# The Impact of the World Economic Recovery on a Small Open Economy: The Case of Singapore

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## THE IMPACT OF THE WORLD ECONOMIC RECOVERY ON A SMALL OPEN ECONOMY: THE CASE OF SINGAPORE<sup>\*</sup>

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### Abstract

This paper uses a computable general equilibrium (CGE) model to predict the likely impact on the Singapore economy of the expansion of the world demand for manufacturing exports due to the recovery in the world economy in the mid 90s. The results show that the increased world demand generates substantial welfare gains to Singapore. The analysis points out that these gains could however be lower if the country maintained a rigid real wage policy. A flexible wage policy would thus increase the benefits to Singapore substantially.

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### I. Introduction

The International Monetary Fund (IMF) projected that the world output would expand by 3 per cent in 1994 and 3.5 per cent in 1995 (IMF, 1994). During the first half of 1994, many developed countries showed strong sings of recovery from the downturn, which lasted since the late 1980s up until 1993. In particular, Western Europe and Japan have begun to recover from some of the worst recessions for nearly half a century. Consistent with the revival of the global economy, the United Kingdom, Canada and Australia have gained developmental momentum while in the United states high level of capacity utilisation witnessed already restored economic activity and trade. Another positive aspect of the world economic situation by 1995 was the rapid growth in many Asian and Latin American countries. This improved world economic environment is expected to contribute to the expansion of world trade substantially over the next decade. The world trade was estimated to grow at a rate of 7 per cent in 1994 and by 6 per cent in 1995, well above the average 5 per cent rate of growth experienced during the past two decades (IMF, 1994, p.11). This upward trend in world trade indicates increased economic activity in industrialised economies, stronger import demand world wide, and continued rapid growth in many developing countries. A phenomenal growth in trade among developing countries is taking place mainly due to the trade liberalization and expanded interregional foreign direct investment.

The strengthening of the recovery across the industrialised countries and positive outlook for rapid growth in developing countries could mean strong demand for world output, resulting improved prospects for world commodity prices. During 1994, prices for coffee, copper and several other metals have risen substantially. The IMF's world export-weighted index of nonfuel commodity prices in August 1994 was up by 14.5 per cent in dollar term compared to 1993 price level. *The Economist*'s widely cited commodity price index, which weights prices by the value of imports into the industrialised economies, has recorded more than 37 per cent increase in the twelve

months through August 1994. It is sometimes argued that the speculative behaviour would have contributed to some of these commodity price increases. However, it is also reasonable to attribute these commodity price changes to the broadening of recovery among industrial countries.

Increased commodity prices arising from improved world economic conditions could benefit economies heavily dependent on export trade. The authorities in such countries should be prepared to adjust their macroeconomic policies to accommodate additional world demand so as to benefit from the global recovery while maintaining employment and output stability in their own countries. Singapore is one of those countries which has traditionally been reliant on the export of manufactured goods and could be regarded as one main beneficiary from a stronger world trade. Export of manufactured goods accounts for about 79 per cent of total exports of Singapore. Its main trading partners are the United States, Japan, Germany and Canada among the developed countries and China, Malaysia, Korea are among the developing countries (WTO, 1995). The rapid growth in east Asian neighbouring nations has created wider prospects for trade in manufactures for Singapore on one hand, but on the other hand they have also become major competitors in the region. Singapore has been traditionally a labour scarce economy and as a consequence wages are relatively higher compared to countries such as Thailand, Korea, Indonesia and Malaysia. This has resulted to some extent a shift in comparative advantage in the production of manufactured goods from Singapore towards these new producers in the region in recent years.

In the face of growing competition for trade, Singapore has adopted a strategy to maintain the external competitiveness by lowering domestic cost through low inflation (Bercuson, 1995). Since the 1985 recession, the monetary authorities in Singapore have been successful in maintaining strong currency which has helped to bring inflation down to record low levels. This exchange rate policy has produced good results in terms of moderate growth in wages and consequently the unit labour cost has declined

substantially improving country's external competitiveness. Singapore's ability to benefit from increased world demand resulting from the recovery in industrial nations is likely to depend on how it will adjust the macroeconomic policies in the future. For the short to medium term, the key policy challenge is to promote country's production capacity to meet the new world demand without adding to inflation. When excess demand pressures are present in the global economy during the expansion, highly open economies such as Singapore are likely to have a major impact on their domestic economic activity.

In this paper we attempt to illustrate some possible outcomes for the Singapore economy which may emerge due to increased world demand. Using a computable general equilibrium (CGE) model for Singapore, simulations are carried out to project the likely macroeconomic and sectoral impact which are of interest to policy makers. These simulation exercises illustrate what economic policy changes are required to achieve economic stability.

The rest of the paper is organised as follows. Section II provides a simple theoretical illustration which pinpoints the likely outcome of an increased world demand for Singapore's exports. While this is essentially a partial equilibrium illustration, it nevertheless gives some intuition to the ensuing analysis. Section III outlines the modelling framework, which is documented in detail in the appendix. The macroeconomic and sectoral results of the simulations are reported and discussed in Section IV. Section V contains the main conclusions of the analysis.

#### **II** Some Key Mechanisms

The mechanisms underlying the simulation of the effects of increase in world demand for manufactured goods exported by the Singapore economy are illustrated in Figure 1. The demand curve  $D_d$  represents the initial domestic demand for manufactured goods

while the demand curve  $D_f$  denotes the foreign demand for the product. The initial aggregate demand is the horizontal addition of these two demand curves and is given by the curve D in Figure 1. The domestic supply curve for manufactured goods is  $S_d$ . Given this aggregate demand and supply curves, the market is in initial equilibrium at point A with price P and quantity Q. At this equilibrium, the domestic sales of the output is shown by Oa and exports are equal to the distance aQ. We may assume now that due to the world recovery the demand for manufactures is increased.

Figure 1: Effects of an increase in foreign demand for manufactures on domestic demand, output and exports.



Note: This graphical presentation is adopted from Higgs (1986).

Consequently, the foreign demand curve shifts outward to  $D'_{f}$ . At the existing level of exports, this will result in an increase in the world price of the good to  $P_{l}$ . As can be seen from Figure 1, this shift in the foreign demand curve for manufactures leads to a shift in the aggregate demand curve to D'. This implies that the domestic price received

by the producers increases from P to  $P_2$  at the remaining output level Q. As this price rise occurs, the domestic production of manufactures can be expected to increase. This increase in supply will tend to lower the price level until a new equilibrium is established at point C. The new equilibrium denotes that both output and price of the good have increased to  $Q_*$  and  $P_*$ , receptively. Notice that higher world demand has increased exports to Od and decreased the domestic demand to Oc.

Figure 1 shows the partial equilibrium effects on the export sector in response to the increased world demand for Singapore's products. The general equilibrium model used in the analysis takes much more direct and indirect effects of the event into account and projects economy wide effects. For example it will incorporate the shift in the export supply curve arising from increase in wages and costs of intermediate inputs, shift in domestic household, intermediate and investment demand curves, and the impact on domestic consumption due to substitution between domestic and imported manufactured goods, etc. In the next section, we present a brief outline of the CGE model of Singapore which will help understand these interactions.

### III The CGE Model of the Singapore Economy

The theoretical structure of the multisectoral model used in the present study is in the tradition of CGE models pioneered by Johansen (1974). The specification of the model follows closely the ORANI model of the Australian economy (Dixon *et. al*, 1982). This section provides a brief outline of the theoretical model, data sources and calibration procedure. The key components of the model are provided in the appendix. For a more detailed presentation of the theoretical model, reader is referred to Siriwardana (1991 and 1995).

### Main Features of the Model

The basic model consists of a simultaneous equation system in linear percentage change form which describes input demands, final demands, output supply, price formation, equilibrium conditions and the international sector of the economy. The model contains eight production sectors, three categories of final demands (i.e., household consumption, investment and exports), and two categories of primary factors (i.e., labour and capital). The producers and consumers behave as they are in a perfectly competitive market environment. The former minimises costs in producing outputs and the latter maximises utility in consuming goods and services.

Consumers maximise utility subject to a budget constraint. The utility function is of a two--level nested form. At the first level, we use the Leontief function which implies that there is no substitution between different commodity groups. At the second level, consumers substitute between domestic and imported sources of commodities of the same category. The choice between imported and domestic sources for a particular good is modelled with the well known Armington specification. The preferences of the consumers are characterised by the Cobb-Douglas aggregation of domestically produced commodities and imports of the same type which are considered to be imperfect substitutes.

Each industry uses sector specific capital goods. The production of capital goods for use in a particular industry is carried out in a perfectly competitive environment under constant returns to scale production technology. The production process represents two levels. At the first level, a given industry chooses effective intermediate inputs to minimise the total costs of the production of capital goods subject to a Leontief production function. At the second level, the industry chooses its inputs for capital creation from domestic and imported sources to minimise costs subject to a Cobb-Douglas production function.

A portion of the output of each sector is exported and the remaining part is sold for domestic consumption. It is assumed that each industry faces an export demand curve which is downward sloping. However, The exact relationship between export demand and the world price level is modelled by adopting different values of export demand elasticities. On the import side, small country assumption is maintained throughout the model.

The Leontief Cobb-Douglas nest is used in describing the production functions for the Singapore economy. This two level production technology is constant returns to scale and all input markets are perfectly competitive. The first level Leontief production technology implies no substitution between different types of intermediate inputs and between intermediate inputs and primary factor inputs, capital and labour. The second level permits some degree of substitution between imported and domestically produced intermediate inputs, and between different primary factors according to the Cobb-Douglas function.

The assumptions of constant returns to scale and perfectly competitive market structures ensure that all economic activities make zero pure profits in equilibrium. Table A1 in the appendix gives the model equations in linear percentage change form. Tables A2 and A3 in the appendix list variables and coefficients of the model, respectively.

### Data and Model Calibration

The calibration of the CGE model of Singapore requires two categories of data. They are various shares or weights (i.e., sales or cost shares) and estimates of elasticity parameters such as household demand elasticities, import-domestic substitution elasticities, capital-labour substitution elasticities and export demand elasticities. The use of Leontief and Cobb-Douglas functional forms in the model formulation allows almost all the parameters and coefficients of the model to be obtained from an inputoutput table of the Singapore economy. The model is calibrated to an eight-sector aggregated version of the input-output table of Singapore (Department of Statistics, 1987).

Sector-specific export demand elasticity estimates are extremely scarce for countries like Singapore. Lim Chong Yah et. al (1988, p.306) has estimated short-run price elasticity of export demand to be 1.67 and the long-run elasticity to be 2.65 for Singapore's exports. Plausible values for export demand elasticities were therefore adopted by referring to these estimates and by performing sensitivity analysis of the model based on such elasticity values. Consequently, the values of export demand elasticities used in the simulations reported in the paper are 2.0 for manufacturing and 20.0 for other sectors (see Siriwardana (1996) for details).

### Increase in World Demand Shocks Under Different Wage Scenarios

The increase in world demand for manufactures implies a rise in the world price of both exports and imports of the commodity. For the purpose of numerical simulation of the model, we have considered a 10 per cent increase in the world price of manufactures. As manufactured goods account for nearly 90 per cent of total imports to Singapore, higher prices for such imports will feed into production costs and consumer prices. This may have direct implications for real wages in the Singapore economy. We have conducted two optional simulations to examine the effects of the world demand expansion on the Singapore economy under two wage scenarios. Option (i) involves with fixed real wages in the face of increased world price for manufacturing exports and thus allows the money wage to adjust according to the consumer price index. An orthodox neoclassical framework is simulated in Option (ii). That is a real wage cut to meet the domestic employment constraint. According to the model variables, the 10 per cent increase in both export and import prices of manufactures is simulated by an exogenous 10 per cent increase in ( $\dot{p}_{(21)}$ ) and ( $\dot{p}_{(22)}$ ) variables, respectively.

### **IV Model Simulation Results**

In Table 1 we present the macroeconomic results of the impact of 10 per cent increase in world price of manufactures under different wage scenarios for Singapore. Similarly, Table 2 summarises sectoral output and employment responses to world demand expansion along with export volume projections. Effects on return to two productive factors, capital and labour, are shown in Table 3. These simulation results should be analysed in conjunction with the individual model closures which are depicted in Table A4 in the appendix. The results of the simulations are dependent upon the selection of exogenous variables which determines the macroeconomic environment of the simulations.

The simulation results presented in the paper illustrate how endogenous variables behave due to the exogenous price shocks. Thus the projections can be used to gauge the impact on the Singapore economy of the world recovery and thereby providing some useful policy implications.

## Option (i): The 10% increase in the world price of manufactures and fixed real wages

The increase in world demand for manufactured goods leads to only a one per cent increase in real GDP in the Singapore economy if real wage rigidity is maintained. From the macroeconomic results in Table 1 it is apparent that 10 per cent world price increase generates a rise in the domestic consumer price index (CPI) by 9.3 per cent. This domestic price change is mainly due to the higher prices of imports of manufactured goods that account for the largest share of Singapore's aggregate imports. As real wages are fixed (i.e., full wage indexation), the nominal wages are to grow by the same rate as CPI.

Variable	Option (i) 10% increase in the world price of manufactures and fixed real wages	Option (ii) 10% increase in the world price of manufactures and fixed money wages
Real GDP	1.06	5.47
Real incomes	-0.90	3.77
Real domestic absorption	2.25	5.82
Aggregate exports	8.63	15.89
Aggregate imports	10.82	17.20
Balance of Trade <sup>(b)</sup>	-4.19	-3.71
Consumer price index	9.33	6.94
Aggregate demand for labour	2.30	11.88
Money wages	9.33	0.00
Real wages	0.00	-6.94
Real exchange rate	-9.33	-6.94

# Table 1Macroeconomic Effects of a 10% Increase in the World Price of<br/>Manufactures(a)

Notes: (a) All projections are in percentage changes except the balance of trade.

(b) Balance of trade is given as a percentage of the base period GDP.

The trade results in Table 1 indicate that aggregate export revenue increases by 8.6 per cent in response to the 10 per cent rise in the foreign price of manufactured goods. Aggregate imports are also projected to increase at a slightly higher rate than exports. This is mainly due to the increased domestic consumption as shown by the 2.2 per cent expansion real domestic absorption. Though Singapore could experience improved demand for its exports of manufactured goods, the end result is a deficit in the balance of trade that is equivalent to 4.1 per cent of the base period GDP. Higher economic activity domestically tends to raise the demand for imports while the increase in the domestic costs arising from general price rise (as shown by the 9.3 per cent increase in CPI) makes domestic substitutes for imports less competitive. In the absence of real wage flexibility downwards, improved price level for exports of manufactures generates employment at a fairly moderate rate (2.3 per cent).

The sectoral level output and employment results shown in Table 2 reveal that six of the eight sectors in the Singapore economy gain from the stimulus provided by the world recovery under the fixed real wage scenario. The two losers are the agriculture, and transport & communication sectors. However, across the board performance of sectors that report output and employment gains is restricted by the real wage inflexibility. The manufacturing sector in particular shows a relatively modest performance. Quite surprisingly, the export volume of manufactures improves by an insignificant proportion (0.9 per cent) despite the 10 per cent increase in world price for manufacturing.

Table 3 gives projections of returns to two primary factors labour and capital employed in various sectors in the Singapore economy. It appears that the increase in world price of manufactures tends to lower the returns to factors employed in agriculture, and transport & communication. Given the fact that the agricultural sector's contribution to real GDP in Singapore is relatively small, this income loss should not be taken seriously in assessing the overall impact of the world demand expansion. As far as the

	Option (1) 10% increase in the world	Option (11) 10% increase in the world
	price of manufactures and	price of manufactures and
Sector	fixed real wages	fixed money wages
	······································	
Outputs:		
-		
Agriculture	-1.68	1.73
Manufacturing	1.10	9.34
Utilities	1.29	6.21
Construction	2.20	5.81
Commerce	1.34	4.27
Transport & communication	-0.22	1.67
Financial & business services	0.82	4.46
Other services	1.72	5.46
Employment		
<u>Employment.</u>		
Agriculture	-7.18	7.42
Manufacturing	2.42	20.59
Utilities	6.21	29.93
Construction	3.93	10.39
Commerce	2.79	8.86
Transport & communication	-0.57	4.31
Financial & business services	2.79	15.25
Other services	1.95	6.17
Export Volume:		
	0.07	10.17
Manufacturing	0.95	10.17

### Table 2 Sectoral Effects of a 10% Increase in the World Price of Manufactures<sup>(a)</sup>

Note: (a) All projections are in percentage changes.

returns to labour are concerned, the construction sector appears to be the main winner. In the case of capital rentals, the utilities sector reports highest returns.

## Option (ii): The 10% increase in the world price of manufactures and fixed money wages

The results in column (II) of Tables 1 to 3 are concerned with the impact of world demand expansion on the Singapore economy in an environment where money wages are fixed (i.e., there is a real wage flexibility downwards). It is interesting to note that the higher world price for manufactures brings strong growth prosects for Singapore if the economy is prepared to accept a cut in real wages. Compared to the 1 per cent GDP growth with fixed real wages, this simulation projects 5.4 per cent GDP growth in response to higher world price of manufacturing exports. The domestic inflationary effect as revealed by the 6.9 per cent increase in the CPI is mainly due to the higher import prices which tend to increase the domestic production costs. Aggregate export revenue is much higher in this fixed money wage scenario but since economy grows faster requiring more imports, the reduction in the balance of trade deficit turns out to be trivial (from a deficit equivalent to 4.1 per cent of the base period GDP to 3.7 per cent).

A remarkable growth in employment (11.8 per cent) is projected indicating the economy's ability to gain employment in an environment of constant money wages. This is one of the most important findings of the analysis which may bring into light the importance of real wage flexibility downwards in the face of world recovery. In a country like Singapore, it is extremely important to control the money wage growth to reduce the domestic cost so that it can improve external competitiveness. Singapore has been successful in lowering inflation over recent year through the appreciation of the exchange rate. The projections in column 2 of Table 1 indicate that the reduction in wage costs is a reasonable alternative to the exchange rate policy and provides strong employment growth in short to medium term.

Sector	Option (i) 10% increase in the world price of manufactures and fixed real wages	Option (ii) 10% increase in the world price of manufactures and fixed money wages	
Labour:			
Agriculture	-1.65	0.11	
Manufacturing	1.09	6.14	
Utilities	1.30	4.83	
Construction	2.20	1.93	
Commerce	1.34	0.92	
Transport & communication	-0.22	-1.03	
Financial & business services	0.81	2.41	
Other services	1.72	-0.68	
<u>Capital:</u>			
Agriculture	-5.54	0.36	
Manufacturing	1.33	7.51	
Utilities	4.91	18.16	
Construction	1.73	1.52	
Commerce	1.45	0.99	
Transport & communication	-0.35	-1.60	
Financial & business services	1.98	5.90	
Other services	0.23	-0.09	

# Table 3 Projected Changes of Real Returns to Productive Factors of Different Sectors of the Economy $^{(a)}$

Note: (a) All projections are in percentage changes.

Column II of Table 2 contains the projections which show the impact on the industrial structure of the Singapore economy of the export price increase under constant money wages. The results clearly show that the reduced wage costs provides major stimulus to the economy, improving the probability of benefiting from the recovery in industrialised economies. The improved external demand for manufacturing exports brings 9.3 per cent increase in output and 20.5 per cent growth in employment in the sector. This is followed by the strong performance of the sector, utilities. All other sectors also show substantial output and employment growth which are mainly due to the general growth of the entire economy. In particular, the demand for nontrading service sectors improve with the growth in GDP. For example, the financial & business services records 15.2 increase in employment.

The resulting projections for real returns to two primary factors are shown in column 2 of Table 3. Except for transport & communication and other services, income gains at different rates are projected for the remaining sectors. Among these gainers, agriculture records the lowest returns for labour and capital while manufacturing and utilities experience substantially high returns.

#### V Conclusions

In this paper we have used a computable general equilibrium model to predict the likely outcomes of the world recovery on a small open economy, namely Singapore. The analysis treats the global economic recovery as an exogenous shock to the Singapore economy. The effects of increased demand for manufactured goods by the world economy has been simulated through a ten per cent rise in the world price of manufactures. The analysis shows what sort of macroeconomic adjustments would be required domestically to cope with the increased world demand. The following conclusions emerge from the analysis. It appears to be that the world demand expansion generally leads to a significant increases in real GDP and the aggregate employment in the Singapore economy. The primary source for this welfare gain is the growth in the manufacturing sector arising from improved export sales. The stimulus provided by this is transmitted to other sectors of the economy through various inter-industry linkages. This is evident from the strong growth prospects projected for the sectors such as utilities, construction, commerce, and financial and business services. The most interesting finding is that the overall impact of the world recovery on the Singapore economy would tend to be lower if the country maintained a real wage rigidity. In other words, a flexible real wage policy would increase the benefits to Singapore tremendously, allowing the economy to be more competitive in the world market.

From policy perspective, results suggest that a reduced wage cost by introducing a flexible real wage policy could provide a reasonable alternative to the present exchange rate policy which has been adopted to lower domestic inflation. The extent of this flexible wage policy and its impact on the economy would largely depends on the expected level of domestic inflation. Notice that the results reported in the paper deal with two extremes. First, a fixed real wage policy with fully flexible money wages (i.e. full wage indexation). Second, a fully flexible real wage policy with fixed money wages (zero per cent wage indexation). The obvious conclusion is that latter is more attractive in terms of potential welfare gains. However, it is possible to consider somewhat intermediate wage policy scenarios and then to observe the outcomes. The analysis presented in the paper is suffice to illustrates how labour market rigidities may lower the possible welfare gains to Singapore from world economic expansion.

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 Table A1:
 Equations of the CGE Model for Singapore in Linear Percentage Change Form

No.	Equation	Subscript range	No.	Description
	Final demands			
(1)	$x_{(is)}^{(3)} = \varepsilon_{(is)}c + \sum_{q=1}^{8} \sum_{r=1}^{2} \eta_{(is)}(qr) P(qr)$	i = 1,,8; $s=1,2$	16	Household demands for commodities
(2)	$x_{(is)j}^{(2)} = y_j - (p_{(is)} - \sum_{r=1}^{2} \alpha_{(ir)j}^{I} p_{(ir)})$	<i>i</i> = 1,,8; <i>s</i> = 1,2 ; <i>j</i> = 1,,8	128	Demand for inputs to capital creation
(3)	$p_{(i1)}^* = -\gamma_i x_{(i1)}^{(4)} + f_{(i1)}^{(4)}$	<i>i</i> = 1,,8	×	Export demands
	Demand for inputs			
(4)	$x_{(is)j}^{(1)} = x_j - (p_{(is)} - \sum_{r=1}^{2} \alpha_{(ir)j}^{(1)} p_{(ir)})$	<i>i</i> = 1,,8 ; <i>s</i> =1,2; <i>j</i> =1,,8	128	Demand for intermediate inputs by source
(2)	$x_{(91)j}^{(1)} = x_j - [p_{(91)} - (\alpha_{(91)j}^{(1)} p_{(91)} + \alpha_{(92)j}^{(1)} p_{(92)j})]$	<i>j</i> = 1,,8	80	Demand for labour
(9)	$x_{(92)j}^{(1)} = x_j - [p_{(92)j} - (\alpha_{(91)j}^{(1)} p_{(91)} + \alpha_{(92)j}^{(1)} p_{(92)j})]$	<i>j</i> = 1,,8	8	Demand for capital
	Zero pure profits			
E	$P_{(j1)} = \sum_{i=1}^{8} \sum_{s=1}^{2} P_{(is)} S_{(is)}^{(1)}_{(is)j} + P_{(91)} S_{(91)j}^{(1)} + P_{(92)j} S_{(92)j}^{(1)}$	<i>j</i> = 1,,8	×	Zero pure profits in production
(8)	$\pi_j = \sum_{i=1}^8 \sum_{s=1}^2 p_{(is)} S_{(is)j}^{(2)}$	<i>j</i> =1,,8	80	Zero pure profits in capital creation
(6)	$p_{(i1)}^{*} + v_i + \phi = p_{(i1)}$	<i>i</i> =1,,8	8	Zero pure profits in exporting
(10)	$P_{(i2)}^{*} + i_i + \phi = P_{(i2)}$	<i>i</i> =1,,8	×	Zero pure profits in importing
(11)	Market Clearing $x_i = \sum_{j=1}^{8} x_{(1)}^{(1)} B_{(i1)j}^{(1)} + x_{(2)}^{(2)} B_{(i1)}^{(2)} + x_{(3)}^{(3)} B_{(i1)}^{(4)} B_{(i1)}^{(4)} B_{(i1)}^{(4)}$	<i>i</i> =1,,8	×	Demand equals supply for domestic goods
(12)	$l = \sum_{j=1}^{8} x^{(1)}_{(91)j} W^{(1)}_{(91)j}$		1	Demand equals employment of labour
(13)	$x_{(92)j}^{(1)} = k_j(0)$	j=1,,8	80	Demand equals employment of capital

No.	Equation	Subscript range	No.	Description
	Miscellaneous Equations			
	$c = f_c + \Phi_1[\sum_{j=1}^8 (p_{(91)} + x_{(91)}^{(1)}) N_{(91)}j]$			
(14)			1	Consumption function
	$+ \Phi_2[\sum_{j=1}^8 (P(92)_j + x^{(1)}_{(92)_j}) N(92)_j] + \Phi_3 t - \Phi_4 v$			
(15)	$c_R = c - \xi^{(3)}$		1	Real aggregate consumption
(16)	$y_R = \sum_{j=1}^8 w_j^{(2)} y_j$		I	Aggregate real investment
(17)	$k_j(1) = k_j(0)(1-G_j) - 100 \Delta D_j G_j^* + y_j G_j$	<i>j</i> =1,,8	8	Capital accumulation
(18)	$\xi^{(3)} = \Sigma_{i}^{8} = 1 \Sigma_{s}^{2} = 1 P_{(is)} W_{(is)}^{(3)}$		1	Consumer price index
(61)	$x_{(i2)} = \sum_{j=1}^{8} x_{(i2)}^{(1)} B_{(i2)}^{(1)} + x_{(i2)}^{(2)} B_{(i2)}^{(2)} + x_{(i2)}^{(3)} B_{(i2)}^{(3)}$	i=1,,8	8	Import volume
(20)	$m = \sum_{i=1}^{8} (p_{(i2)}^{*} + x_{(i2)}) M_{(i2)}$		1	Foreign currency value of imports
(21)	$e = \sum_{i=1}^{8} \left( p_{(i1)}^{*} + x_{(i1)}^{(4)} \right) E_{(i1)}$		Ч	Foreign currency value of exports
(22)	$100\Delta B = (Ee - Mm)$		1	Balance of trade
(23)	$p_{(91)j} = \xi^{(3)}h + f_{(91)}$	<i>j</i> =1,,8	∞	Flexible handling of wages
(24)	$t = \sum_{i=1}^{8} \left[ \zeta_{i}^{t} t_{i} + p_{(i2)}^{*} + x_{(i2)} \right] T_{i}^{t}$		П	Aggregate tariff revenue
(25)	$v = \sum_{i=1}^{8} \left[ \zeta_{i}^{v} v_{i} + p_{(i1)}^{*} + x_{(i1)}^{(4)} \right] T_{i}^{v}$		-	Aggregate export subsidies
(26)	$gdp = \sum_{i=1}^{8} V_j x_j$		1	Real gross domestic product
(27)	$f_R = c_R - y_R$		-	Ratio of real aggregate consumption
	Total		373	to real investment

Table A1: (continue)

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Variable	Subscript Range	Number	Description
 x <sub>j</sub>	<i>j</i> = 1,,8	8	Industry outputs
$x^{(1)}_{(is)j}$	i = 1,,8; $j = 1,,8$ ; $s = 1,2$	128	Demands for inputs for current production
$x^{(1)}_{(91)j}$	<i>j</i> = 1,,8	8	Industry demand for labour
$x^{(1)}_{(92)j}$	<i>j</i> = 1,,8	8	Industry demand for capital
$x^{(2)}_{(is) i}$	i = 1,,8; $j = 1,,8$ ; $s = 1,2$	128	Demand for inputs for capital creation
y <sub>j</sub>	<i>j</i> = 1,,8	8	Sectoral capital formation
$x_{(is)}^{(3)}$	i = 1,,8; $s = 1,2$	16	Household demand for domestic and imported goods
$x_{(i1)}^{(4)}$	<i>i</i> = 1,,8	8	Export demands
$P_{(is)}$	i = 1,,8; $s = 1,2$	16	Price of good $i$ from source $s$
<i>P</i> (91)		1	Wage rate
<sup>p</sup> (92) <i>j</i>	<i>j</i> = 1,,8	8	Rental rate on capital
$p_{(i1)}^{*}$	<i>i</i> = 1,,8	8	Foreign currency export prices (f.o.b.)
$p_{(i2)}^{*}$	<i>i</i> = 1,,8	8	Foreign currency import prices (c.i.f.)
$\pi_i$	<i>j</i> = 1,,8	8	Cost of units of capital
c		1	Nominal aggregate consumption
$f_{(i1)}^{(4)}$	<i>i</i> = 1,,8	8	Export demand shift variable
φ		1	Nominal exchange rate
vi	<i>i</i> = 1,,8	8	One plus the ad valorem export subsidies
ti	<i>i</i> = 1,,8	8	One plus the ad valorem tariffs
$k_j(0)$	<i>j</i> = 1,,8	8	Employment of capital in each industry
$k_{i}(1)$	<i>j</i> = 1,,8	8	Future capital stocks
$100\Delta D_i$	<i>j</i> = 1,,8	8	Depreciation rate
CR		1	Real aggregate consumption
y <sub>R</sub>		1	Real aggregate investment
بر (3)		1	Consumer price index
5	<i>i</i> = 18	8	Aggregate imports by commodity
~(12) l		1	Aggregate employment
$\Delta B$		1	Balance of trade
e		1	Foreign currency value of exports
m f.cov		1	Wage shift variable
<sup>7</sup> (91)		-	

 Table A2:
 Variables of the Model in Percentage Change Form

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### Table A2: (continue)

Variable	Subscript Range	Number	Description
gdp		1	Real gross domestic product
t		1	Aggregate tariff revenue
ν		1	Aggregate export subsidy
f <sub>c</sub>		1	Shift in the average propensity to consume
$f_{R}$		1	Ratio of real aggregate consumption to investment
Total variable		432	

### Table A3: Coefficients of the Model

Coefficient	Description
$\varepsilon_{(is)}$	Expenditure elasticities in household consumption for good $i$ from source $s$
$\eta_{(is)(qr)}$	Own and cross price elasticities in household demands
γ <sub>i</sub>	Reciprocals of the foreign demand elasticities for Australian exports of commodity i
$lpha_{(ir)j}^{(1)}$	Share of commodity <i>i</i> from source <i>r</i> (domestic or imported) in industry <i>j</i> 's purchases of <i>i</i> for current production
$\alpha^{(2)}_{(ir)j}$	Share of commodity $i$ from source $r$ (domestic or imported) in sector $j$ 's purchases of $i$ for capital creation
$\alpha^{(1)}_{(91)j}$	Share of wages in total primary factor costs of industry j
$\alpha^{(1)}_{(92)j}$	Share of rentals in total primary factor costs of industry j
$S^{(1)}_{(is)j}$	Share of industry $j$ 's production costs represented by intermediate inputs good $i$ from source $s$
$S^{(1)}_{(91)j}$	Share of industry $j$ 's production costs represented by labour inputs
$S^{(1)}_{(92)j}$	Share of industry $j$ 's production costs represented by capital inputs
$S^{(2)}_{(is)j}$	Share of industry $j$ 's investment costs represented by input $i$ from source $s$
$B_{(i1)j}^{(1)}$	Share of the total sales of domestic good $i$ absorbed by industry $j$ as intermediate inputs
$B_{(i1)}^{(2)}$	Share of the total sales of domestic good <i>i</i> used in capital creation
$B_{(i1)}^{(3)}$	Share of the total sales of domestic good $i$ used in household consumption
$B_{(i1)}^{(4)}$	Share of the total sales of domestic good <i>i</i> absorbed by exports
W <sub>(91)j</sub>	Share of industry <i>j</i> in aggregate employment
$W_j^{(2)}$	Share of total investment accounted for by industry $j$
Gj	Ratio of gross investment to next period capital stock of sector j
$G_j^*$	Ratio of current capital stock to next-period capital stock of sector $j$

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Table A3: (continue)

Coefficient	Description
$W^{(3)}_{(is)}$	Expenditure weight of good $i$ from source $s$ in the consumer price index
$B^{(1)}_{(i2)j}$	Share of the total sales of imported good $i$ absorbed by industry $j$ as intermediate inputs
$B^{(2)}_{(i2)}$	Share of the total sales of imported good $i$ absorbed by capital creation
$B^{(3)}_{(i2)}$	Share of the total sales of imported good <i>i</i> absorbed by household consumption
$M_{(i2)}$	Share of total foreign currency costs accounted for by imported good i
$E_{(i1)}$	Share of total foreign currency export earnings accounted for by export good $i$
E M h	Aggregate foreign currency value of exports Aggregate foreign currency value of imports Wage indexation parameter
$\Phi_i$	Share in domestic income accounted for by wage income, tariff revenue, export subsidies and capital income
N <sub>(91)</sub> j	Share of industry j in total wage payments
N <sub>(92)</sub> j	Share of industry $j$ in total returns to capital
$\zeta_i^t$	Ratio of the power of the tariff on good <i>i</i> to the ad valorem rate
$T_i^t$	Share of total tariff revenue accounted for by tariffs on good $i$
$\zeta_i^{\nu}$	Ratio of the power of the export subsidy on good <i>i</i> to the ad valorem rate
$T_i^{\nu}$	Share of total export subsidies accounted for by export subsidies on good i
V <sub>j</sub>	Share of sector <i>j</i> in GDP

Variable	Subscript Range	Option (1)	Option (2)
<i>p</i> <sup>*</sup> <sub>(i2)</sub>	<i>i</i> =2	10	10
	<i>i</i> = 1,3,,8	0	0
ti	<i>i</i> = 1,,8	0	0
$p_{(i1)}^{*}$	<i>i</i> =2	10	10
vi	<i>i</i> = 2	0	0
$x_{(i1)}^{(4)}$	<i>i</i> = 1,3,,8	0	0
$f^{(4)}_{(i1)}$	<i>i</i> = 1,,8	0	0
$k_{j}(0)$	<i>j</i> = 1,,8	0	0
$100\Delta D_j$	<i>j</i> = 1,,8	0	0
$\pi_j$	<i>j</i> = 1,,8	0	0
P(91)		(en)	0
$f_{(91)}$		0	(en)
φ		0	0
f.		0	0

 Table A4:
 Values of Exogenous Variables (in percentage changes)

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Note:	(1) Each optional simulation has 59 exogenous variables.	
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(2) The notation "(en)" denotes that the variable is endogenous in this experiment.

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