 1988, it appeared that central purchases of many commodities had declined markedly since that time, with a corresponding increase in local orders, although some recentralization appears to have occurred since that time in response to 'disorder' at the peak of liberalization.

Non-plan imports are divided into restricted and non-restricted goods. Restricted goods, of which there were 45 in 1986 (World Bank 1988:136) included most of the command plan imports (e.g. steel, rubber, timber, synthetic fibres, tobacco), 'luxury' consumer durables such as motor vehicles, televisions and refrigerators, and assembly lines for such 'luxury' consumer durables.

Since the primary objective of import licensing is to keep the current account in reasonable balance, the extent to which it constrains imports will depend upon the seriousness of imbalances in the exchange rate, and in domestic spending. For restricted goods under the import plan, an import licence can generally be obtained relatively readily (World Bank 1988:138), while applications outside the plan are subjected to more careful scrutiny. While the total imports by a province or enterprise, as well as imports of particular goods are apparently constrained by import licensing, it appeared, in 1986 at least, that a restricted import with suitable finance, and for which no domestic substitutes were readily available, would eventually receive approval (World Bank 1988:113). Under these conditions, imports are essentially being constrained by the general shortage of foreign exchange rather than the commodity-specific import licensing system.

The import tariff includes a minimum tariff schedule and an import surcharge, whose combined rate ranges from zero to 200 per cent (World Bank 1988:146). The tariff structure includes several categories of exemption (World Bank 1988:150), including:

- imports used directly for re-export;
- capital goods used for the transformation of industry; and
- imports of intermediate and capital goods for the Special Economic Zones, the coastal cities and Sino-foreign joint ventures.

The overall pattern of the tariff schedule appears to be broadly consistent with the structure of import licensing, with those goods essentially banned under the import licensing system (such as motor vehicles) facing very high tariffs (200 per cent in the case of motor vehicles). The overall pattern of the tariff schedule may provide at least a general guide to the pattern of industry protection desired by policy makers and implemented through the range of instruments available to them.

For non-command imports, the Foreign Trade Corporations usually act as agents for the purchasing enterprises. The enterprises are generally free to select an appropriate Foreign Trade Corporation (World Bank 1988:23). Thus, the price signals resulting from exchange rate changes and import tariffs would generally be transmitted back to the importing enterprise.

3. The foreign exchange system.

Given the apparent price responsiveness of the main sectors of the Chinese economy, the foreign exchange system can be expected to have an important role in influencing trade and the overall performance of the

economy. Here, key features of the Chinese foreign exchange system are examined and likely implications for the traded goods sector are assessed.

Prior to 1979, the exchange rate had a relatively limited role in influencing the allocation of resources. With a heavy emphasis on planning in determining the level and pattern of exports, the exchange rate performed largely an accounting function.

Since 1979, the foreign exchange system has been substantially reformed. A substantial devaluation, at least for trade related transactions, was implemented with the introduction of the Internal Settlement Rate for Trade in 1981. The 1981 reforms, however, also involved a highly centralized system of foreign exchange control with tight restrictions on holding of foreign exchange (Zhang 1987). Successive devaluations resulted in the official exchange rate being devalued from 1.49 yuan/US\$ in 1980 to 3.72 yuan/US\$ in 1986. The exchange rate was pegged to the US dollar at 3.72 yuan/US\$ from July 1986 to December 1989 when it was devalued by 21 per cent.

A particularly important institutional change has been the introduction of legal secondary markets for foreign exchange (Jiefang Ribao, 19 October 1988:5). The existence of these Foreign Exchange Adjustment Centres in each province allows foreign exchange to be transferred between enterprises to reflect differences in its value in each use, and reduces the waste resulting from hoarding of foreign exchange. Some degree of arbitrage between centres is possible, and reportedly keeps the extent of divergences between provincial markets relatively small.

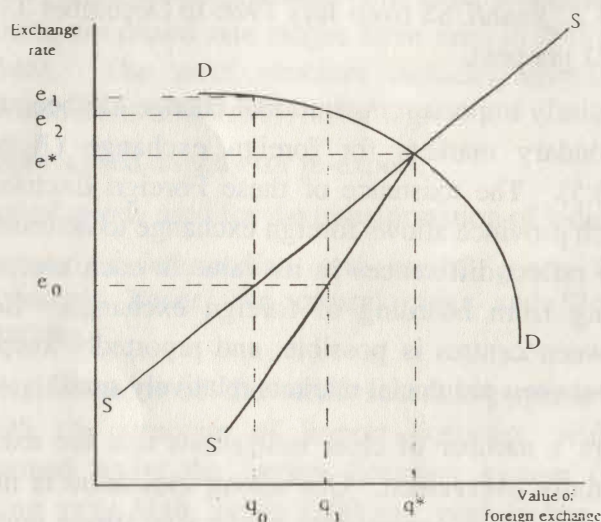
There are a number of clear indications that the exchange rate has been substantially overvalued. One strong indication is the 'shortage' of foreign exchange which necessitates a policy of strong controls on the use and holding of foreign exchange (Zhang 1987). Such a shortage arises because, at the official rate of exchange, imported goods are artificially cheap, and selling goods on the export market is not sufficiently attractive to generate the volume of imports demanded.

Another indication of the overvaluation of foreign exchange is provided by the substantially higher rates apparently prevailing in the secondary markets for foreign exchange. In March 1989 the rate on the Shanghai secondary market for foreign exchange was reported to be around 6.6 yuan/US dollar, well above the official rate of 3.72 yuan/US dollar (*Far Eastern Economic Review*, 2 March 1989:103) and subsequently rose to around 7.0 yuan/US dollar prior to a decline in late 1989 (*China Daily*, 3 December 1989). Even after the devaluation of the official exchange rate in December 1989, the secondary market rate remained above the official rate. Since transactions in these secondary markets are a legal means of transferring foreign exchange between entities, these rates do not reflect the

risk premium likely to be associated with black market transactions. Rather such high rates in the secondary market would appear to reflect a very marked overall shortage of foreign exchange.

A simple, stylized model of the market for foreign exchange is depicted in Figure 2, which is based on the repressed deficit case considered by Desai and Bhagwati (1979). The upward sloping curve SS depicts the supply of foreign exchange at any given nominal exchange rate (for a fixed numeraire price of nontraded goods) assuming an export demand curve with an elasticity greater than unity in absolute value. In terms of the single sector general equilibrium model proposed by de Melo and Robinson (1989), it can be thought of as representing transformation possibilities around a fixed production possibility frontier.

Figure 2 Supply, demand and price of foreign exchange



The downward sloping curve DD in Figure 2 represents the demand for foreign exchange, again with a fixed numeraire price of nontraded goods. Using the de Melo and Robinson (1989) general equilibrium model framework, this curve can be thought of as representing substitution possibilities between imported and nontraded goods at the highest attainable level of aggregate absorption.

At a fixed, overvalued official exchange rate, e_0 , and in the absence of foreign exchange retention arrangements, the supply of foreign exchange earnings is given by q_0 in Figure 2. At the official rate, e_0 , the demand for foreign exchange would exceed supply in the absence of exchange controls, causing a run down in foreign exchange reserves. In fact, under this simple repressed deficit model, the secondary market price can be viewed as being determined by the 'short' side of the market, the supply side, at q_0 . With

the supply of foreign exchange determined at q_0 , the secondary market price is indicated by e_1 .

This simplified discussion of exchange rate determination does not incorporate the foreign exchange retention arrangements which are an important feature of the market. Under these arrangements, enterprises or the local authorities responsible for enterprises, are entitled to retain a certain proportion of their foreign exchange earnings to use for purchasing imports, or to sell on secondary markets (Chan 1989). Since this increases the attractiveness of exports to price-responsive enterprises and authorities, it results in a rightward shift in the supply curve for foreign exchange at any point below e^* in Figure 2.

The effect of a secondary market retention scheme is depicted by the shift from SS to S'S in Figure 2. At a given official exchange rate, e , the supply of foreign exchange shifts out from q_0 to q_1 . The increase in the availability of foreign exchange created by the retention scheme drives down its domestic price from e_1 to e_2 . The higher the retention rate, is the greater is the rightward shift in the foreign exchange supply curve. In the limit, with a 100 per cent retention rate, this curve becomes vertical below the e^* , q^* intersection and the secondary market price is given by e^* irrespective of the degree of overvaluation of the official exchange rate.

As is evident from Figure 2, the effect of a foreign exchange retention arrangement is to increase the supply of foreign exchange and hence the overall volume of trade. Tam (1987:9) estimates that the average retention rate of local authorities, ministries and enterprises was around 30 per cent in 1986 while Zhang (1987:52) points to a wide range of retention ratios for different products and regions, with most commodities appearing to be in the range 25 to 100 per cent.

Where the base rate of 25 per cent retention applies, the usual practice is for 12.5 per cent to be allocated to the enterprise and 12.5 per cent to the provincial government. Even with a relatively large divergence between the official exchange rate and the secondary market rate, a 12.5 per cent retention rate provides only a limited incentive to exporters. It appears, however, that provincial governments frequently respond to this incentive by encouraging the enterprises under their control to expand their production for export. Where provincial governments react in this way, the effect of the foreign exchange retention arrangements may be greater than would be indicated by the direct retention rate to the enterprise.

As was noted in Section 2, the retention rate applying to a substantial proportion of trade is probably now substantially above the base rate of 25 per cent. The 75 per cent retention rate for exports of arts and crafts, clothing and light industry products (Chan 1989) means that some of

China's most important exports are now covered by this much higher retention rate.

The implications for China's foreign exchange system arise from the overvaluation of the currency and the consequent disincentive to export. In addition, it necessitates individuals devoting time and resources to non-productive activities such as attempting to obtain artificially scarce foreign exchange. In a dynamic context, it also introduces an important non-neutrality into the economy. As a consequence of this non-neutrality, changes in the money supply and hence in the general price level also change the relative prices of exports relative to other goods.

4. A Model to analyse effects of changes in China's economic policies

Prior to specifying the model a number of modelling issues were considered. Following these steps, it was possible to collect the necessary data and construct the model. Following completion of the model and its properties, it was used for policy simulation. Each of these modelling stages is reviewed in this section.

4.1 Modelling issues. The effects of the exchange rate system are inherently general equilibrium in nature. All of the key aggregates in the system are affected by exchange rates and any satisfactory model must take into account these interactions. Even the simple diagrams presented in Section 3 were implicitly general equilibrium in character being based on the single sector model of de Melo and Robinson (1989).

One means of overcoming this problem is to develop a computable general equilibrium (CGE) model of the Chinese economy. Dervis, de Melo and Robinson (1981) have demonstrated the feasibility of using such a model to analyse foreign exchange shortages while Kis, Robinson and Tyson (1986) have applied models of this type to post-reform socialist economies. The technology for constructing such models has improved substantially with the development of specialized programs such as GEMPACK (Codsì and Pearson 1988), making it possible to focus on the economic rather than the computational issues.

Two recent World Bank papers (1985a, 1985b) provide consistent input-output tables on an SNA basis and estimates of many of the relevant parameters (e.g. income elasticities) needed to construct a model of the ORANI type (Dixon, Parmenter, Sutton and Vincent 1982). Data shortcomings pertinent to this analysis are the lack of distinction between domestic and imported intermediates in the intermediate use matrix and the high degree of aggregation of the agricultural sector (into crops and animal husbandry) and the textiles and clothing sector (one industry). The somewhat dated nature of the latest available database is also of some

concern given the dramatic changes in the structure of the Chinese economy in recent years. More fundamentally, the database is based largely on official prices, rather than the free-market prices which are relevant for resource allocation at the margin.

In developing a model of the Chinese economy, a number of adaptations of the techniques used in modelling other developing countries (Robinson 1989) were required. The more important of these adaptations were:

- . adapting the input-output and price data to reflect secondary-market rather than official prices for material inputs;
- . modelling the effects of the foreign exchange retention scheme; and
- . updating the database to reflect changes in the composition of trade (Reynolds 1989).

Given the evolving policy changes in the Chinese economy associated with rapid economic growth, any modelling exercise can lead, at best, to a highly stylized representation of the economy. Despite this constraint, modelling can provide many useful insights. It provides an explicit framework for analysis, frequently leading to the discovery of important, but otherwise overlooked, causal linkages.

4.2 Broad features of the model. Like most models of the ORANI type (Dixon *et al.* 1982; Vincent 1985; Dee 1989), this model focuses on the real side of the economy, with particular emphasis on the response of the economy to trade policy changes.

The behavioural assumptions of the model involve cost minimization by producers and utility maximization by households, and the assumption that there is sufficient competition for unit profits (at market prices) to be driven to zero. The crucial assumption is that economic agents respond to marginal market prices for inputs and outputs, rather than official prices. Official prices are thus irrelevant to the behaviour of the model, as was demonstrated in Section 2 of this paper. Although it is recognized that the income re-distribution induced by divergences between official and market prices may have an impact on demand behaviour, this second round effect seems likely to have a relatively minor impact on the results and hence has not been incorporated in the model.

While agents are assumed to respond in a manner consistent with neo-classical theory to the market prices which they experience, these market prices are affected by distortions such as overvaluation of the official exchange rate, the foreign exchange retention system and import tariffs and licensing, all of which can be incorporated in the model.

To facilitate solution by Johansen's method, the model is linearized in percentage changes. Following Armington (1969) domestic and imported products are treated as imperfect substitutes. A standard simplifying feature of CGE models adopted in this model is a two-level representation of technology in which intermediate inputs and a composite primary factor input are demanded in fixed proportions to output. Changes in output levels thus require changes in the composite primary factor input levels which, in the presence of any fixed factor, require substitution between factors. In general, this substitution is represented using constant elasticity of substitution (CES) technology.

For many goods, there are marked differences between the product produced for the export market and that produced for the domestic market: both in the product's physical characteristics and in its less tangible marketing requirements. To capture these differences, it is assumed that products sold on the domestic market are differentiated from those sold on the export market. These differences are represented using a constant elasticity of transformation (CET) functional form (Robinson 1989; Powell and Gruen 1968).

The model is short-run in character, with capital assumed to be fixed in each sector. It would be possible to build a longer-run version of the model in which the capital stocks in each industry were endogenous, although investment behaviour in China seems likely to be difficult to model adequately. In the absence of a well-developed theory of investment for China, investment in each sector has been specified as simply changing in line with total real absorption. As is common in short-run models, investment does not add to the effective capital stock. The underlying time period is assumed to be sufficiently long for new equipment and machinery to be produced, but not brought into production.

Given the complexities of the government revenue and expenditure system in China (Blejer and Szapary 1989), an explicit set of fiscal accounts was not incorporated in the model. Implicitly it is assumed that the authorities make whatever adjustments to fiscal policies are needed to keep real absorption at an exogenously determined level. Similarly, monetary policy is assumed to be able to control the money supply. Accordingly, a skeletal monetary sector is incorporated to allow determination of the aggregate price level as a numeraire.

4.3 Data and structure. The initial source of data for the model was the World Bank (1985a:55-6) table for 1981, the latest currently available. This table has the advantage of having been prepared using the SNA conventions, rather than the material product system (MPS) used in Chinese input-output tables. Some use was made of the Chinese input-output tables for 1981 (State Planning Commission/State Statistical Bureau

1987) and other sources where needed. Details of the construction of the complete data set are given in Thompson (1990).

In the development of standard CGE models, it is assumed that the economy is in equilibrium in the benchmark year. Clearly, the conventional approach of assuming that the value shares in the model were in equilibrium would not be appropriate since the flows in the input-output table are valued at official prices rather than the market prices required for the analysis. To make the model operational, it was assumed that the (largely) planned system operating in 1981 resulted in the same set of quantity variables as would have resulted from a market system in equilibrium. Some support for this (admittedly strong) assumption is provided by Anderson's (1989:70) conclusion that the pattern of development in the Chinese economy since 1949 has been consistent with the predictions of Western economic theory. Under this assumption, a data set corresponding to a market equilibrium could then be obtained by adjusting the prices. These price adjustments were made with a set of relativities between official and free-market prices collected in 1988 (Peng, Zhaoyang, University of Adelaide, personal communication.) when a fairly well-developed set of secondary markets was operating.

The price adjustment process changed the gross output value of all industries. Since dual-tier pricing is not generally used in the labour market these price changes were assumed to cause changes in profits. This assumption seems reasonable in the light of the widely held proposition that the official pricing system leads to major distortions in the relative profitability of different industries in China (e.g. Chen 1988). The resulting estimates of factor intensities appear to be more consistent with expectations, and with the range of estimates observed in market economies, than the set of estimates obtained in the non-adjusted table.

The modified input-output table on which the model is based is presented in Appendix 1. It contains 27 sectors: the 23 sectors presented in the original World Bank table, with textiles and clothing split into separate sectors, and additional production sectors identified for each of the fibre inputs to the textile sector:

- . chemical fibres;
- . wool production;
- . cotton production;

Separating out the sectors not explicitly identified in the original table (e.g. textiles, apparel, wool, cotton and chemical fibres) necessitated the use of information from a wide range of sources as detailed by Thompson (1990). Following standard practice in CGE modelling, the elasticity parameters used in the study were largely obtained by surveying the

econometric estimates obtained in countries for which empirical estimates are available.

4.4 Equations of the model. The set of equations making up the model is presented in Appendix 2 together with the definitions of the variables and coefficients.

The first six sets of equations specify the final demands for goods and the demands for intermediate goods by each sector. The first set specifies the demands for each good by households as a function of household disposable income and the (marginal) prices of each good. In the absence of any elasticity estimates based on the appropriate marginal prices, the set of elasticities was calculated using expenditure elasticities for each good (World Bank 1985b), budget share data at market prices, and an estimate of the Frisch Parameter (-6.9) obtained by interpolating from the international estimates provided by Lluch, Powell and Williams (1977). By virtue of the method used in their construction¹ (Dervis, de Melo and Robinson 1981:482-5), the resulting estimates satisfy the theoretical constraints on demand systems: homogeneity of degree zero in prices and income, symmetry of the compensated cross price effects and adding up.

Equation categories (2), (3) and (4) specify proportional changes in fixed investment, investment in stocks and government consumption demands for each commodity as equal to the proportional changes in gross real absorption in the economy. This behavioural hypothesis is seen as reasonably plausible given the considerable uncertainty about how these categories respond to relative prices.

Equation set (5) summarizes China's external trade environment. Thus China's exports of each commodity i are represented using a CES function (linearized in percentage changes) consistent with the Armington (1969) model. The demand for exports of good i is determined by the prices of China's exports relative to exports from the rest of the world, and the total demand for that particular commodity. In turn, world demand was specified as a linear (in proportional changes) function of the weighted average price for good i , where the weights are the shares of China and the rest of the world in total exports of good i . The supply of imports is specified as a function of the world price of imports, allowing for the possibility of China being 'large' in particular markets.

Equation set (6) specifies the demands for intermediate inputs of commodities in the production process. For simplicity, and for consistency with most models of this type, intermediate inputs are generally assumed to be used in fixed proportion to outputs, that is according to a Leontief

¹It was necessary to slightly re-scale all of the expenditure elasticities following the price adjustment in order to preserve the Engel aggregation property.

technology. The exception is the demand for fibres by the textile industry where it is assumed that the three fibres identified in the model (cotton, wool and chemical) can be aggregated into a composite fibre input using a CES function.

Equation (7) aggregates intermediate usage, household stocks, consumption and government demand into a total absorption variable for each good. Value share weights are used to convert this linear identity into percentage change form. Because export and domestic products are differentiated, export demand is not a component of total absorption of i .

Equation set (8) specifies imperfect substitution between domestic and imported products consistent with the Armington (1969) model. Equation set (9) specifies imperfect transformation between domestically produced products supplied to domestic and export markets. This equation is a linearization in percentage changes of the constant elasticity of transformation (CET) function discussed in the context of CGE models by Robinson (1989).

Equation set (10) specifies the demand for primary factor inputs by industry i as a function of the output level in industry i and the relative prices of each of the primary factor inputs (land, labour and capital). It is assumed that these inputs can be aggregated into a composite primary factor bundle using a CES function, and the demand equations are obtained by imposing the first order conditions for cost minimization and linearizing in percentage changes.

The market clearing conditions for commodities are specified in equation block (11). In 11(a) domestic demand for good i from domestic sources (q_{i1}) is equated with domestic production of good i for the home market (x_{i1}). Similarly, export demand for good i from China must equal Chinese production of good i for export (x_{i1}).

Equation set (12) deals with market clearing for primary factors. Equation 12(a) embodies the assumption, standard in models of this type, that labour is able to move between different industries in response to changes in the demand for labour. While this is undoubtedly a strong assumption given the restrictions on the physical mobility of labour in China, the explosive growth of the lightly regulated rural industries in China has greatly increased the opportunities for labour to move between agriculture and industry, and between industrial sectors. Furthermore, there appears to have been a tendency for restrictions on the physical movement of labour to be relaxed over time.

The stock of capital in each industry, and the stock of land in each agricultural industry, are specified exogenously in 12(b) and 12(c). Equation set (13) imposes the condition of zero pure profits on activities

conducted at marginal (free market) prices. In production, this condition involves the inherent assumption of constant returns to scale - reasonable given the very large number of enterprises involved in most industrial (and certainly agricultural) activities in China. While the dual-tier pricing system generates large profits and losses, these are assumed to be infra-marginal.

The zero-profit or arbitrage conditions in exporting and importing are of vital importance and therefore are examined in some detail.

The condition for the import market is simply a linear in percentage change version of:

$$P_{i2} = P_i^m(1 + T_i)\Phi_2$$

Where P_{i2} is the landed, domestic currency price of imported good i , P_i^m is the 'world' price for imports of good i , T_i is the rate of tariff applying to imports of i (or the tariff equivalent of any import quota) and Φ_2 is the nominal exchange rate in the secondary market for foreign exchange. At the margin, it is assumed that the opportunity cost of all imports involves the secondary market rate. If an enterprise has less foreign exchange than it demands, it must purchase additional foreign exchange in the secondary market. If it initially has more foreign exchange than it requires its opportunity cost of using foreign exchange is also the secondary market rate.

In exporting, the returns available depend upon the foreign currency price received, the rate of any export tax, and a weighted average of the official and secondary market exchange rates. The higher the rate of retention allowed to enterprises, the larger the weight on the secondary market, and hence the higher the domestic currency price of exports. Equation 13(c) was derived by expanding the nonlinear export value equation about base period values for the retention rate and the official and secondary market exchange rates. It allows the effects of changes in both the official exchange rate and in the retention rate applied in each industry to be examined. The weight FES reflects an assumed base retention rate to enterprises of 0.25 and allows the effects of changes from this level to be investigated.

Equation set (14) includes identities to form aggregate Gross Domestic Product and absorption in current and constant prices. Equation 14(c) is used to make aggregate real absorption an exogenous variable in the model. Equation 14(d) requires that total household consumption, and the spending associated with investment and government purchases add to total absorption.

Equation (15) defines the balance of trade, and equation set (16) includes identities for trade volumes and values.

Equation (17(a)) is a demand for money equation, with a unitary income elasticity of demand imposed. This equation essentially imposes the quantity theory of money and implies that a 1 per cent increase in the money supply will raise the Gross Domestic Product price deflator by 1 per cent. Chow (1987) finds evidence that the quantity theory applies reasonably well to China and in fact concluded that it appeared to offer a better representation of price behaviour for China than for the USA.

While Chow's results did not support the strict quantity theory result that an increase in the money supply would have an equiproportional effect on the price level, this result may have reflected the stickiness of official prices over much of his sample period. Feltenstein and Ziba (1987 :153) conclude that the official price indices of the type used by Chow substantially understated the true rate of inflation. If the true rate of inflation in China (2.5 times the official rate) is combined with the estimate by Chow that a 1 per cent increase in the money supply would raise official prices by one-third of 1 per cent, the unit elasticity used in this study appears reasonable. Institutions for management of monetary policy are evolving (de Wulf and Goldsborough 1986) to provide greater scope for exogenous policy control of the money supply.

The final four equations of the model 17(b)-17(e) define the price of each of the composite goods (import plus domestic sourced goods) consumed domestically, and the price of composite goods (export plus domestic destination goods) produced domestically and composite prices for total absorption and total Gross Domestic Product.

The complete model contains 1390 equations, and 1390 endogenous variables. The model is linear in percentage changes and was solved using the GEMPACK program (Codsí and Pearson 1988).

In addition to the input-out data discussed above, the model requires that a number of elasticity parameters be specified. The elasticities involved were:

- . consumer demand elasticities;
- . elasticities of substitution between domestic and imported good i (Base value 2.0);
- . elasticities of transformation between domestic and export good i (Base value 5.0);
- . elasticities of substitution between Chinese exports of i and the exports of other countries (Base value 10.0);
- . the elasticity of demand for total world exports of i (Base value - 2.0);
- . the elasticity of supply of import i to China (Base value 100);
- . the elasticity of substitution between primary factors in industry i (Base value 0.5); and

elasticities of substitution between fibres in the textile sector (Base value 1.0).

As previously discussed, the consumer demand elasticities were derived using expenditure elasticities, budget shares and the Frisch parameter.

It seemed unlikely that reasonable estimates of the elasticities of substitution and transformation for each commodity could be estimated using the available data for China. Time series of the relevant market price data are extremely scarce and, in any event, the time period over which enterprise managers have been free to allocate their resources in response to relative price changes is short. Accordingly, the approach taken was to impose selected base values chosen on the basis of the evidence from other countries, leaving open the option of examining the sensitivity of the results obtained to these assumptions.

The base value of 2.0 used for the elasticity of substitution between domestic and imported commodities is within the range of values used for this parameter in CGE studies. While the values used in the Grais, de Melo and Urata (1986) study range only from 0.4 to 1.2, the corresponding parameters are larger in many other CGE studies. If one accepts the weight of empirical evidence marshalled by Goldstein and Khan (1985:1076) that the aggregate elasticity of import demand is in the range -0.5 to -1.0 then an elasticity of substitution of 2.0 at the individual commodity level would seem entirely reasonable.

Unfortunately, the empirical evidence on the elasticity of transformation between domestic and export production is extremely limited. The estimate of 2.90 cited by Tarr (1989 :5-6) provides some indication of the order of magnitude, at least for manufactured products. While well below the value of infinity implicit in models constructed without explicit transformation in production, it is well above the values of 0.5 and 1.5 assumed by Grais, de Melo and Urata (1986). The evidence that the aggregate supply elasticity of exports may lie in the range from 1.0 to 4.0 (Goldstein and Khan 1985:1087) also seems to point to higher values for this parameter than those chosen by Grais, de Melo and Urata (1986:74). The value of 5.0 used in this study was subjectively set somewhat above the empirically estimated values given the well-known difficulties involved in obtaining such estimates. Experimentation with higher values for this parameter, and with different values across commodities would be of interest.

The elasticities of substitution between exports from China and other export products were set at 10.0 in the belief that Chinese exports of many products are close substitutes for other products in world markets. This assumption is at variance with the few available direct estimates of the

elasticity of export demand for China's exports but the likelihood that such estimates are biased downwards is well known (see, for example, Leamer and Stern 1970:56-74). For commodity exports, at least, the value of 10.0 does not seem unreasonable, and is broadly consistent with values used in many other CGE modelling exercises (e.g. Dixon *et al.* 1982).

The base value elasticity of demand for total world exports was set at -2.0 in light of the relatively low elasticity of substitution between domestic and imported goods assumed in the model. Since the focus of the model is on a relatively short time period, supply adjustment in other countries may be fairly low, placing the major burden of adjustment on world demand. Given China's small share of world exports, the elasticity of demand for her exports would generally be expected to depend more heavily on the elasticity of substitution than this overall market elasticity.

The very high base value for the elasticity of supply of imports to China was chosen to make China essentially a price taker in the market for imports. Given China's small share in most markets this assumption, used in most models, does not appear unreasonable.

The elasticity of substitution between primary factors was set to a base value of 0.5. This value was selected by Dixon *et al.* (1982) after an extensive literature search. While it is substantially below some of the estimates presented in the developing country literature (e.g. Limskul 1988) it does not seem unreasonable as a short run estimate, particularly when the effects of any constraints on adjustment resulting from the operation of the planning system are considered.

The base value of 1.0 for the elasticity of substitution between fibres in the production of textiles is in the same order of magnitude as the recent estimates of fibre demand elasticities reported by Ball, Beare and Harris (1989).

Given the potentially very different responses of an exporting or an import-competing industry to changes in the foreign exchange system and the marked changes in the pattern of China's trade over recent years (Reynolds 1987), the trade structure used in the analysis was seen as a particularly important issue. Accordingly, the behaviour of the model was examined using both the original 1981 trade pattern, and an alternative based upon the pattern of trade in 1986.

This adjustment was made in a relatively simple way. The share of each category of exports (imports) was first adjusted by the change in the share of the corresponding category of exports (imports) estimated using broadly comparable data series obtained from the International Economic Data Bank at the Australian National University. The resulting shares were then rescaled to sum to unity, and expressed as shares of total exports

(imports) before price adjustment. The share of total exports (imports) was also increased in line with the rise in the share of trade in the Chinese economy over the period (World Bank 1989). Finally, the price adjustment factors applied throughout the model were used to adjust the values of exports (imports) in each row of the table. The final balancing of the table was then undertaken using total costs in each sector as the balancing item.

4.5 Simulation results. The model developed in this study was used to examine the impact of a 10 per cent nominal devaluation (increase) of the official exchange rate (Y/\$), with the aggregate price of absorption held constant by control of the money supply. As a simplification, it was assumed that the retention rate for foreign exchange was held constant at 25 per cent in all industries. While the retention rate is known to be substantially higher in some industries, and in some regions, the effective retention rate may be lower in others. Furthermore, the results provide an initial indication of the effects of liberalization from a particular point.

The results for an initial simulation experiment are presented in Table 1. The results in Column 1 refer to the model with all parameters set at their base values. The results in the second column are based on the modified model using the 1986 trade structure, rather than the 1981 trade structure.

Table 1 Simulated effects of a 10 per cent devaluation of the official exchange rate: percentage change from control

Macro/Variables	Base run	1986 trade structure
Market exchange rate	-6.6	-5.8
Export volume	11.5	13.4
Import value	10.9	8.9
Balance of trade - % of GDP	0.8	1.1
Real GDP	0.4	0.7
Real wage rate	0.2	1.0

The results presented in Appendix 1 suggest that the effects of exchange rate devaluation on the Chinese economy could be both large and highly beneficial.

Given increased availability of foreign exchange, the price of foreign exchange in the secondary market is projected to fall (that is to appreciate) markedly. This lowers the cost of imports, placing downward pressure on the price of consumer goods.

Under both of the scenarios considered, a depreciation of the official exchange rate leads to a substantial fall (appreciation) of the secondary market exchange rate. The increase in the supply of foreign exchange generated by the greater incentive to export alleviates the shortage of foreign exchange which in turn brings about the large fall in its price. Clearly, this result means that the devaluation needed to remove the gap between the official and the secondary market rate would be considerably less than the initial gap between the two rates.

An extremely important consequence of the devaluation is the large expansion it brings about in the size of the traded goods sector. Even a 10 per cent change in the official exchange rate with the general price level held constant brings about an increase in export volume of 11.5 percent in the base case. Total imports also grow substantially, as the lower price of imports reallocates demand towards imports where this is economically efficient. The balance of trade improves noticeably because of an increase in total income, and an improvement in the price of exports relative to imports.

Real GDP grows slightly in the base case, with a ten percent devaluation resulting in an increase of 0.4 percent. Using the 1986 trade shares, the gains are substantially greater, with GDP rising by 0.7 per cent. These gains measure only the short-run static gains from improved resource reallocation and need to be considered together with the important longer-run gains in income which are likely to result from increased openness of the economy. Studies by Feder (1982) and Chenery (1986) suggest that these gains in improved resource allocation and from possible inter-sectoral externalities may be substantial. These dynamic gains would, in turn, reinforce the effects on growth of GDP, exports and imports considered in this static analysis.

Another important macroeconomic effect of real exchange rate devaluation is its impact on wages. The expansion of relatively labour-intensive export-oriented activities would be expected to result in an increased demand for labour. With the original 1981 trade data base, this effect was relatively small. However, with the change in the trade structure between 1981 and 1986, this effect was expected to have become more important. Reynolds (1987) reported a marked increase in the labour intensity of China's exports between 1981 and 1985. From the results using the 1986 trade shares, a devaluation of 10 per cent would strengthen the aggregate demand for labour sufficiently to raise wage rates relative to the consumption price index by one percent.

These results demonstrate the usefulness of the model in analysing an important policy issue. The model can, of course, be used to analyse a

wide range of other macroeconomic or sectoral policy issues, and to examine the impacts at both the aggregate and the sectoral level.

5. Conclusions

The basic purpose of this paper is to outline an empirical model of the post-reform Chinese economy, with particular emphasis on the foreign exchange and foreign trade regime.

The first question addressed is whether the major sectors of the Chinese economy are now sufficiently price responsive for the exchange rate to have an effect on production and consumption behaviour. From all the evidence examined, it seems clear that this is the case even though important elements of planning remain.

The yuan has consistently been overvalued, discouraging exports and imports and encouraging the production of import substitutes. By inhibiting exports and creating a scarcity of foreign exchange, the overvaluation actually increases the secondary market price of foreign exchange. Consumption of exportable goods is artificially encouraged while consumption of imported goods is generally discouraged. By discouraging socially desirable exports and imports, the overvaluation also lowers national income.

Based on the analysis of the Chinese economy, a 27-sector Computable General Equilibrium model was specified and constructed. The crucial distinguishing feature of this empirical model was its use of market, rather than plan, prices throughout. The model was constructed to represent the behaviour of the post-reform economy in which the important determinants of economic behaviour are the prices received (paid) at the margin.

The model is linear in percentage changes and derives much of its general theoretical structure from the ORANI model of the Australian economy. Its 27 sectors were based primarily on those included in the 1985 World Bank study of the Chinese economy, but with additional attention devoted to the dynamic textile, apparel and fibre sectors.

The model was used to explore the implications of a reduction in the overvaluation of the currency brought about by a devaluation of the official exchange rate, with appropriate monetary and fiscal policies operating to control the price level and the level of total absorption.

Under these circumstances, a devaluation was found to have major beneficial effects on the economy as a whole. In the base model, a ten percent devaluation of the official exchange rate was found to cause an appreciation of 6.6 percent in the secondary market exchange rate, substantially reducing the cost of all imports. Devaluation was also found to result in a substantial increase in the level of exports and imports, with a ten percent devaluation resulting in an increase of 11.5 percent in total export volume. GDP increases slightly following the devaluation and the balance of trade improves. The expansion of relatively labour-intensive export industries also leads to an increase in the demand for labour and hence the wage rate.

Overall, it appears that removal of the serious overvaluation of the official exchange rate would have a number of important advantages for China through its beneficial effects on export performance, on the level of income and on trade. The model is applicable to a wide range of policy analyses.

Appendix 1 (cont) **Input-output table for the People's Republic of China, 1981** (market prices, current billion yuan)

Sectors	Passngr transpt	Com- merce	Misc. service	Education Health	Public admin	Housing	Inter- mediate	Consumption Household Govt.	Investment Fixed Stock	Trade Exports Imports	Gross Output			
Crops	0.00	6.66	0.00	1.86	0.00	0.00	141.68	119.99	1.55	5.40	29.45	3.94	9.90	292.11
Cotton	0.00	0.00	0.00	0.25	0.00	0.00	18.57	0.00	0.00	1.11	6.06	0.07	5.30	20.51
Animal husbandry	0.00	3.00	0.00	0.00	0.00	0.00	22.85	32.25	0.00	0.00	4.47	1.20	0.00	60.77
Wool	0.00	0.00	0.00	0.00	0.00	0.00	1.79	0.00	0.00	0.00	0.00	0.00	0.63	1.16
Metallurgy	0.00	0.00	0.00	0.00	0.00	0.00	73.06	0.00	0.00	0.00	2.40	2.80	5.10	73.16
Electricity	0.02	0.47	0.20	0.30	0.00	0.00	18.59	0.35	0.50	0.00	0.00	0.00	0.00	18.81
Coal	0.14	0.32	0.11	0.54	0.00	0.00	20.18	4.04	0.41	0.00	0.00	0.50	0.14	24.98
Petroleum - mining	0.00	0.00	0.00	0.00	0.00	0.00	45.20	0.08	0.00	0.00	0.00	6.32	0.00	51.60
Petroleum - refining	3.00	0.00	0.00	0.06	0.00	0.00	39.42	0.99	0.87	0.00	0.00	3.63	0.06	44.85
Chemicals	1.20	3.80	0.20	14.52	0.00	0.20	109.34	11.94	2.00	0.00	3.12	5.92	9.12	123.20
Chemical fibre	0.00	0.00	0.00	0.00	0.00	0.00	11.76	0.00	0.00	0.00	0.35	0.00	6.47	4.03
Machinery	1.44	6.02	0.21	2.24	0.00	0.21	81.19	21.18	11.77	48.58	3.50	6.08	13.94	158.36
Building material	0.00	0.00	0.00	0.00	0.00	0.60	33.94	0.00	0.30	0.00	0.30	0.29	0.02	34.81
Wood	0.00	0.00	0.00	0.00	0.00	0.38	11.67	4.97	0.75	0.00	0.30	0.57	1.77	16.48
Food processing	0.00	5.60	0.28	2.10	0.00	0.00	22.54	72.80	0.90	0.00	0.63	3.71	1.79	98.78
Textiles	0.00	1.56	0.20	2.30	0.00	0.00	78.99	20.59	0.52	0.00	3.74	6.00	2.90	106.94
Apparel	0.00	0.14	0.10	1.10	0.00	0.00	8.40	34.43	0.48	0.00	0.76	4.99	0.00	49.06
Paper	0.00	2.20	0.33	5.17	0.00	0.00	17.85	2.46	0.67	0.00	1.21	0.36	0.64	21.92
Misc. manufacturing	0.00	0.26	0.00	4.49	0.00	0.00	14.84	4.04	2.60	0.00	1.82	3.64	2.04	24.90
Construction	0.00	0.15	0.00	0.44	0.00	1.23	23.35	0.00	3.05	82.51	0.00	0.00	0.00	108.90
Freight transport	0.08	1.49	0.24	1.16	0.00	0.00	23.36	3.81	0.16	1.35	1.08	3.31	1.57	31.50
Passenger transport	0.00	0.13	0.00	0.00	0.00	2.64	0.00	3.10	2.56	0.00	0.00	0.00	0.00	8.29
Commerce	0.11	1.14	0.22	1.62	0.00	0.11	23.43	28.53	0.30	2.20	0.72	3.78	1.61	57.35
Misc. services	0.00	0.10	0.10	0.35	0.00	0.00	1.99	8.00	2.00	0.00	0.00	0.00	0.00	11.99
Education and health	0.00	0.00	0.00	0.00	0.00	0.03	0.00	3.60	75.28	0.00	0.00	0.00	0.00	78.91
Public Admin. & defence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70	0.00	0.00	0.00	0.00	12.70
Housing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.97	0.00	0.00	0.00	0.00	0.00	13.97
Intermediate	5.99	33.03	2.19	38.49	0.00	2.73	847.00	391.12	119.36	141.15	59.90	57.11	62.99	1550.03
Labour value added	1.25	11.67	2.04	18.40	11.91	0.57								
Capital value added	1.05	12.65	7.76	22.02	0.79	10.67								
Land value added	0.00	0.00	0.00	0.00	0.00	0.00								
Gross Output Value	9.59	62.21	12.36	57.69	12.71	14.85								

**Appendix 1 Input-output table for the People's Republic of China,
1981 (market prices, current billion yuan)**

Sectors	Crops	Cotton	Animal husb	Wool	Metallurgy	Electricity	Coal	Petroleum Mining	Refining	Chemicals	Chemical fibre	Machinery	Building materials	Wood	Food proc.	Textiles	Apparel	Paper	Misc. manuf.	Construction	Freight transpt
Crops	19.21	0.00	36.00	0.00	0.00	0.00	0.47	0.00	0.00	4.73	0.00	0.02	2.70	4.50	49.77	0.67	0.71	4.68	3.78	6.30	0.00
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	1.31	0.00	0.00	0.00	0.00	0.00	16.62	0.18	0.00	0.15	0.00	0.00
Animal husbandry	0.00	0.00	1.29	0.21	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.01	0.00	1.19	16.96	0.03	0.00	0.12	0.00	0.00	0.00
Wool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00	1.74	0.00	0.00	0.00	0.00	0.00
Metallurgy	0.29	0.01	0.02	0.00	17.71	0.11	0.72	0.24	0.00	1.44	0.00	39.04	0.64	0.16	0.08	0.02	0.13	0.00	1.28	10.37	0.80
Electricity	1.22	0.19	0.29	0.05	2.81	2.87	1.22	0.35	0.17	3.36	0.05	1.40	0.71	0.14	0.44	0.94	0.05	0.43	0.65	0.17	0.09
Coal	0.88	0.14	0.21	0.03	3.00	4.34	1.65	0.02	0.00	2.07	0.00	0.78	2.49	0.15	0.65	0.70	0.08	0.33	0.45	0.24	0.89
Petroleum - mining	0.00	0.00	0.00	0.00	1.24	3.40	0.00	2.24	33.08	3.00	0.00	0.64	0.28	0.04	0.16	0.72	0.04	0.04	0.32	0.00	0.00
Petroleum - refining	7.07	1.15	1.68	0.27	1.68	2.16	0.36	0.54	0.60	7.02	0.16	2.46	0.48	0.27	1.17	2.00	0.12	0.39	0.66	1.35	4.77
Chemicals	25.02	3.98	0.02	0.00	0.60	0.02	0.50	0.80	0.20	31.86	0.02	5.20	1.00	0.50	5.60	3.58	1.22	3.00	1.20	4.80	0.30
Chemical fibre	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.76	0.00	0.00	0.00	0.00	0.00
Machinery	1.89	0.21	0.12	0.02	3.92	0.01	0.98	0.70	0.14	2.10	0.01	41.22	1.12	0.35	0.14	2.41	0.18	0.28	0.42	13.58	1.26
Building materials	0.20	0.02	0.06	0.02	0.15	0.02	0.08	0.15	0.02	0.30	0.00	0.45	2.27	0.15	0.08	0.07	0.00	0.00	0.15	29.18	0.00
Wood	0.14	0.02	0.06	0.02	0.38	0.02	0.90	0.02	0.02	0.08	0.00	0.60	0.60	2.07	0.02	0.28	0.03	1.95	0.38	3.75	0.00
Food processing	0.72	0.12	0.45	0.03	0.56	0.01	0.14	0.14	0.01	3.50	0.00	0.56	0.14	0.07	5.96	0.03	1.06	0.07	0.70	0.14	0.14
Textiles	0.24	0.04	0.06	0.01	1.04	0.01	0.50	0.70	0.03	1.47	0.01	1.00	0.80	0.14	0.21	31.92	5.00	0.40	0.98	0.33	0.04
Apparel	0.11	0.01	0.03	0.00	1.01	0.00	0.30	0.10	0.01	0.24	0.00	0.77	0.35	0.07	0.07	0.05	2.33	0.00	0.27	1.18	0.16
Paper	0.09	0.00	0.01	0.00	0.53	0.01	0.02	0.11	0.01	0.70	0.02	0.55	0.44	0.11	0.15	0.53	0.13	5.58	0.44	0.50	0.22
Misc. manufacturing	0.12	0.01	0.06	0.01	0.52	0.01	0.26	0.13	0.01	0.59	0.07	0.85	0.26	0.09	0.01	1.21	0.23	0.26	3.58	1.82	0.00
Construction	0.66	0.07	0.00	0.00	2.61	0.00	2.32	0.00	0.00	1.09	0.00	2.18	0.87	0.00	0.00	0.00	0.00	0.00	0.15	5.80	5.80
Freight transport	0.87	0.14	0.06	0.01	3.20	0.12	0.41	0.41	0.11	1.96	0.14	4.66	1.22	0.45	1.11	0.00	0.84	0.54	0.95	2.67	0.54
Passenger transport	0.01	0.00	0.01	0.00	0.19	0.03	0.06	0.06	0.03	0.32	0.00	0.52	0.06	0.24	0.38	0.12	0.06	0.06	0.20	0.06	0.06
Commerce	1.06	0.07	0.05	0.01	1.58	0.10	0.40	0.57	0.02	2.90	0.02	3.52	2.06	0.24	0.79	2.06	0.24	0.54	1.49	1.77	0.74
Misc. services	0.03	0.01	0.02	0.00	0.25	0.01	0.04	0.03	0.01	0.20	0.00	0.34	0.04	0.02	0.10	0.10	0.03	0.03	0.03	0.08	0.06
Education and health	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public Admin. & defence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Housing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Intermediate	59.82	6.18	40.49	0.69	42.98	13.25	11.38	7.30	34.46	70.32	0.54	106.77	18.52	9.58	83.85	78.83	42.76	18.58	18.19	84.23	15.87
Labour value added	137.05	8.45	11.97	0.28	3.90	1.09	5.78	0.73	0.10	4.52	0.56	14.27	4.47	2.68	3.73	4.85	4.06	2.14	2.63	11.09	6.77
Capital value added	27.87	1.72	2.43	0.06	26.28	4.48	7.82	43.57	10.29	48.36	2.93	37.32	11.82	4.22	11.20	23.26	2.25	1.20	4.08	13.58	8.86
Land value added	67.36	4.15	5.88	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Output Value	181.28	24.78	59.09	0.70	59.13	24.98	19.74	15.94	40.42	90.21	4.14	147.54	28.71	14.55	102.41	102.54	52.55	25.43	24.45	103.23	30.97

Appendix 2 (cont) Model equations and variables

Endogenous Variables (Percentage Change)

a - Nominal absorption	1
a^* - Household nominal absorption	1
e - Export value	1
e_n - Export volume	1
gdp_r - Real gdp	1
gdp - Nominal gdp	1
m - Import value	1
m_n - Import volume	1
p_{is}^* - Foreign currency price of export i , $s = 1$, China	g
p_{vj}^* - Return to primary factor v in industry j	$2g + 1$
p_i^* - Foreign currency price of import i	g
p^* - Composite price for absorption	1
p_i^1 - Price for absorption of i	g
p_{ik} - Price of i in 1, export; 2, import; 3, domestic	$3g$
p_i^2 - Price for production of i (composite of domestic and export)	g
p^x - Aggregate price of output (gdp deflator)	1
q_i - Total absorption of i	g
$q_{ij}^{(1)}$ - Intermediate use of i by industry j	g^2
$q_i^{(2)}, q_s^{(2)}$ - Stock demand for good i	$2g$
$q_i^{(3)}$ - Household demand for i	g
$q_i^{(4)}$ - Export demand for i from China	g
$qw_i^{(4)}$ - World demand for good i	g
$q_i^{(5)}$ - Government demand for i	g
q_{is} - Demand for i from source $s = 1$, import; 2, domestic	$2g$
q_{vj}^* - Demand for primary factor v by industry j ($v = 1$, labour; 2, capital; 3, land)	$3g$
x_j - Output level of industry j	g
x_{id} - Supply of good i to destination d ; export (1) or domestic (2)	$2g$
π - Balance of trade as a share of gdp	1
ϕ_2 - Secondary market exchange rate	1

Total No. of Endogenous Variables

$$g^2 + 24g + 13$$

Exogenous Variables (Percentage Change)

a_n = Real absorption
k_j = Capital stock in industry j
l_j = Land use by industry j
m_s = Money supply
p_{is}^* = Foreign currency price of good i , $s = 2$, R.O.W.
q_1^* = Total labour force
rr_i = Foreign exchange retention rate for exports of i
t_i = Power of the tariff on imports of i ($1 +$ nominal tariff rate)
v_i = Power of the export tax on exports of i ($1 -$ nominal export tax)
ϕ_1 = Official exchange rate (Yuan / US dollar)

Value Share Coefficients

A_{is} = Share of absorption of i derived from source s
$B_{ij}^{(1)}$ = Share of intermediate use in j in total absorption of i
$B_i^{(2)}$ = Share of investment in total absorption of commodity i
$BS_i^{(2)}$ = Share of stock demand in total absorption of commodity i
$B_i^{(3)}$ = Share of household consumption in total absorption of commodity i
$B_i^{(5)}$ = Share of government in total absorption of i
ES_{is} = Share of China and R.O.W. in world export markets for i
F_j = Share of fibre j in total fibre demand by the textile industry
FES_1 = Share of export revenue obtained from sales at official exchange rate, (($1 - R_o$) ϕ_1)/($R_o\phi_2 + (1 - R_o)\phi_1$) where R_o = base period retention rate
$H_{ij}^{(1)}$ = Share of intermediate good i in total costs of industry j
H_{vj}^* = Share of primary factor v in total costs of industry j
J_{id} = Share of good i production to destination 1, export; 2, domestic
K_i = Share of sector i in total value added
L_j = Share of industry j in total employment
M_i = Share of i in total imports
RC = Conversion factor from proportional change in retention rate (R) to change in ($1 - R$) i.e. ($-R_o/(1 - R_o)$)
S_{vj}^* = Share of primary factor v in primary factor inputs of j
SM = Imports as a share of nominal gdp
SN_{ij} = Share of end-use demand j for commodity i in final absorption
SX = Exports as a share of nominal gdp
V_i = Share of 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_{ij} = Price elasticity of household demand for good i with respect to price j
σ_i^k = Elasticity of substitution between fibres in the textile industry (set to zero for non-fibre inputs)
σ_i^m = Elasticity of substitution between import and domestic products of good i
σ_i^p = Elasticity of substitution between primary factor inputs in sector i
σ_i^x = Elasticity of substitution between domestic and export production of good i
σ_i^w = Elasticity of substitution between Chinese and R.O.W. products in world market for i

Appendix 2 Model equations and variables

1.	<u>Household Consumption Demands</u>				
	$q_i^{(3)} = e_i a^* + \sum_{k=1}^3 \eta_{ik} p_k^l$	g			
2.	<u>Fixed Investment Demand</u>				
	$q_i^{(3)} = a_n$	g			
3.	<u>Investment in Stocks</u>				
	$q_s^{(3)} = a_n$	g			
4.	<u>Government Demand</u>				
	$q_i^{(3)} = a_n$	g			
5.	<u>Traded Good Demand/Supply</u>				
	(a) Export Demand from China				
	$q_i^{(4)} = q w^{(4)} - \sigma_i^* (p_i^l - \sum_{s=1}^3 ES_{is} p_{is}^l)$	g			
	(b) World Demand				
	$q w^{(4)} = \beta_i (\sum_{s=1}^3 ES_{is} p_{is}^l)$ ($s = 1$, China; 2, Rest of World)	g			
	(c) Import Supply to China				
	$q_{is} = \tilde{E}_i p_i^m$	g			
6.	<u>Intermediate Demands</u>				
	(a) excluding textile sector				
	$q_{ij}^{(1)} = x_j$	$g^2 - g$			
	(b) textile sector				
	$q_{ki}^{(1)} = x_i - \sigma_i^k (p_k - \sum_j F_j p_j)$	g			
7.	<u>Domestic Absorption of Good i from all Sources</u>				
	$q_i = \sum_j B_{ij}^{(1)} q_j^{(1)} + B_i^{(2)} q_i^{(2)} + BS_i^{(3)} q_s^{(3)} + B_i^{(3)} q_i^{(3)} + B_i^{(4)} q_i^{(4)}$	g			
8.	<u>Domestic/Import Substitution</u>				
	$q_{is} = q_i - \sigma_i^m (p_{is} - p_i^l)$ ($s = 1$, Imported; 2, domestic)	$2g$			
9.	<u>Transformation in Production</u>				
	$x_{id} = x_i + \sigma_i^l (p_{id} - p_i^l)$ ($s = 1$, export; 2, domestic)	$2g$			
10.	<u>Primary Factor Inputs</u>				
	$q_{vj}^p = x_j - \sigma_j^p (p_{vj}^p - \sum_{v=1}^3 S_{vj}^p p_{vj}^p)$	$3g$			
11.	<u>Product Market Clearing</u>				
	(a) Domestic market clearing				
	$q_{i2} = x_{i2}$	g			
	(b) Export market clearing				
	$q_i^{(4)} = x_{i1}$	g			
12.	<u>Factor Market Clearing</u>				
	(a) $q_1^l = \sum_{j=1}^J L_j q_j^l$ - Labour	1			
	(b) $q_2^p = k_j$ - Capital in i	g			
	(c) $q_3^p = l_j$ - Land in i	g			
13.	<u>Zero Pure Profits at the Margin</u>				
	(a) In Production				
	$\sum_{d=1}^3 J_{jd} p_{jd} = \sum_i H_{ij}^{(1)} p_i^l + \sum_{v=1}^3 H_{vj}^p p_{vj}^p$	g			
	(b) In Importing				
	$p_{i2} = p_i^m + t_i + \phi_2$	g			
	(c) In Exporting				
	$p_{i1} = p_i^e + v_i + FES_i(RC + rr_i + \phi_1) + (1 - FES_i)(rr_i + \phi_2)$	g			
14.	<u>GDP, Absorption and Household Absorption</u>				
	(a) $gdp_r = \sum_i K_i x_i$	1			
	(b) $gdp = \sum_i K_i (p_i^e + x_i)$	1			
	(c) $a_n = \sum_i SN_{i3} q_i^{(3)} + \sum_i SN_{i6} q_i^{(5)} + \sum_i SN_{i2} q_i^{(2)} + \sum_i SN_{i6} q_s^{(3)}$	1			
	(d) $a = \sum_i SN_i a^* + \sum_i SN_{i3} (p_i^l + q_i^{(1)}) + \sum_i SN_{i2} (p_i^l + q_i^2) + \sum_i SN_{i6} (p_i^e + q_s^{(2)})$	1			
15.	<u>Balance of Trade Condition</u>				
	$\pi = SXe + SMm$	1			
16.	<u>Balance of Trade Identities</u>				
	(a) Total Export Value				
	$e = \sum_i V_i (p_{i1} + x_{i1})$	1			
	(b) Total Import Value				
	$m = \sum_i M_i (p_{i2} + q_{i2})$	1			
	(c) Total Export Volume				
	$e_n = \sum_i V_i x_{i1}$	1			
	(d) Total Import Volume				
	$m_n = \sum_i M_i q_{i1}$	1			
17.	<u>Composite Price Variables</u>				
	(a) Price Level Determination				
	$p^l = ms - a_n$	1			
	(b) Price Deflator for gdp				
	$p^r = \sum_i K_i p_i^l$	1			
	(c) Price Deflator for Total Absorption				
	$p^s = \sum_i W_i p_i^l$	1			
	(d) Price Deflator for Absorption of i				
	$p_i^l = \sum_{s=1}^3 A_{is} p_{is}$	g			
	(e) Price Deflator for Output of i				
	$p_i^l = \sum_{d=1}^3 J_{id} p_{id}$	g			
TOTAL NUMBER OF EQUATIONS					$g^2 + 24g + 13$

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