THE BANGLADESH ECONOMY: SOME POLICY ISSUES

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***To the loving memory of
my nana***

Declaration

Unless otherwise indicated, this thesis is my own work

M Helal Uddin Ahammad
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Abstract

Bangladesh is a poor country that has not performed well in economic terms since independence. It was hoped that industrialization would lead to rapid growth, but protectionist import-substitution policies failed to deliver industrial development. Following the trend toward identifying policy problems as being key to growth, this study sets out to examine the effects of foreign exchange and trade policies on industrial development.

An ORANI-type computable general equilibrium model, CGE-B89, for the Bangladesh economy (on a 1989 database) was developed for policy analysis. The model was simulated for an exogenous inflow of foreign aid to estimate the shadow exchange rate. It was then simulated for changes in the official exchange rate, money supply, tariffs and export subsidies.

Simulations were designed for the short-run in identical economic environments. For each simulation two alternative assumptions about the labour market were made: fixed nominal wages in the presence of involuntary Keynesian unemployment and aggregate employment fixed by the exogenous supply of labour. The macroeconomic and sectoral effects were analysed, and the aggregate welfare gain (or loss) was evaluated for each exogenous change.

Harberger's fundamental equation of applied welfare economics (Harberger 1971) was used to disaggregate the change in welfare, due to a small change in an exogenous variable, into the direct welfare impact of the change and indirect gains (or losses) from alleviating (or exacerbating) distortions in all other markets. To apply Harberger's fundamental equation, it was necessary to extend his analysis to allow for intermediate goods, terms of trade effects, indirect taxes on consumption and intermediate inputs, production subsidies, exchange controls and wage rigidity

(for simulations in which changes in involuntary Keynesian unemployment are allowed).

In the case of shadow price of foreign exchange, the direct effect on welfare of a costless increase in foreign exchange availability of US$1, due to increased foreign aid, is the value of US$1 at the official exchange rate (taka 32.14). The indirect effects equal the sum, across all distorted markets, of the change in distorted activity multiplied by the excess of marginal social benefit of that activity over its marginal social cost. For example, in the case of tariffs, the marginal social benefit of an extra unit of imports is domestic price, while the marginal social cost is the world *cif* import price (exogenously given in the model). Therefore the gap between the marginal social benefit and marginal social cost is the amount of the tariff, and the indirect benefit of additional foreign aid in alleviating tariff distortions is the tariff times the rise in imports due to the increased foreign aid availability. In the case of Keynesian unemployment, the indirect benefit is the difference between wage and the disutility of labour (assumed to be zero in the model) times the change in employment.

With rigid nominal wages in the presence of involuntary Keynesian unemployment, the indirect effect on welfare of a costless increase in foreign exchange availability was estimated to be more than 30 per cent of the official exchange rate. This percentage also measures the extent by which the shadow exchange rate exceeded the official exchange rate. The shadow exchange rate was 15 per cent above the official exchange rate when the nominal wages were flexible and aggregate employment was fixed at the base-year level.

Model results suggested that the inflow of foreign aid would raise households' welfare at the expense of reduced production in the tradable sectors. Foreign aid inflow would cause a fall in the real exchange rate, defined as the ratio of the price of tradable goods to the price of nontradable goods. Production of most of the importables and exportables would decline against a substantial expansion in the nontradable sectors.

In a small open economy with a unified exchange rate and no exchange controls, a devaluation of the exchange rate increases the money stock through the Hume mechanism. But such a causality does not take place in an economy confronting exchange controls under a dual exchange rate system (involving an exogenously fixed official exchange rate and the market determined secondary exchange rate). In such an economy, changes in money supply and changes in the official exchange rate may be viewed as two separate policy tools to affect the secondary exchange rate premium, and hence implicit taxes on imports and exports. Production and consumption decisions in the economy are thus influenced.

The study explored the consequences of two instruments for exchange rate unification: devaluation of the official exchange rate and a contraction of the domestic money supply. Simulations of the devaluation of the official exchange rate and increases in money supply have suggested that a devaluation of approximately 2 per cent or a contraction of domestic money supply by 2 to 2.5 per cent would unify the exchange rates. When aggregate employment is fixed, devaluation and money supply contraction would both reduce the aggregate implicit taxes on exports, and would lead to a deterioration in the international terms of trade. As a result, welfare would fall. In other words, unification of the exchange rates in the absence of optimal export taxes is estimated to be welfare worsening. A nominal contraction (or expansion) degenerates (or produces) a Keynesian stimulus under conditions of sticky nominal wages. As a result, a contraction in the domestic money supply would be welfare worsening, and a devaluation which is equivalent to a monetary expansion would be welfare augmenting in conditions of wage rigidity. But a 2 per cent devaluation, which would unify the exchange rates, would raise households' welfare, albeit by only 0.14 per cent of the base-year GDP at market prices.

An equiproportional reduction of tariffs was found to be welfare improving. Both exports and GDP at market price rose. Simulation results, however, suggested that the welfare gains from a 10 per cent equiproportional reduction in tariffs were quite small as a proportion of base-year GDP: only 0.11 per cent under the assumption of nominal wage rigidity and 0.02 per cent under the exogenously fixed aggregate employment assumption.

Simulation results also showed that the equiproportional reduction of the Export Performance Benefit entitlement rates was welfare worsening. The simultaneous reductions in the Benefit entitlement rates and tariffs by the same percentage, however, were welfare augmenting. All exports except jute experienced a rise. This seemed to reveal the inadequacy of the Benefit Scheme in overcoming the deleterious effects of nominal protection on exports. The results also showed that the elimination of subsidies under the Benefit Scheme had to be accompanied by a reduction in nominal protection to raise welfare and exports.

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Symbols and Glossary

n.a.	not applicable
..	not available
-	zero
•	insignificant
taka (TK)	domestic currency; US$1 = taka 32.14 being the official rate; and US$1 = taka 32.91 being the secondary rate in 1989 (Bangladesh Bank 1991)
year	data correspond to fiscal year (unless otherwise stated): July 1 to June 30; for example GDP for the year 1989 is GDP for the fiscal year 1988-89.
AIDS	Almost Ideal Demand System
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	computable general equilibrium
cif	cost, insurance and freight
CPI	consumer price index
fob	free on board
GDP	gross domestic product
GNP	gross national product
I-O	input-output
LES	Linear Expenditure System
TOT	terms of trade
VES	Variable Elasticity of Substitution
XPB	Export Performance Benefit

1

INTRODUCTION

Bangladesh is a very poor country. It has not performed well in economic terms since independence. Per capita GDP fell at an average annual rate of 0.4 per cent between 1970 and 1980, and it only grew at an average annual rate of 0.9 per cent between 1980 and 1989 (World Bank 1991, 1993). Agriculture has been the traditional mainstay of the Bangladesh economy. As in most other developing countries, with economic development, manufacturing, public utilities and services were expected to become increasingly important in output and employment as the economy deepened and diversified. But industry has failed to grow sufficiently to lead to perceptible growth in the economy as a whole.

Policies, industrialization and growth

In recent years it has become increasingly evident in Bangladesh that the economic policies are not appropriate for industrial or overall growth (Sahota 1990, Bhuyan and Rashid 1993a).

Structuralist view of industrialization, owing much to Prebisch (1959), dominated economic policies in Bangladesh until recently. Despite policies that led to excessive capital and technology intensity, industrialization was seen as a source of rapidly growing employment. Although empirical research showed the high costs of protection *via* quantitative import restrictions and escalating tariffs (Little, Scitovsky, and Scott 1970), a repressed financial system with subsidies for favoured producers (Mckinnon 1973, 1980) and over-valued foreign exchange regimes (Bhagwati and Krueger 1973), Bangladesh has retained, or only partially reformed, all these policies.

These policies distorted relative prices and profitability leading to resource misallocation and inefficiency.

Empirical research in the last decade has shown that sectoral as well as overall economic performance of the economy largely depends on economy-wide policies (Krueger *et al.* 1988). Policy controls over investment, imports, prices and production, create impediments to the economy's response to economy-wide policies. If controls are reduced and various parts of the economy become increasingly integrated, economy-wide policies become more effective. Exchange rate, monetary and trade policies, always important for industrialization, become even more important with the reduction of direct controls.

The objective of the study and the analytical framework

The objective of this study is to examine the economic consequences (including welfare implications) of exchange rate, monetary and trade policies. These policies significantly affect the structure and growth of industries in Bangladesh.

For economy-wide policy analysis, a computable general equilibrium model is developed for the Bangladesh economy. The principal institutions and policies operating in the Bangladesh economy in 1989 are modelled. The costless exogenous inflow of foreign exchange is simulated to estimate the shadow exchange rate. This gives a summary measure of the distortions modelled. Changes in the official exchange rate, money supply, tariffs, and export subsidies under the Export Performance Benefit Scheme are then simulated. The macroeconomic and sectoral effects of each exogenous policy change are analysed and the aggregate welfare gain (or loss) is estimated.

The welfare effects are disaggregated into their components using a version of Harberger's (1971) fundamental equation of applied welfare economics. Harberger's fundamental equation expresses the change in welfare (defined as the change in utility divided by the marginal utility of income) due to a small change in an exogenous variable as equal to the direct impact of the change plus the indirect gains (or losses) from alleviating (or exacerbating) distortions in all other markets. The indirect gains (or losses) equal the sum, across all distorted markets, of the change in distorted activity multiplied by the excess of the marginal social benefit of that activity over its marginal social cost. To apply Harberger's fundamental equation, it is necessary to extend his analysis to allow for intermediate goods, terms of trade effects, indirect taxes on consumption and intermediate inputs, production subsidies, exchange controls and wage rigidity (in case of the simulations which allow for changes in involuntary Keynesian unemployment).

The simulation of the costless increase in the foreign exchange inflow to estimate the shadow exchange rate follows Harberger (1971) and Fane (1991). The sources of additional units of foreign exchange could be technical innovations or additional aid receipts. It is, however, assumed, taking into consideration the economy's heavy dependence on foreign aid, that the costless additional inflow of foreign aid is the source of increased foreign exchange availability. The simulation thus also examines whether the exogenous inflow of foreign aid improves the aggregate welfare at the expense of tradable sectors.

Devaluation of the official exchange rate and expansion in the domestic money supply are simulated to evaluate their economic consequences, and to highlight the importance of economy-wide policies in influencing sectoral performance. Devaluation of the official exchange rate and contraction in the domestic money supply are viewed as instruments of exchange rate unification. The simulation results can also be used to examine the economic consequences of exchange rate unification.

Simulations of changes in tariffs and export subsidies are designed to indicate the effects of the tariff reduction and withdrawal of export subsidies on resource allocation and welfare.

Organization of the study

Chapter 2 discusses the socio-economic characteristics of the Bangladesh economy and assesses its structure and performance. It then describes the structure and performance of manufacturing, and the principal policies that affect industry.

Chapter 3, after discussing computable general equilibrium modelling, chooses an ORANI-type applied general equilibrium analytical framework for the policy analysis in this study. A selection of existing computable general equilibrium models for the Bangladesh economy is then reviewed in relation to the model chosen for this study.

A 19-sector computable general equilibrium model is constructed in Chapter 4. The assumptions and broad features of the model are discussed and the structural equations of the model and the main identities are specified. On the basis of the general equilibrium relations, a version of Harberger's (1971) fundamental equation of applied welfare economics, called the Efficiency Equation in the study, is derived for decomposing the components of welfare effects.

Chapter 5 constructs a database for the year 1989 to implement the model. It describes solution methods, and designs the various policy simulations. The analysis of the simulation results is presented in the following three chapters. Chapter 6 simulates the model for an exogenous change in foreign aid, analyses the results and estimates the shadow exchange rate for the Bangladesh economy. Chapter 7 analyses the simulation results of a devaluation of the official exchange rate and an increase in the domestic money supply. The impacts of equiproportional reductions in tariff rates and the Export Performance Benefit entitlement rates are analysed in Chapter 8.

The final chapter summarizes the main findings and policy implications of the study.

2

THE BANGLADESH ECONOMY: PERFORMANCE AND POLICIES

This chapter starts with an assessment of the performance of the Bangladesh economy to 1989 with a special emphasis on manufacturing. This provides the framework for an assessment of the effects of the policies which affected the structure and growth of industries in Bangladesh.

The economy of Bangladesh

Bangladesh remains one of the poorest countries in the world. Its very large population is poorly educated, and its GDP as well as social indicators confirm that its *per capita* income and standards of living are extremely low (Table 2.1).

Table 2.1 **Bangladesh: key social indicators, 1989**

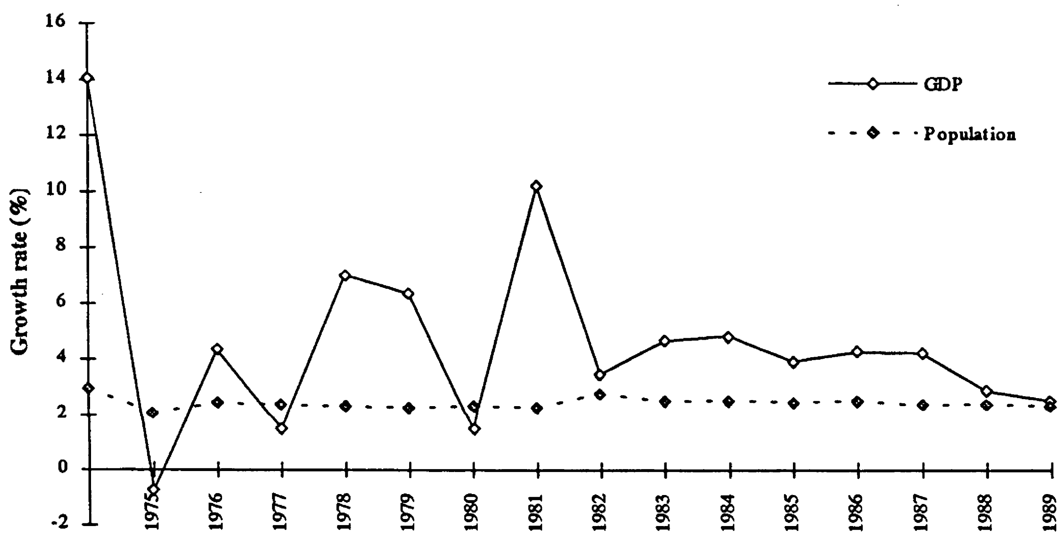
	Bangladesh	Low-income economies[1]
Population (million)	110.7	n.a.
Density of population (persons per square km)	769	42
Literacy rate (per cent)[2]		
male	35	55
female	22	44
Life expectancy at birth (years)	51	55
Daily *per capita* calorie intake	2021	2298
Per capita energy consumption (kg oil equivalent)	51	124
GNP *per capita* (US$)	180	300

Notes: [1]Low-income economies, excluding China and India, as defined by the World Bank. All figures are weighted average estimated by the World Bank. [2]For the year 1990.

Sources: World Bank, 1991. *World Development Report 1991*. Washington DC. World Bank, 1992. *World Development Report 1992*, Washington DC.

In the 1950s and 1960s, when Bangladesh was part of the then Pakistan, *per capita* GDP grew only 0.7 per cent *per annum* (Khan and Hossain 1989:22-3). Even after political independence in 1971, GDP *per capita* has grown little (Figure 2.1). During 1973-89, GDP grew at an annual rate of 4.6 per cent while population increased at an annual rate of 2.4 per cent, so that GDP *per capita* grew only at 2.2 per cent *per annum.*

Figure 2.1 **Growth rates of population and GDP at 1985 constant prices, 1974-89**



Source: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka (various issues);

Slow growth of *per capita* income was exacerbated by unequal income distribution (Khan 1977, Ahmad and Hossain 1985, Osmani and Rahman 1986, Khan and Hossain 1989). Between 1964 and 1986 the lowest 40 per cent of the population received only 20 per cent of national income (Table 2.2).

Table 2.2 **Income distribution[1] and the Gini coefficient for selected years (%)**

	1964	1974	1986
Quintile 1	7.7	7.0	7.0
Quintile 2	10.7	11.3	11.2
Quintile 3	14.6	15.1	15.1
Quintile 4	21.3	22.8	20.7
Quintile 5	45.7	44.8	46.0
Gini coefficient	36.0	36.0	37.0

Note: [1]Percentage shares of national income accruing to the fractions of population ranked in ascending order of income per household.

Sources: Bangladesh, Government of, 1988. *Report on the Bangladesh Household Expenditure Survey 1985-86*, Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka; Bangladesh, Government of, 1986. *Report on the Bangladesh Household Expenditure Survey 1981-82*, Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka.

Table 2.3 **Bangladesh: contribution to GDP by sectors, 1989 (%)**

	Bangladesh	Low-income economies[1]
Agriculture	44	33
Industry[2]	14	28
Manufacturing	7	14
Services	42	39

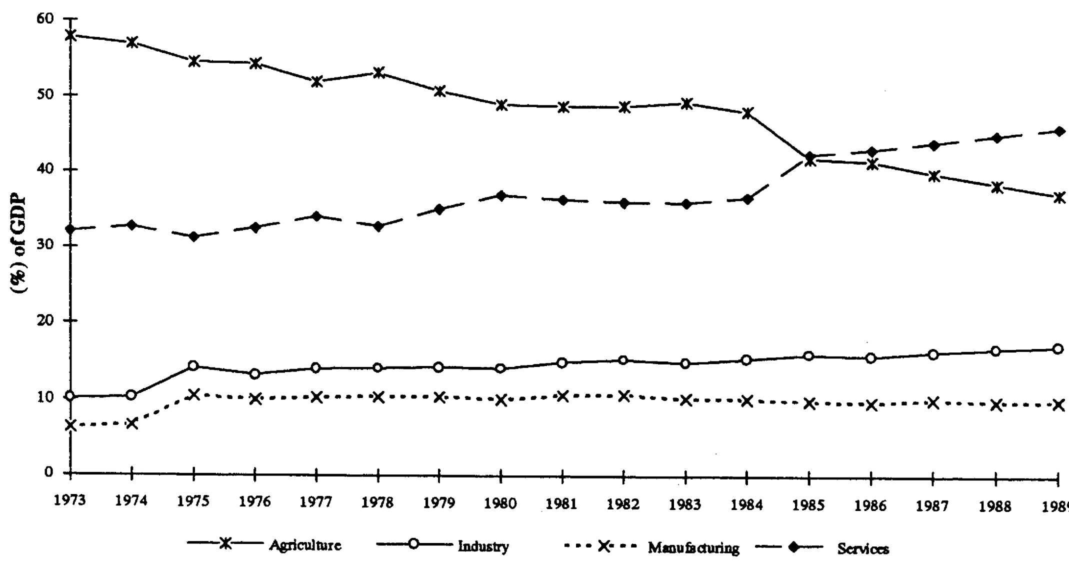
Notes: [1]Low-income economies, excluding China and India, as defined by the World Bank. All figures are weighted average estimated by the World Bank. [2]Industry comprises mining, manufacturing, construction, electricity, water and gas.

Sources: World Bank, 1991. *World Development Report 1991*. Washington DC. World Bank, 1992. *World Development Report 1992*, Washington DC.

Even among the low income countries, Bangladesh's share of agriculture in the economy was high and that of industry was low (Table 2.3). The composition of GDP began to change only recently. Until 1984 agriculture was dominant (Figure 2.2). Since 1985 services have a larger share in the economy. Trade, housing, transport, communication, professional and miscellaneous services accounted for 40 per cent of GDP in 1989 (Bangladesh 1993:467). Industry has lagged behind services and agriculture. The contribution of industry to GDP has remained unchanged at around 15 per cent over the whole period from 1975 to 1989. The share of manufacturing in

GDP has also stagnated. During 1973 and 1990, manufacturing contributed only 9 per cent to the real growth of GDP (Table 2.4).

Figure 2.2 **GDP at constant prices[1] by sector of origin[2], 1973 to 1989**



Notes: [1]Until 1984 at 1973 constant prices and therefrom at 1985 constant prices.
[2]Manufacturing is only a part of industry which comprises value-added in mining, manufacturing, construction, electricity, water and gas.

Source: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka (various issues).

Table 2.4 **Average annual real growth of GDP and its sectoral contribution, 1973-90** (%)

	1973-80	1980-90	1973-90
Gross Domestic Product (GDP)[1]	4.3	4.3	4.6
Sectoral contribution to GDP growth[2]:			
Agriculture	23	26	25
Industry	23	17	19
Manufacturing	16	6	9
Services	54	57	56

Notes: [1]At 1885 prices. [2]Sectoral contribution to GDP growth equals the growth of the sector weighted by its percentage share in GDP.

Sources: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka (various issues); Table 3.3 in Bhuyan A.R., and Rashid, M.A., 1993. *Trade Regimes and Industrial Growth: A case study of Bangladesh*, Bureau of Economic Research, University of Dhaka, Dhaka.

The share of manufacturing in total employment is also small (Table 2.5). In 1989, it provided employment for only 14 per cent of the economy's work force although female employment in garment industries rose rapidly in the 1980s (Bhuyan and Rashid 1993a:116). Manufacturing absorbed only 21 per cent of new entrants into the active labour force between 1974 and 1989 (Table 2.5).

In sum, manufacturing is still a very small sector in Bangladesh.

Table 2.5 **Aggregate employment and its distribution by sectors, selected years**

	1974[1]	1981[1]	1989[2]	Change between 1974 to 1989
Total (million)	21.4	25.3	50.1	29
Distribution by sectors (%)				
Agriculture	78.7	61.0	65.0	55
Manufacturing	4.8	4.5	13.9	21
Others	16.5	34.5	21.1	24

Notes: [1]Based on Population Census, 1974 and 1981.
[2]Based on the Labour Force Survey 1989.

Source: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues).

Manufacturing: structure and performance

The manufacturing sector in Bangladesh is characterised by structural dualism and little diversification. The larger manufacturing industries, defined as those employing 10 persons or more with fixed assets of more than taka 2.5 million (US$0.11 million), produced about 52 per cent of manufacturing value-added in 1982. The remaining 48 per cent of value-added was produced by small, handloom and other cottage industries, which together employed 83 per cent of the labour force in manufacturing (Khan and Hossain 1989:68-9). The dualism exists also in ownership. Despite recent divestment and denationalization efforts, the 170 public sector industries owned 69 per cent of fixed assets, contributing 44 per cent to total value-added and absorbing 46 per cent of employment in the large manufacturing sector in 1987 (Bangladesh 1990a:7-8).

Table 2.6 **Structure of large-scale manufacturing in Bangladesh, selected years (%)**

	Share of total value-added in large-scale manufacturing	
	1981	1989
Food (311-2)	10.0	16.6
Tobacco (314)	11.9	5.5
Textiles (321-2)[1]	36.0	26.2
Garments (323)	0.4	8.0
Leather (324)	2.0	2.2
Paper (341)	3.1	2.8
Chemicals (351-353)	13.8	20.2
Petroleum (354)	0.4	0.6
Basic metals (371-2)	9.9	2.0
Metal products (381-2)	1.0	1.6
Machinery (383-4)	4.6	3.4
Transport equipment (385)	1.6	1.8
All others	5.3	9.1
Total	**100.0**	**100.0**

Notes: [1]Textiles include both jute textiles and cotton textiles.

Source: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues).

The shares of the major manufacturing groups in the total value-added (Table 2.6) and employment (Table 2.7) in the large manufacturing sector showed little change. The value-added shares of tobacco and basic metals fell, while the share of garments rose. In 1989, the garment industry employed about 15 per cent of the labour force and produced about 8 per cent of the value-added of large manufacturing. Textiles (cotton and jute combined), chemicals and food manufacturing continued to dominate the manufacturing sector, producing 63 per cent of the value-added and employing 64 per cent of labour in large-scale manufacturing in 1989. Consumer goods made up about 60 per cent of the total manufacturing value-added (Table 2.8).

Table 2.7 **Share of major industry groups in total manufacturing employment, selected years (%)**

	1975	1981	1989
Food (311-2)	10.5	9.4	12.7
Tobacco (314)	1.6	1.4	3.4
Textiles (321-2)	61.4	66.1	46.7
Garments (323)	1.4	0.2	15.2
Leather (324)	0.8	0.6	1.0
Paper (341)	2.3	2.1	1.6
Chemicals (351-353)	10.0	7.4	4.6
Petroleum (354)	0.1	0.1	0.1
Basic metals (371-2)	2.5	2.2	1.5
Metal products (381-2)	2.2	1.9	2.4
Machinery (383-4)	1.6	1.4	2.2
Transport equipment (385)	1.5	1.1	1.1
Others	4.1	6.1	7.5
Total	**100.00**	**100.00**	**100.00**

Source: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues).

Table 2.8 **Manufacturing outputs by end-use, selected years (%)**

	1970	1980	1986
Consumer goods	56	59	59
Intermediate goods	37	35	39
Capital goods	7	6	2

Sources: Bangladesh, Government of, 1981. *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka; ____________, 1991. *The Fourth Five Year plan 1990-95*, Planning Commission, Dhaka.

Despite the emphasis on import substitution, the share of imports of manufactures in apparent domestic absorption (domestic production plus imports minus exports) increased (Table 2.10). This seemingly paradoxical effect is consistent

Table 2.9 **Merchandise imports: total and by end-use, selected years**

	1973	1980	1990
Total imports (million US$)	780.0	2372.0	3759.0
Total imports (% of GDP)	5.0	18.6	16.5
Imports by end-use (% of total):			
Food (food grains and edible oils)	**46.6**	**29.1**	**16.6**
Other consumer goods	**25.8**	**21.9**	**36.0**
Intermediate goods	**14.8**	**26.0**	**22.3**
petroleum (crude and refined)	3.9	16.2	12.7
fertilizer	3.1	5.6	2.4
raw cotton and yarn	6.8	2.7	4.7
other	1.0	2.5	3.5
Capital goods	**12.8**	**23.0**	**25.1**

Sources: Bhuyan A.R., and Rashid, M.A., 1993. *Trade Regimes and Industrial Growth: A case study of Bangladesh,* Bureau of Economic Research, University of Dhaka, Dhaka (Table 4.5); World Bank, 1990. *Trends in Developing Economies 1990,* World Bank, Washington D.C.

Table 2.10 **Domestic production and trade of manufactures: total and share in domestic absorption , selected years**

	1977	1981	1983	1985
Domestic production (million taka)	24,717	66,251	78,204	101,301
Exports (million taka)	3,654	8,103	11,689	18,149
Imports (million taka)	7,500	26,556	33,881	42,050
Share of exports in production (%)	14.8	12.2	14.9	17.9
Share of imports in apparent domestic absorption (%)[a]	26.3	31.4	33.7	33.6

Note: [a]Apparent domestic absorption is equal to the domestic production plus imports minus exports.

Source: Stern, J.J., Mallon, R.D. and Hutcheson, T.L., 1988. `Foreign exchange regimes and industrial growth in Bangladesh', *World Development,* 16(12):1419-39.

with experience in other countries (Balassa and Associates 1971, Bhagwati 1978, Krueger 1978, Adams and Klein 1983). Most of these studies suggest that undue reliance on protectionist import-substitution policies fails in its objectives of developing a dynamic industrial sector or reducing the current account deficits. In case of small economies like Bangladesh, the small size of the domestic market tends to limit the expansion of import substituting industries. They can not attain substantial economies of scale in the domestic market. Lack of international competition leads to inefficiency and poor product quality, and often dooms these industries to stay infants that never grow up. Opportunities for substituting imports of final consumer goods tend to be exhausted after a short period of insulated industrialization. Import-substitution policies tax exports. Protection offsets to export-oriented industries are introduced to enable exporters to access inputs at world prices (through tariff exemptions, duty drawbacks and so on). This makes exports highly import intensive. The economy as a whole increases its ratio of imports to output.

Table 2.11 **Share of domestic production in apparent[1] domestic absorption of some major industries, selected years (%)**

	1977	1981	1988
Food and Tobacco			
sugar	77.5	45.9	41.6
cigarettes	92.9	99.8	99.9
Textiles			
cotton yarn	63.3	83.7	83.8
cotton cloth	83.8	62.9	34.0
Paper and paper products	90.1	85.1	69.5
Fertilizer			
Urea	95.9	72.9	98.1

Note: [1]Apparent domestic absorption equals the domestic gross production plus total imports minus exports. It was not possible to distinguish between imports of final goods and intermediate products for the years reported in the table although it was possible for the 1989 input-output database for the study. Such an estimate of absorption exaggerates the true absorption, and hence is called the `apparent' domestic absorption. If the shares of final uses in total imports do not change significantly over the years, such an estimate of domestic absorption would not lead to considerable bias.

Source: Computed from Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues).

Protectionist import substitution maintained in industries such as cigarettes, cotton yarn and urea fertilizer until recently by import restrictions and prohibitive tariffs has led to high domestic production shares in domestic absorption (Table 2.11). In other industries domestic market shares have been falling. In particular, the share of domestic absorption of highly protected cotton cloth has fallen. The growth of garment exports in the 1980s gave rise to growing demand for cloth. But the inefficiency of domestic suppliers made it impossible for them to compete for the business created by exporters (Mallon and Stern 1991, Stern *et al.* 1988).

Import-substitution has affected manufacturing exports in particular, and exports in general, adversely. The share of exports in manufacturing production was low and did not rise until policies became less inward looking (Table 2.10). Total exports as a percentage of GDP have also remained very low (Table 2.12) as a result of the prolonged discrimination against exports (discussed later). Until recently, exports of primary goods dominated. Only in recent years when the government made some attempt to provide offsets to protection, have garment exports grown markedly.

Table 2.12 **Merchandise exports by major commodity groups, selected years**

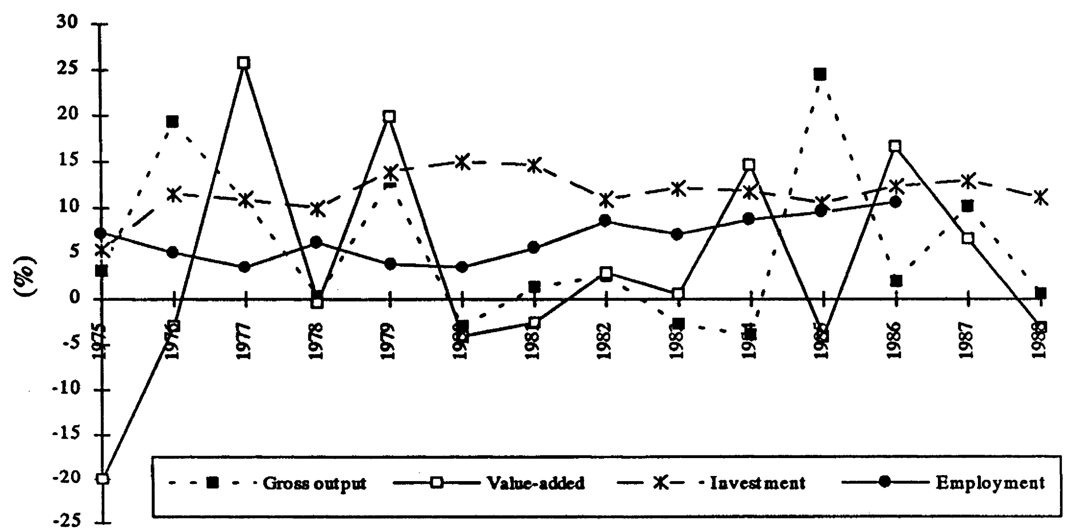
	1973	1980	1990
Total exports (million US$)	354.2	722.3	1523.7
Total exports (% of GDP)	6.0	5.7	6.7
Exports by commodities (% of total):			
Raw jute	37.8	19.9	8.2
Jute goods	52.3	54.3	21.5
Tea	2.7	4.6	2.6
Leather and leather products	4.5	9.1	11.7
Ready-made garments	•	0.1	40.0
Shrimp and fish	1.3	5.2	9.5
Others	1.4	6.8	6.5

Sources: Bhuyan A.R., and Rashid, M.A., 1993. *Trade Regimes and Industrial Growth: A case study of Bangladesh*, Bureau of Economic Research, University of Dhaka, Dhaka (Table 4.6); World Bank, 1990. *Trends in Developing Economies 1990*, World Bank, Washington D.C.

Total manufacturing investment as per cent of GDP started to decline in 1982, the year when the New Industrial Policy was announced (Figure 2.3). The policy environment was not conducive to private investment except in garment exports.

Since 1980 the growth of value-added in manufacturing was either negative or very low. In 1984 and 1986, manufacturing value-added recorded a two-digit growth rate, but such growth was preceded by negative or no growth. The growth of value-added mostly remained below the upward moving growth path of manufacturing employment, indicating a welcome shift to higher labour intensity industries.

Figure 2.3 **Growth of manufacturing output and employment, and manufacturing investment as percentage of GDP, 1975-1988**



Note: The manufacturing gross output and value-added series are at 1984-85 prices.

Sources: Manufacturing gross output and value-added series from Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues); Investment-GDP ratios and employment growth rates are respectively from tables 3 and 4 in Sahota, G. S., 1990. *An Assessment of the Impact of Industrial Policies in Bangladesh*, Development Discussion Paper No. 333, HIID, Harvard University, Massachusetts.

Policies affecting industry

Research on development demonstrated in the 1980s that economy-wide policies are the dominant factors in industrial (and other sector) growth (Krueger *et al.* 1988). Macroeconomic policies, including stable and appropriate exchange rates, are essential to maintain international competitiveness, and trade policies are the principal determinants of resource allocation and factor utilization.

Exchange rate policy

Before independence, Bangladesh was part of a dual system of fixed and partially market related exchange rates (taka per US$). There was a system of export bonus vouchers. Exporters entitled to these vouchers, could retain a part of their export earnings. They could use the foreign currency entitled to import necessary raw materials or sell at a premium, and could capture some of the rents import license holders normally captured (Bruton and Bose 1963). By the end of the 1960s, nearly 60 per cent of all exports were under the scheme and about 15 per cent of imports were purchased using the bonus vouchers (Stern and Falcon 1970). This, in effect, maintained a partial free market for foreign exchange, even though a fixed exchange system was maintained. After independence, the bonus voucher system was abolished.

In 1974, the Wage Earner Scheme, intended to attract more wage remittances from the Middle East, established a legal secondary exchange market. Initially, some restricted commodities could be imported under this Scheme. Importers thus had to pay higher rates for foreign exchange than the official exchange rate. The difference between the two rates constituted the rent to the wage remitters. Exporters continued to surrender their foreign exchange at the fixed official exchange rate. Over time the Scheme was simplified and the number of commodities that could be imported increased.

In the 1970s, import controls and export incentives meant that the official exchange rate played a minor role. Rationing of foreign exchange through import licenses was the rule. The taka was over-valued in the sense that, because of tariffs and exchange controls, the official exchange rate (taka per US$) was lower than it would have been, at an unchanged money supply, if these barriers to trade had been eliminated. In the first few years of the introduction of the Wage Earner Scheme, the situation did not change much. Importers had greater access to raw materials and other goods, but exchange controls as an adjunct to the industrial and import licensing system dominated. Subsequently, as a result of the introduction of export subsidies under the Export Performance Licensing Scheme in 1977 (discussed later) and the marked rise in the flow of wage earner remittances from the mid-1970s, the secondary exchange market assumed greater importance. In 1987, the market covered all non-government imports, excluding only those financed by foreign aid or imported under barter arrangements. The only major items imported under the official exchange rate were food grains, fertilizer and certain capital goods for officially sponsored projects (Mallon and Stern 1991:203). In 1989, half of the total imports was financed through the secondary exchange market (Table 2.13). The evolution of the secondary exchange market reduced the impact of direct controls on imports, production and investment, and became a critical instrument in freeing up the foreign exchange market (Mallon and Stern 1991:202).

Table 2.13 **Structure of import financing, selected years**

	1973	1975	1981	1982	1987	1988	1989
Total imports (million US$)	987	1191	2669	2687	2620	2987	3375
Sources of finance (% of total)							
Official exchange market	40	23	40	36	14	15	13
Secondary exchange market	n.a.	3	12	13	34	37	45
Barter and special trade	5	6	4	4	4	4	6
Loans and grants	55	68	44	47	48	44	36

Source: Bhuyan A.R., and Rashid, M.A., 1993. *Trade Regimes and Industrial Growth: A case study of Bangladesh*, Bureau of Economic Research, University of Dhaka, Dhaka (Table 5.2)

Over the years, both the official and market related exchange rates depreciated (Table 2.14). Two major devaluation of the official exchange rate took place in the early 1970s. The exchange rate was devalued by 58 per cent immediately after independence in 1971 and by 85 per cent in May 1975 with respect to the Pound Sterling (Bhuyan and Rashid 1993a:94). In mid-1979, the exchange rate was pegged to a basket of currencies of its major trading partners with the Pound Sterling as the intervening currency. In the early 1983, the Pound Sterling was replaced by US dollars as the intervening currency because of the United States' higher relative trade weight. The official exchange rate has been allowed to adjust with fluctuations in the currencies of the major trading partners relative to the intervening currency. As a result, the official exchange rate depreciated. From 1980 to 1989 the ratio of taka to US dollars had doubled.

The secondary exchange rate reflects the market more closely (Bhuyan and Rashid 1993a:72). The rate is determined by auctions, but since 1984, the Bangladesh Bank (the central bank) has been intervening in the auctions to avoid sharp fluctuations.

Table 2.14 **Exchange rates, selected years** (taka per US$)

	1973[1]	1976[1]	1978	1981	1983	1987	1988	1989
Official exchange rate	7.9	15.1	15.1	16.3	23.8	30.6	31.2	32.1
Secondary exchange rate	n.a.	n.a.	19.9	20.1	24.1	33.1	32.9	32.9
Exchange rate premium[2]	n.a.	n.a.	31.4	23.7	1.4	8.0	5.4	2.4

Notes: [1]Until 1977, there was only official exchange rate.
[2]The wedge between the two exchange rates expressed as percentage of the official exchange rate; commonly known as the Wage Earner Scheme (WES) Premium. The rates are rounded to the nearest number.

Source: Bangladesh Bank, 1991. *Economic Trends*, Dhaka, 16(7):47

In the 1980s, the wedge between the two rates diminished sharply (Table 2.14). The exchange rate premium, defined as the difference of the two exchange rates and expressed as percentage of the official exchange rate, fell from 31 per cent in 1978 to 2.4 per cent in 1989. A reform program was begun in 1987 to unify the exchange rate, and the two exchange rates were unified on 1 January, 1992.

Aid inflows have played an unusually large role in balance of payments in Bangladesh. Table 2.13 shows that the share of imports financed by loans and grants was relatively high and still 36 per cent in 1989. This as a `booming sector' overvalued the exchange rate (see Chapter 6).

Monetary policy

In the 1970s, foreign loans and grants were increasingly used to finance government budget deficits. Rather than allow foreign exchange reserves to fall the government resorted to exchange controls. As a result, domestic prices grew substantially faster than world prices despite the maintenance of an unchanged official exchange rate from 1976 to 1981 (Table 2.14). During 1980-89, the average annual rate of inflation in Bangladesh was 10.6 compared to a weighted-average annual rate of 4.6 per cent in

Table 2.15 **Inflation, growth of money supply and GDP, selected years (%)**

	1975	1977	1979	1984	1987	1988	1989
Money supply growth (%)[1]	1.2	24.9	28.9	29.7	16.3	14.3	16.3
Inflation[2]	70.2	-3.28	13.0	16.6	10.9	7.4	7.6
GDP growth (%)[3]	-0.7	1.5	6.4	4.9	4.2	2.9	2.5

Notes: [1]Broad money (M_2) = (currency outside banks) + (demand deposits) + (time deposits) = (domestic credits) + (net foreign assets) + (other net liabilities)
Growth rates have been calculated as percentage change over end of last June.
[2]Measured as percentage changes in implicit GDP deflator with base 1974=100 upto 1985 and therefrom 1985=100.
[3]GDP at constant 1985 market prices.

Sources: Bangladesh, Government of, *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of statistics, Ministry of Planning, Dhaka, (various issues). Bangladesh Bank, 1991. *Economic Trends*, Dhaka, 16(7).

industrial economies, and even lower rates in leading East Asian countries (World Bank 1991). In recent years, the monetary authorities succeeded in reducing monetary growth, and thus reduced the annual inflation rate to below 10 per cent (Table 2.15). But the rate of inflation is still high by international standards (except for Latin American and African standards).

The increasing importance of the secondary exchange rate enabled the money supply to be brought under control in the 1980s. The improvement in fiscal discipline (helped by pressure from the International Monetary Fund and World Bank) also contributed to monetary stability in the economy. Nevertheless, the real effective exchange rate depreciated during 1980-90 by only 12 per cent in Bangladesh compared to 41 per cent in India and 63 per cent in China (Bhuyan and Rashid 1993a:85).

Trade and industrial policies

Investment Controls. In 1972, all large-scale manufacturing industries were nationalised together with banks and insurance companies (except those owned by non-Pakistani foreigners). Foreign trade in jute (the principal exports of Bangladesh) was also nationalized. About 92 per cent of the fixed assets in manufacturing thus came under the government's direct control. In 1973, private investment was restricted to small-scale enterprises with initial assets not exceeding taka 2.5 million (US$315,000). Reinvestment of profits in these industries was allowed up to the level where the value of fixed assets reached taka 3.5 million (US$441,000). Direct foreign investment was permitted, but only in collaboration with the public sector, and with a minority foreign equity participation. A limited ten-year moratorium on nationalization was ensured. The economy turned into a command economy, characterized by an increasing centralization of economic power and the extension of a system of direct controls that eventually affected almost all aspects of economic decision making.

Restrictions over the size and area of private industrial activities have gradually been relaxed over time. By the end of 1978, the private investment ceiling was abolished, and a fair and just compensation was assured where any industry was nationalized. The New Industrial Policy, adopted in 1982, codified three areas of industrial activities. The `reserve list' restricted six industries (arms and ammunitions, automatic energy, air transport, telecommunications, electricity generation and distribution, and mechanized forest extraction) to only public sector investment. The `concurrent list' kept thirteen industries (jute textiles, cotton textiles, sugar, paper and newsprint, iron and steel, ship-building and heavy engineering, heavy electrical industry, minerals and oil and gas, cement, petrochemicals, heavy and basic chemicals, and pharmaceuticals, shipping, and appliances and equipment for telecommunication services) open to both public and private sectors. The remaining industries which made up the `free list' were open to the private sector. The Revised Industrial Policy, adopted in 1986, dropped the `concurrent list' and retained in the `reserve list' seven industries (arms and ammunitions, automatic energy, air transport, telecommunications excluding distribution and services, electricity generation and distribution, and mechanised forestry, and security printing) (Bangladesh 1986a). The scope for private investment has continued to expand in recent years. The latest industrial policy deleted electricity generation and distribution, and telecommunication from the 1986's `reserve list', and secured only five sectors for public sector (Bangladesh 1992b).

A denationalization program was adopted in the mid-1970s. By the end of 1978, seventy-seven firms worth taka 330 million had been sold back to private entrepreneurs. The process of denationalization was accelerated with the promulgation of a New Industrial Policy. Twenty-five jute and thirty-five cotton textile mills were to be returned to private ownership. In the 1991 industrial policy, forty-two public sector industries were earmarked for privatization.

The Industrial Investment Schedule was originally a vehicle for allocating industrial investment under the Five Year Plans. When most of the industries were owned by the government, detailed allocations and targets were made for some 200 sub-sectors in the Schedule issued under the Plans, to serve as a guide for allocations in the annual budget. As the private sector became more important, the Schedule was to guide the industrial sanctioning authorities in approving industrial investment projects. More recently, the Schedule has become `indicative'. It no longer sets investment targets. But it still `guides' private investors into industries in which increased capacity is deemed to be warranted to prevent excess capacity.

The most important instrument of control over industrial investment was the sanctioning of investment. Until the beginning of the 1980s, investment in industry required approval from a number of government agencies including the Department of Industries, development finance institutions, the Bangladesh Small and Cottage Industries Corporation, and government-owned commercial banks. The sanctioning authority delegated to these agencies depended on the size of investment and nature of assistance the investor sought. The most frequent complaint from industrial investors about sanctioning procedures concerned inordinate delays in obtaining approvals and loans from the development finance institutions.

Since the New Industrial Policy in 1982, the approval process has been simplified. The amounts that sanctioning authorities delegated to government departments and financial institutions were raised. Specific time limits for completing sanctioning procedures were set. A `one-stop' service was established at the Board of Industries to handle the requirements of private investors. An industry in the `free list' needs no formal permission if finance is from an enterprise's own fund, or by loans from commercial banks and private financial institutions and if imports of machinery and materials are through the secondary exchange market, with suppliers' credit or non-repatriable foreign exchanges. These reforms have eroded the influence of government investment schedules and sanctions considerably in recent years.

Import Controls. The government established import controls for balance of payments reasons, and to maintain the interlocking control regime in industry. These included outright bans and discretionary quantitative restrictions through Import Policy Orders[1] and import licenses in the 1970s. The expansion of the secondary exchange market made import liberalization possible from the early 1980s, and the failure of the dirigiste policies gave an impetus to overall liberalization.

Until 1986, no product could be imported unless it was included in one of the three or four lists published in the Import Policy Order. Since 1986, the Import Policy Order has been used to document only the items which were banned or restricted in `negative' and `restricted' lists. Commercial and industrial importers can now import any items not listed in the Order provided the item is in the `passbook' issued by the import control authorities to industrial consumers, commercial importers and indentors specifying the items that the holder can import.

Foreign currencies for imports are made available from five sources: (i) cash from export earnings sold to the Bangladesh Bank; (ii) external aid; (iii) barter and special trading agreement; (iv) remittances under the Wage Earner Scheme; and (v) non-reimbursable foreign exchange. Foreign currency from the first three sources is sold at the official fixed exchange rate. Until 1984, import licenses were used to ration

[1]The Import Policy Order lists permissible imports, and prescribes import procedures and documentation. Imports financed by project aid, barter and special trading arrangements, or commodity aid are not included in the Import Policy Order. It was published annually until 1989 when it came into effect for two years.

foreign currency at the official exchange rate to importers. Three key elements were taken into account in allocating licenses to industrial importers: (i) capacity of the firms sanctioned by the Department of Industries relative to actual output; (ii) the imports permitted per unit of capacity; and (iii) the percentage of import entitlement eligible for cash licenses. While the first two were industry specific, the last one was firm specific. The privileged access to imports at the official rate provided benefits to the individual firms. This very complex, discretionary and interventionist system of import controls and foreign exchange allocation created a formidable disincentive to industrial production. It could be circumvented by side-payments disadvantaging small business. The large and influential firms could manipulate the system to their advantage (Bangladesh, TIP 1986a).

The import licensing system was abolished in the mid-1980s. Imports are permitted against letters of credit authorisation forms, which need to be accepted by banks designated by the industrialists. All non-governmental imports, except those financed by foreign aid or through barter arrangements could be brought in through the secondary exchange market. Industrialists thus had easier access to imported raw materials and intermediate goods.

Tariffs. Apart from the provision of protection to domestic industries, the government uses tariffs to raise revenue. Even in the late 80s, more than 30 per cent of annual revenue came directly from tariffs (Bangladesh 1993). The tariff structure thus has a variety of objectives. In general they lead to high and discriminatory rates. Tariff rates not only vary with end-use but also with the type of importers and geographical location of the firms. Discretionary exemptions are rampant. Sales taxes are in addition imposed on the tariff inclusive value of imports. Instead of guiding investment decisions, the tariff structure tends to be an instrument of ensuring *ex post* profitability of investments (Salma 1992).

Table 2.16 **Nominal and Effective rates of Protection (%)**

	Nominal	Effective[1]
Rice growing	5.0	3.9
Wheat growing	5.0	3.6
Jute growing	22.4	25.9
Cotton growing	23.4	31.6
Tea cultivation	2.3	-6.1
Other crops	5.0	1.6
Livestock	7.9	6.9
Fishing	11.6	6.5
Forestry	32.6	33.8
Sugar	42.7	291.9
Edible oils	35.4	962.2
Salt	28.6	30.2
Tobacco products	7.5	-89.8
Other foods, nec	28.7	44.0
Cotton yarn	56.3	*
Mill-made cloth	48.9	61.8
handloom cloth	48.5	45.8
Jute textiles	2.1	-5.2
Paper and paper products	69.6	290.4
Leather	2.7	-29.6
Fertilizer	-6.5	-28.6
Pharmaceuticals	33.2	21.8
Other chemicals, nec	58.0	225.6
Cement	13.9	-15.5
Basic metals	52.2	62.6
Metal products	61.9	87.5
Machinery	26.0	9.6
Automotive vehicles	147.2	994.8
Wood products	34.8	41.6
Miscellaneous products, nec	55.5	92.1
Petroleum products	27.7	38.5
Averages		
Primary activities	7.1	12.6
Manufacturing	45.9	114.3
Import substituting	49.5	134.9
Export sectors	10.2	11.2

Notes: [1]Based on 1977 inter-industry table. The estimates were based neither on Balassa (1965) method nor on Corden (1966) method, but on the conversion factor approach (for details, see Hutcheson and Stern 1986). The rates based on the prevailing exchange rate were called 'gross effective rates of protection'. If the entire protection structure were withdrawn, the exchange rate would have to rise sufficiently to maintain the same trade balance as before. The gross effective rates adjusted for such exchange rate effect, are the 'net effective rates of protection' (Hutcheson and Stern 1986). (*) Indicates negative value-added at border prices.

Source: Hutcheson, T.L., 1986. *Effective Rates of Protection: An Input-Output Analysis*, Trade and Industrial Policy reform Program, Doc.TIP-MU-H.3, Dhaka.

Protection varies widely among industries. The estimates of the effective rates of protection by Hutcheson (1986), reproduced in Table 2.16, show that while the overall level of effective protection to manufacturing was 114 per cent, there was wide dispersion in the rates ranging from minus 90 to as high as 995 per cent. The rates reflect the outcome of series of *ad hoc* decisions (Hutcheson and Stern 1986).

In 1980s several attempts were made to reform the tariff structure by reducing the variance of tariffs. In 1986, the number of statutory rates was reduced from 24 to 11. In 1988, government adopted a phased three-year program to eventually reduce maximum tariffs (i) for most final good imports from over 200 per cent to 100 per cent; (ii) for raw materials to 20 per cent; (iii) for intermediate products to 75 per cent.

However, the situation has not improved much in recent years. Bhuyan and Rashid (1993a) estimated the effective rates of protection for selected industries using survey data for 1990 and the Balassa *et al.* (1971) method of treating the non-traded inputs. The nominal rates of protection for most activities were very high, as high as 208 per cent for frozen food, crust and finished leather for example. The estimates showed that industries enjoyed varying degree of effective protection. Wet-blue cow leather had a 4483 per cent effective rate of protection for domestic sale, while handloom industry produce had effective protection as low as 20 per cent. Effective protection for many industries was negative, by as much as minus 693 per cent for cotton yarn for example.

Protection offsets and export incentives. The Government increasingly realized that it was necessary to expand and diversify export growth, but the understanding of policies that could achieve this was weak. The `first best', eliminating protection and greatly improving monetary and financial policies, was not even considered. Instead, an array of so-called `export incentives' and offsets to protection was introduced in the late 1970s to compensate for the implicit taxes associated with protection.

Bonded Warehouse Facility. This facility to offset protection allows a 100 per cent export units to import industrial materials duty-free. Only garments, specialized textiles and leather goods are entitled to this facility. Firms producing for both domestic and foreign markets are not entitled to this facility.

Duty Drawbacks. These protection offsets are used to compensate manufacturers, who are not eligible for a Bonded Warehouse Facility. Exporters of manufactured products are entitled to obtain a refund, in part or full, for the value of the customs duties, sales taxes already paid (except in the notional drawback scheme) on the importation of raw materials used in the production of the export products.

Initially tariffs and taxes were paid when inputs were imported. Manufacturers were subsequently reimbursed on a case-by-case basis. Bureaucratic formalities led to long time lags between duty payments and reimbursements. Data on input co-efficients were needed. Only a limited number of industries were entitled to this privilege.

To simplify the reimbursement process, a Flat Rate Drawback Scheme was introduced in 1980. Under this refunds on duties and taxes were estimated according to a pre-fixed schedule. The rate was based on periodic calculations of the average percentage value of customs duties and sales taxes for a product or product group. Duty payments are now being aided by interest free bank credit. This scheme, however, only applies to 13 product groups and the rates are not updated regularly to reflect changes in imported input prices and exchange rates.

For some fast-moving items such as ready-made garments, the Notional Payment Scheme was introduced in 1983. A limited number of industries can import materials duty-free at the time of importation, but require the recording of imported raw and packaging materials and the establishment of a `suspense' account for the duties and taxes payable on them. Liability to pay the amounts in suspense is removed on proof of exports. In practice, this scheme has hardly been used due to difficulties involved in processing input co-efficient information.

The success of these case-by-case or product-by-product facilities very much hinges on administrative efficiency, and involves considerable administrative costs. The duty drawback system is complicated, and lengthy procedures are required to verify the legitimacy of claims. It offers officials administrative discretion in such verification. Since the facility is only available after exports are made, the costs involved in delays are high.

Export Performance Benefit Scheme. An Export Performance Licensing Scheme was introduced in 1977 to raise the profitability of exports. Eligible exporters obtained Import Entitlement Certificates equal in value to a certain percentage of their gross *fob* export earnings. The certificates could be freely traded, and entitled the holder to obtain import licenses for commodities which could be imported through the Wage Earner's Scheme. Exporters were free to use the certificates to satisfy their own import requirements, or sell in the Wage Earner's Scheme auctions where exporters obtained additional revenue to the extent of exchange rate premium. The benefits under this system depended on the entitlement rates and the import premiums. Eligible exports and their entitlement rates, which were determined arbitrarily, were published in Import Policy Orders. In 1986, the cash subsidies, based on the differential between the official exchange rate and the secondary exchange rate, were given instead of certificates and this scheme of export incentives was renamed the Export Performance Benefit Scheme.

The scope of the Scheme has been expanded over time. Nearly all exports are now brought under the Scheme. It has also been extended to the producers of intermediate inputs used in export manufactures. In 1986, the entitlement rates were 40, 70 and 100 per cent; the rates are to be raised gradually to 100 per cent.

The Scheme enabled exporters to overcome the overvaluation of the exchange rate. A hundred per cent exporters could also obtain exemption from import tariffs. They were thus able to obtain their inputs at international prices. Garments industry grew accordingly.

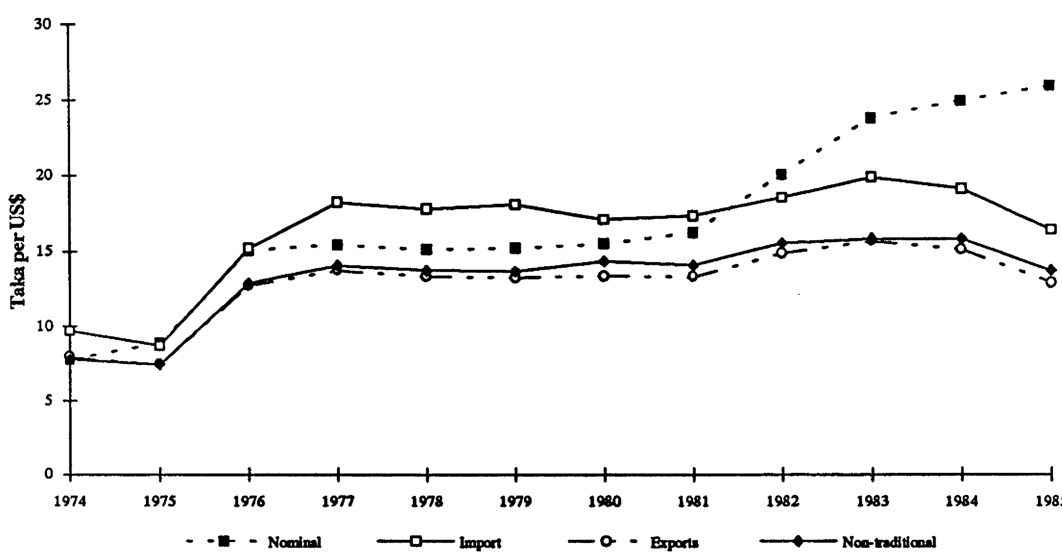
The benefits under the Export Performance Benefit Scheme diminished with the decline in the exchange rate premium in recent years. The benefit per unit of the *fob* export value is given by the product of the entitlement rate and the exchange rate premium so that a zero premium means no benefit. The unification of the exchange rates has thus made the Scheme redundant.

Other export incentives were tax rebate on export income, export credits (pre-shipment and post-shipment) at concessional interest rates, export credit guarantee scheme to ensure export credit, back-to-back letter of credit system for purchase of inputs, raising Export Development Fund to run institutions for export administration. In keeping with the experience of other countries, however, they had little positive impact (Herderschee 1990) while serving to further complicate industrial controls.

Overall policy bias

The effective rate of protection for import-substituting activities was 135 per cent compared to 11 per cent for export industries (Table 2.16). Import-substitution activities continued to enjoy very high protection. (Bhuyan and Rashid 1993a). Stern *et al.* (1988) estimated the real effective trade-weighted exchange rates for imports and exports, incorporating the effects of taxes, subsidies, relative inflation rates[2], and changes in the relative values of trading partner currencies. These estimates plotted in Figure 2.4 give a summary measure of the economic incentives provided by the policies used to promote export-oriented and domestic market industries. From 1974

Figure 2.4 **Nominal and real effective trade-weighted exchange rates for imports, total exports and non-traditional exports** (taka/US$), **1974-85**



to 1985, the real effective exchange rate for imports consistently exceeded the real effective exchange rate for total exports. The real effective exchange rates for non-traditional exports always exceeded those for the total exports reflecting the policy bias towards the non-traditional activities and discrimination against the traditional exports.

[2]Inflation in Bangladesh relative to the index of inflation rates of its trading partners.

3

COMPUTABLE GENERAL EQUILIBRIUM MODELLING FOR POLICY ANALYSIS

The chapter discusses the application of computable general equilibrium modelling to the study of economic policies in Bangladesh. After discussing the issues involved in computable general equilibrium modelling and classifying computable general equilibrium models, it explains why the ORANI-type model was chosen for the present study. The last section of the chapter reviews the principal computable general equilibrium models constructed for Bangladesh and compares them with the model constructed here.

Industrial growth depends largely on economy-wide policies and only to a lesser extent on industry-specific policies. The interactions of macro and micro economic policies are crucial in determining the direction and growth of the industrial sector as a whole as well as of specific industries. A general equilibrium framework can better incorporate these interactions than a partial equilibrium one. Effective protection and real effective exchange rate estimates have proved useful in studying resource allocations, and domestic resource costs are useful in estimating distortions. The development of computable general equilibrium models, however, has extended analysis to the interactions of policies tracing intersectoral linkages and adjustments. A general equilibrium model provides numerical guidance on the economic impact of alternative policy options (Piggot 1985:1). A computable general equilibrium model with well-specified policy distortions can also provide second-best shadow prices (Dervis *et al.* 1982:274).

The input-output analyses, programming techniques and general equilibrium models - all permit the tracing of the consequences of changes in a particular sector throughout the entire economy. Empirical multisectoral general equilibrium models, however, allow greater flexibility in modelling the consumer side of the economy, and need fewer restrictions on the production side without losing the strong flavour of neoclassical microeconomics. One of the advantages of general equilibrium models is that both quantities and relative prices are endogenously determined within the models. This marks an improvement over input-output and programming models in economy-wide policy analysis.

Econometric models rely on historical evidence to estimate relationships among economic variables. There are problems in attaining reliable time-series data for sufficiently long periods in developing countries, such as Bangladesh. Where available, the data are often too weak to make standard econometric analysis possible, and require considerable manipulation to remove inconsistencies. As changes in policy regimes take place, different structural models are needed. As a result, the time span of data available for testing hypotheses within a selected model is reduced. Thus it is sometimes claimed that econometric techniques are not well suited to economy-wide policy analysis in many developing countries (de Melo 1987:470). It is often difficult to trace the mechanisms at work if the econometric specification of macroeconomic forecasting models rely heavily on lagged endogenous variables and reduced form equations to capture the role of expectations (Dervis *et al.* 1982:3). Mayer (1989:443) pointed out that when econometric estimates are based on a given set of structural features, econometric models are not very suitable for counter-factual experiments. Having noted these anti-econometric arguments, however, it is necessary to note that computable general equilibrium models use econometric estimates of various elasticity parameters to implement the model numerically. The above shortcomings of econometric techniques thus also apply, to some extent, to numerically specified general equilibrium models. Nevertheless, a general equilibrium model, which captures the details of intersectoral linkages and traces intersectoral adjustments following exogenous changes, suits the analysis of sectoral adjustments due to hypothetical policy changes better than econometric models.

A number of empirical studies based on the general equilibrium approach (Mundlak *et al.* 1990, Milner 1990a, Sjaastad 1980) have followed the theoretical tradition of Dornbusch (1974). These studies disaggregate the economy into three broad sectors - exportables, importables and home goods. Among these studies, Mundlak *et al.* (1990) try to evaluate the effects of macroeconomic and trade policies on real exchange rates (defined as the price of tradables - exportables or importables - in terms of home goods) as well as their effects on sectoral prices.

Decomposing the economy into these three broad categories is not adequate to the investigation undertaken here. A number of industries have heterogeneous production structures and respond differently to exogenous changes. The Dornbusch type of model is not suitable for the analysis of industry-specific effects of a particular policy shock. For example, it would be difficult to examine the effect of an increase in the foreign exchange retention rate on the growth of the ready-made garment industry of Bangladesh. A highly aggregated model can only predict changes in the real exchange rate.

The notion of a general equilibrium goes back to Walras (1954). It was improved upon by Debreu (1959, 1962) and Arrow *et al.* (1954, 1971). But Johansen (1960) first established the empirical implementation of the general equilibrium model in his pioneering model of the Norwegian economy. Since then computable general equilibrium models have proliferated both for industrial and developing countries and with diverse policy focus. The first computable general equilibrium model implemented for a developing country was that of Adelman and Robinson (1978). Advances in solution methods and computer facilities have been spectacular. Data availability has improved over time. Software development has made the use of a computable general equilibrium analytical framework less time consuming than it was in the past.

A computable general equilibrium model simulates the working of a market economy subject to behavioural and institutional constraints that reasonably represent the reality of the economy. It is commonly argued that in the presence of extreme structural rigidities the economy does not respond to changes in macroeconomic policies. In such circumstances, macroeconomic policies will not be able to cause changes in domestic prices, domestic demand, domestic resource allocation or lead to export expansion. The rigidities thus have to be modelled when examining the effects of policy changes.

A computable general equilibrium model adequately reflect microeconomic realities. Many parameters are derived or estimated at the micro level. With carefully chosen parameters, such models can be relatively stable and less susceptible to the problem of structural breaks. A computable general equilibrium model is therefore suitable for the conduct of counter-factual experiments.

An ORANI-type (Dixon *et al.* 1982, Dee 1989) numerically specified multisectoral general equilibrium model (hereafter called CGE-B89) is chosen for the study of Bangladesh. The model incorporates the structural features of the highly regulated economy of Bangladesh. It is used to assess the impact of the principal macroeconomic and microeconomic policies and to estimate shadow exchange rate for Bangladesh. Recognizing the difficulty of exhaustively modelling existing protectionist practices and the complex web of incentives, CGE-B89 incorporates only the most important policy distortions such as trade taxes, the foreign exchange rationing system under the dual exchange rate regime, subsidies under the Export Promotion Bonus Scheme, excise and sales taxes. The evaluation of the economic policies under consideration thus will be done in a `second-best' situation.

Optimal behaviour and the basic structure of a computable general equilibrium model

Autonomous optimizing behaviour in production and consumption by various economic agents lies at the core of a computable general equilibrium model. The market mechanism produces the outcome, in the form of prices, and quantities produced and consumed, on the basis of the general equilibrium links within the production structure, the incomes of various factors and the pattern of demand. Policy interventions, through the price system, by regulation, or direct interventions affect the outcome.

A computable general equilibrium model typically involves (i) input demands and supply of commodities based on the economic behaviour of producers and production technologies, factor and commodity market structures, and the institutional and policy constraints they confront; (ii) demand for commodities by households and government for current and future consumption; and (iii) homogeneous and mutually dependent excess demand equations. A solution to the general equilibrium model is a price vector such that excess demands equal zero for all markets. A solution to the general equilibrium model exists (in other words, an equilibrium exists for the economy) provided behavioural assumptions are satisfied (see for details Debreu 1959, Varian 1984:219). Note that it is the relative price set that is important. In a closed economy, basic technological and demand variables determine the price system. With the introduction of international trade, international prices influence (or are influenced by) the domestic price system if the country is small (or large). Although close in spirit to the Walrasian construct, computable general equilibrium models featuring various policy interventions and structural rigidities may be viewed as reflecting a `constrained' general equilibrium (Dervis *et al.* 1982:180).

Appropriate specification of production technology and consumer preference is of great significance for a computable general equilibrium model designed for policy analysis. Incorporation of flexible functional forms into a computable general equilibrium model is appropriate, but often considerably demanding in terms of model estimation and solution (Hertel 1985:281-2). Mostly due to data problems, modellers are frequently forced to utilize `convenient' functional forms in formulating empirically tractable computable general equilibrium models, which thereby embody potential restrictiveness inherent in those functions. Where data and available estimates restrict the model to a particular functional form, the potential limitations have to be assessed carefully, and the model results interpreted with care.

In formulating a computable general equilibrium model, sectors (or industries) and commodities have to be carefully aggregated. Obviously, there are limits to the detail which can be presented. If the model is designed to analyze a particular policy, however, care should be taken to separate sectors subject to differential policy treatments. Otherwise, model results may not be able to trace the effects of policy change accurately and may even be misleading. These points are kept in mind while specifying the CGE-B89 in Chapter 4.

Product differentiation and the `almost' small-country assumption

An important assumption of CGE-B89 involves product differentiation. The theme of product differentiation has come to play an increasingly important role in computable general equilibrium analysis. The key feature of the product differentiation or imperfect substitutes theme is that neither imports nor exports are perfect substitutes for domestic goods. Results from policy simulations depend on the assumption of product differnetiation for tradables, that is, on how export demand and import supply behaviour are modelled (de Melo and Robinson 1989).

Some analysts, in keeping with pure trade theory, prefer to view domestic goods as perfect substitutes for imports (Taylor and Black 1974, de Melo 1978a, 1978b, Clarete and Whalley 1988). Such treatment rules out cross hauling: country may be either an exporter or importer but not both. Most importantly, the domestic prices of tradables are internationally determined. Under conditions of constant returns to scale and perfect competition, if the number of factors is less than the number of traded goods such perfect substitute assumption leads to over-specialization (called the `bang-bang' effects), that is, either the domestic or foreign good swallowing up the whole domestic market (Samuelson 1953, Melvin 1986). The supporters of such treatment often try to tackle this problem by assuming sector specificity of capital (Taylor and Black 1974) or other factors of production (Clarete *et al.* 1987, 1988), or by assuming a non-competitive market structure (Staelin 1976). Others prefer to accommodate the phenomenon of two-way trade flows in a trade-oriented applied general equilibrium model by differentiating domestic goods from the goods produced in other countries (Armington 1969, Dixon *et al.* 1982, Grais *et al.* 1986, Lewis 1986). The Armington assumption (Armington 1969), that domestic goods are imperfect substitutes for comparable goods produced in other countries, prevents the problem of over-specialization, allows for cross hauling, and confers some sort of market power on a small open economy.

In many cases, marked differences in characteristics exist between domestic good and comparable import, as well as between good produced for domestic markets and comparable export. These differences manifest themselves both in the physical characteristics of the products and in the package of services involved in their marketing, and are supported by price differentials between domestic and overseas markets. More importantly, the multisector models, even they are disaggregated, do not disaggregate products sufficiently. To capture this feature in CGE-B89, a product produced and sold in the home market is assumed to be differentiated from (i.e., to be an imperfect substitute for) the product produced for (or in) foreign markets. On the import side, the constant elasticity of substitution (CES) functional forms, and on the export side, the constant elasticity of transformation (CET) functional forms are used to accommodate the symmetric product differentiation assumption (Powell and Gruen 1968, Armington 1969, Dixon *et al.* 1982, Dervis *et al.* 1982, Lewis 1986, Robinson 1989).

The above assumption of product differentiation is not consistent with the strict small-country assumption. The small-country assumption implies that the prices of domestic tradables equal the exogenously given international prices[1] adjusted for tariffs (or subsidies); in other words, that the international terms of trade of the economy is exogenously fixed. But under the above variant of the product differentiation assumption, terms of trade of the country are not fixed. Prices of exports are endogenously determined. Nevertheless, the product differentiation assumption can be made along with the large world demand elasticities for domestic exports that may characterize the smallness of the economy. The Armington assumption also allows world prices of imports to be fixed and exogenous (Dixon *et al.* 1982, 1992, Dervis *et al.* 1982). The economy with the price-taking behaviour for imports along with constant elasticity downward-sloping foreign demand curves for exports may be called an `almost' small open economy (Harris 1984).

[1]Given by the perfectly elastic supply of imports and perfectly elastic demand for domestic exports.

The `industrial organization' approach to trade or the `new' trade theory

The market approach to trade policy in developing economies is typically based on intuitions and insights derived from models with perfect competition and constant returns to scale, the two basic premises of the traditional Heckscher-Ohlin trade model. It is observed that protection, by restricting the market size and limiting foreign competition, typically promotes too many firms in an industry operating at too low a level of scale economies. Protection is likely to facilitate an oligopolistic market for the protected industry.

Those who advocate the `industrial organization' approach to trade theory, emphasize that if scale economies are large enough then calculations of the cost of protection and welfare gains from trade liberalization based on the competitive neoclassical models underestimate the true costs and gains (Harris 1984). Models based on a competitive paradigm might also predict a misleading pattern of inter-industry adjustments following policy changes. Some economists thus emphasize the need to incorporate an imperfectly competitive market structure and scale economies internal to firms in empirical work on developing countries (Krugman 1980, 1986b, Harris 1984, Hamilton and Whalley 1987, Rodrik 1988).

Deardorff (1986), however, points out why particular assumptions about market structure are necessary to the Harris model. The price-setting behaviour in the Harris model crucial for substantial gains to be derived from trade liberalization is not based on theory of profit-maximizing behaviour (Wooton 1986). Both Deardorff and Wooton suspect that a different price-setting assumption would substantially alter the size of benefits of trade liberalization. Because of the particular assumptions concerning scale economy parameters and pricing behaviour, the estimates of potential gains from trade liberalization that the Harris model produces may be doubtful.

Gunasekera and Tyres (1989), however, observe the limited relevance of economies of scale and imperfect competitive market structures in developing countries with small manufacturing sectors. In view of the small manufacturing sector in Bangladesh and doubts about the appropriateness of Harris-type assumptions on price-setting behaviour and scale economy parameters, imperfect competition and scale economies, the basic assumptions of the `industrial organization' approach are not considered in CGE-B89.

Relevance of a time horizon: long-run versus short-run, and dynamic versus static models

The time horizons become an issue in computable general equilibrium modelling of scale economies. Because of the sector-specificity of capital, increasing returns to scale in the short run are masked by decreasing returns to variable factors. In the long run, capital is endogenous and it is more sensible to assume that free entry and exit prevail. In the long run, industry capital stocks vary in such a way that rates of return attain the values set for them by the international capital market. The underlying idea is that investment is freely available internationally at rates of return which are not affected by the economy concerned. A long-run simulation encompasses a wider range of potential gains from policy changes towards freer trade (Horridge 1987). The short-run gain, also known as a static or allocative gain, is derived from a more optimal movement along the given production possibility frontier. In the long run, due to competition, firms are forced to take advantage of a given technology. The results are similar to those of an increased rate of technical progress, that is, an outward movement of the production possibility frontier. Thus, the long-run policy effects consist of both static and dynamic gains.

Dynamic specification is not attempted in the construction of CGE-B89. The simulation results of the computable general equilibrium model, CGE-B89, are comparative-static. With policy changes, a new equilibrium is established. The initial values of the endogenous variables are compared with the new set of equilibrium quantities. The path of adjustment is not traced. There is growing experimentation by analysts to incorporate adjustment mechanisms between the two equilibria. Some try to capture intertemporal issues by extending the static model by a sequence of static equilibria carried out with the sequence of updated data, using exogenous growth rates and investment behaviour (Fullerton *et al.* 1981, Summers 1981, Auerbach and Kotlikoff 1983, Auerbach, Kotlikoff and Skinner 1983, Fullerton and Gordon 1983). Others emphasize the incorporation of intertemporal optimization *per se* (King 1980, Atkinson and Sandmo 1980). Inclusion of dynamics in consumption, production and financial markets, and expectation formation in a computable general equilibrium model is desirable, but given the state of existing theory, it poses a great challenge to applied modellers (Robinson 1989).

Modelling the effects of economic policies

While empirical multisectoral general equilibrium models developed for policy analysis are based on the notion of Walrasian general equilibrium, they go further to incorporate stylized facts about the economy. For practical purposes, structural and institutional features are modelled. There is a tension between theoretical parsimony and empirical realism. Care has to be taken while modelling various rigidities to retain empirical relevance, and to maintain analytical tractability.

Computable general equilibrium models designed for trade and industrial policy analysis typically incorporate trade barriers in the form of trade taxes (or subsidies), quantitative restrictions enforced through licensing systems, and systems of multiple exchange rates (if relevant for the economy in question). Modelling trade taxes (or subsidies) is relatively straight forward. Quotas can be modelled by equivalent tariffs in a simple static competitive model. But the non-equivalence of tariffs and quotas under various situations (see Vousden 1990:60-83) restricts modelling quantitative restrictions by tariff equivalents. In a static comparative model, quantitative restrictions can be modelled by adopting either a fix-price or flexi-price approach according to the quantitative restriction mechanism used (Dervis *et al.* 1981, 1982). If imports are tied to user-specific quotas and licenses, which are not allowed to be resold, the user price remains fixed. This is modelled according to a fix-price rationing approach. If resale of quotas or licenses is permitted by law, or if a legal or semi-legal parallel market for foreign exchange is in place, the quantity rationing is viewed as premium rationing and a flexi-price approach is appropriate. Under a multiple exchange rate system, the government often allows exporters to sell a pre-specified proportion of export earnings in the secondary exchange market to lessen discrimination against exports. Effectively, under various names, this is a hidden subsidy to the exporters (Martin 1989).

CGE-B89 recognizes that the wastage of resources associated with rent-seeking under quantity restrictions is of considerable significance (Krueger 1974, Bhagwati and Srinivasan 1980, Dervis *et al.* 1982, Grais *et al.* 1986, Tullock 1988, Nogues 1990). Rationing gives rise to special rents. It becomes worthwhile to spend resources on the pursuit of these rents rather than on normal productive activities. Resource diversion may also occur because the rationing mechanism involves unavoidable administrative costs. Any government intervention can potentially lead to rent-seeking. The potential beneficiaries and losers may lobby and waste resources. Since the policy formations are not endogenized, such possibilities are not considered. Modelling rent-seeking phenomena and administrative costs is important but not easy because of the complexity inherent in the rationing mechanism and lack of knowledge of rent-seeking and administrative costs, and was not attempted in CGE-B89.

Other government controls also have associated modelling problems. If, along with various government controls, there exists a parallel market, legal or illegal, then the market clearing price in the parallel market, rather than the price in the controlled market, will directly affect the production and consumption decisions at the margin (Sicular 1988). Rationed prices and quotas cause lump-sum transfers among producers, consumers and sectors, and also between government and non-government sectors of the economy. They also influence decisions of various economic agents indirectly through their effects on the distribution of income, and thereby market prices. When the model considers only one household, indirect effects via income distribution can be ignored. The Bangladesh computable general equilibrium model has adopted this methodology while modelling the dual exchange market, and various other markets in which government controls seem to coexist with a parallel market.

Reconciliation between economy-wide and sectoral features

Sometimes a computable general equilibrium model incorporating micro structural features is extended even further to include such macro structural features as non-neutrality, asset markets, interest rates, and rigidities in various nominal macro variables. Although macro extensions of the computable general equilibrium model are worthwhile from a policy point of view, the reconciliation of macro and micro structural features strains existing theory. The Walrasian general equilibrium model is an uneasy host for macro models. The usual approach is to impose a macro rigidity on the computable general equilibrium model from outside, and then to examine how the resulting mixed model performs. Recognizing both the theoretical difficulties in extending the computable general equilibrium model and the potential payoff in useful policy analysis of the extended computable general equilibrium model, it seems useful to add to a computable general equilibrium model only limited complications at each step so that a clear view of the causal mechanisms at work is retained (Robinson 1989:917).

Typologies of computable general equilibrium models

The last few decades have seen development in computable general equilibrium modelling. Different models focus on different issues. Dervis *et al.* (1982:137) classify models according to the problems on which they focus. Four general categories of the computable general equilibrium models are distinguished.

- models that focus on issues of international trade, growth, economic structure, and/or income distribution (Taylor and Black 1974, Dervis 1975, de Melo 1977, Whalley 1977, Adelman and Robinson 1978, Feltenstein 1980, Lysy and Taylor 1980, Dungan 1980, Dixon *et al.* 1982, Dervis *et al.* 1982).
- some models that focus on issues in the theory of public finance (Shoven and Whalley 1974, Fullerton *et al.* 1981).
- other models explore issues concerning the volume and direction of trade and their impact on particular regions (Ginsburgh and Waelbroeck 1978, Deardorff and Stern 1979).
- a group of models that focuses on energy resource policy (Hudson and Jorgenson 1978, Manne *et al.* 1980).

All these models generally concern a single industrial or developing economy and/or region.

Some modellers (Bergman *et al.* 1990, Robinson 1989:889) classify computable general equilibrium models on the basis of their mathematical structure and solution techniques. Four basic approaches have so far been identified.

- the Johansen approach
- the Harberger-Scarf-Shoven-Whalley approach
- Jorgenson's econometric approach
- the Ginsburgh-Waelbroeck-Auerbach-Kotlikoff approach.

In the path-breaking model of his doctoral dissertation, Johansen (1960) linearized all the equations of the general equilibrium model of an essentially closed economy and solved the linear approximation by simple matrix inversion. Since then, this approach has inspired a number of applications including the ORANI model of an open economy by Dixon *et al.* (1982) for Australia. In fact, Dixon and others have extended the approach considerably and eliminated the main disadvantage of approximation errors arising from the linearization. Such errors tend to increase with the magnitude of changes in exogenous variables. Two comprehensive surveys of the Australian experience with ORANI have been undertaken by Powell and Lawson (1990) and Vincent (1990).

The Harberger-Scarf-Shoven-Whalley approach to computable general equilibrium modelling seems to have been developed independently of, although later than, Johansen's work. The pioneering work is Harberger's (1962) two-sector model for the analysis of United States' tax policies. The point of departure consists of solution algorithms designed to solve the model in its non-linear form. The solution of computable general equilibrium models involves either fixed-point algorithms to find a fixed point in a mapping of prices to prices through excess demands (Scarf 1967, Scarf and Hansen 1973) or numerical solution techniques to visualize a computable general equilibrium model as a collection of non-linear algebraic equations (Adelman and Robinson 1978, Dervis *et al.* 1982). As these models were developed to evaluate the impacts of policy changes in terms of efficiency of resource allocation and income distribution, more than one consumer is typically considered. As the models remain in non-linear form, they come close to being the numerical counterparts of Walrasian general equilibrium models. A survey of this kind of model can be found in Shoven and Whalley (1984). Fullerton *et al.* (1984) and Mieszkowski (1984) give positive evaluations of their performance. For paramaterization of these computable general equilibrium models, the `calibration' method is used extensively. This implies the strong assumption that the observed values of the endogenous variables are determined only by the factors explicitly specified in the model. The model simulations are not forecasts.

In contrast to the common practice of `calibrating' parameters for a computable general equilibrium model, Jorgenson advocates the use of a stochastic specification of a model and direct econometric estimation of the model parameters. Jorgenson (1984a, 1984b) provides a survey of the current status of models based on this approach. Hudson and Jorgenson (1975) offer the first example of the econometric approach to computable general equilibrium modelling. However, the Hudson-Jorgenson model is not a complete computable general equilibrium model. It also incorporates a macroeconometric submodel and lacks an endogenous mechanism ensuring supply and demand equality for capital and labour services. Subsequent work by Jorgenson and others (Jorgenson 1984a, 1984b, Jorgenson and Slesnick 1985, Jorgenson and Yun 1986) have made the approach promising. Nevertheless, the integration of the econometrically estimated production and consumption models within a consistent general equilibrium model has not yet been achieved. The evaluation of how well a model based on the Walrasian general equilibrium notion can explain relative price determination and resource allocation patterns in a real world market economy remains to be undertaken.

Originating from the linear programming modelling tradition, Ginsburgh-Waelbroeck's `activity analysis general equilibrium' model takes a different approach to computable general equilibrium modelling (Ginsburgh and Waelbroeck 1981, 1984).

The basic idea is to generate additional restrictions to the linear program on the basis of economic theory rather than on the basis of *ad hoc* assumptions. Thus in their `activity analysis general equilibrium' model the assumption of constant marginal utility of consumption, implied by the linear utility function, is replaced by a conventional, but piecewise linearized, concave utility function. This allows for a set of economically meaningful additional linear constraints in the model. It is a matter of definition whether these models are regarded as a different class of computable general equilibrium models or as an alternative to computable general equilibrium models.

Why CGE-B89 was based on ORANI

CGE-B89 was based on ORANI because of some advantages of this type of models. The ORANI-type computable general equilibrium models allow the advantages of Johansen's computational approach while eliminating the disadvantages of linear approximation errors. They contain the advantage of the Johansen solution technique of maximum flexibility in fixing model size, in model modifications and applications. These models can easily be modified by changing equations, adding or deleting equations. Often they just require data file manipulations without any re-writing of the solution algorithm. This type of model confers maximum freedom in choosing suitable closures by reclassifying variables between the exogenous and endogenous categories. Last but not the least, the ready availability of the computer solution package, GEMPACK (Codsi and Pearson 1988a, 1988b, 1991), also influences the choice in favour of the ORANI-Johansen-type computable general equilibrium model for the present study.

Computable general equilibrium modelling and the Bangladesh economy

Several computable general equilibrium models have been developed for the Bangladesh economy. These cover a wide range of issues from the resource reallocation implications of trade policies to nutritional effects of food price changes. A study of these models provides valuable insights into policy modelling for Bangladesh and helps to justify the present study. With this end in view, the principal features of a selection of these computable general equilibrium experiments are reviewed. Some models are compared and contrasted with CGE-B89.

The advantages of the computable general equilibrium modelling technique for policy experiments and their detailed analysis induced the government to undertake computable general equilibrium experiments early in the last decade. The Bangladesh Agriculture Model (Centre for World Food Studies 1983) was developed at the request of the Bangladesh Planning Commission. The model was later used for the formulation of the Third Five Year Plan (Bangladesh 1985, Ahmad *et al.* 1985). The Bangladesh Agriculture Model is an applied general equilibrium model that can be linked to an international model for food and agriculture, coordinated by the International Institute for Applied Systems Analysis (Parikh and Rabar 1981). The focus is on food and agriculture. While agriculture has been disaggregated into 17 sub-sectors, the rest of the economy has been aggregated into two non-agricultural sectors: tradable non-agriculture (manufacturing) and non-tradable non-agriculture (services). The model includes a government sector and a detailed specification of final demands by 10 socio-economic classes based on a variant of the Almost Ideal Demand System (AIDS). It incorporates principal policy interventions in agricultural commodity markets, namely, food-rationing, procurement schemes, buffer stocks, fertilizer subsidies, trade taxes, quantitative restrictions on international trade, and other indirect taxes. The model comprises two components: the supply component and the exchange component. The supply component formulates, in base-year prices, production and investment plans for the economy. The exchange component describes the economic interactions once the commodities are brought to market, and hence determines the set of market clearing prices on the basis of demand conditions.

The exchange component of the Bangladesh Agriculture Model was used by Keyzer (1986) for three static simulation runs involving trade liberalization and excise tax adjustment conditional upon the base-year trade deficit. The static nature of the simulations follows from the fact that the supply component of the Bangladesh Agriculture Model is taken as given. That is, the commodity supplies (with the exception of non-tradable non-agriculture) and initial distribution of commodities are assumed as given, presumably determined in the past. The policy parameters are treated either as fixed or adjusted endogenously by adjustment rules unique to the Bangladesh Agriculture Model. Given a fixed exchange rate and international trade prices, policy changes are simulated to evaluate their impacts on commodity prices, trade flows and foreign exchange position, tax revenue by commodity, national accounts and the nutritional implications for the ten social classes.

Although the effects on prices are analyzed, the simultaneous supply-demand interactions are not considered. Consequently, the issue of resource re-allocation and production efficiency remains largely unexplained. With reference to international trade, imports and domestically produced goods are assumed to be homogeneous. Also, perfect transformation is assumed between exports and goods sold domestically. Given the infinitely elastic import supply and export demand curves at two different domestic currency prices (which may be brought about by higher transport costs abroad and/or differential rates of tariffs and export taxes, not explicit in the Bangladesh Agriculture model), the model allows the direction of trade in each commodity to be endogenously determined. Each commodity can be imported, exported, or not traded at all. Trade policy changes can change the status of a good in this regard. According to Deardorff (1986:316) this is an unusual but interesting feature of the Bangladesh Agriculture Model. Another interesting feature is that `processing' costs which further widen the domestic-currency price differential between exportable and importable goods are endogenous to the model. The supply of non-tradable non-agricultural goods which does the processing is not fixed, but bounded by capacity limits. Production of non-tradable non-agriculture draws heavily on inputs from the tradable non-agricultural sector. Between the upper and lower capacity constraints, the price of processing (and thus a part of the trade barrier) depends on the price of tradable non-agricultural goods, and hence trade policies. Trade liberalization has two rounds of effects. First, it reduces the import price in domestic currency immediately, and then indirectly, by lowering the cost of the processing service. In this way, the trade effect of tariff reduction is magnified.

CGE-B89, in contrast, has considered only one consumer, made the Armington assumption with regard to imports, domestic goods and exports. The physical overhead sector which does the processing is one of the 19 sectors and is not bounded by any capacity limits. As the focus of the study is on the industrial sector, CGE-B89 considers a number of industries rather than lumping them into only two sectors.

Lewis (1986) discusses the revenue implications of trade and industrial policy reforms which formed a part of the Trade and Industrial Policy Reform Project in Bangladesh from 1983 to 1987. While modelling the trade regime, he incorporated tariffs, import controls, overvalued exchange rates and the system of multiple exchange rates, and assumed sector-specific scarcity premium rates due to import and exchange controls. The scarcity-premium had two components: the exchange rate premium (the wedge between the secondary exchange rate and the official exchange rate) and the import premium (or the tariff equivalent of the quantity restriction), the later being sector specific. The sector-specific import premium existed due to binding quota constraints even in case of imports through the secondary exchange market.

With the exogenously given sector-specific import premium, the movements in either the official exchange rate or exchange rate premium retain the external balance. Imports are assumed to be an Armington substitute for comparable domestic goods. Consistently, imperfect transformation is assumed between exports and domestically sold goods. The model is used to conduct simulation experiments, based on the 1983-84 data base, with excise taxes, import controls and trade taxes (or subsidies). More precisely, the elimination of quantitative restrictions, the replacement of excise taxes by broader based consumption taxes on imports and domestic goods, and the reduction of the variability of the existing tariff structure are considered. The aim of these experiments is to show the positive implications of the proposed trade and industrial policy reforms for government revenue in Bangladesh.

The Lewis model and CGE-B89 have many features in common, for example, the single consumer and Armington assumptions. CGE-B89, however, marks a significant departure from the Lewis modelling approach by considering a uniform premium for all sectors. Most importantly, CGE-B89 is simulated to examine the effects of policy changes on, *inter alia*, allocative efficiency and welfare, and to decompose the welfare gain (or loss) into its components.

Hossain (1989) develops his computable general equilibrium model to analyze the effects of tariff reduction and partial removal of quantitative restrictions on resource allocation and welfare in Bangladesh. His model resembles that of Taylor and Black (1974) and incorporates tariffs, and quantity restrictions and foreign exchange rationing. In modelling the international trade, he has assumed domestic goods as perfect substitutes for imports but adopted Lewis (1986) approach in decomposing the scarcity premium into the exchange rate premium and the sector-specific tariff equivalent of quantity restriction. Under the exogenously fixed official exchange rate, the movements in the foreign exchange premium contain the base-year external imbalance. The major findings of his experiments are that the unilateral tariff reduction and removal of quantity restrictions increase efficiency by reallocating resources in favour of exporting industries (although results are mixed with regard to resource pulls for non-tradables), and that these policy changes improve welfare in Bangladesh but by only a small percentage. Sensitivity analysis with respect to different sets of elasticities supports the consistency of the results.

Chowdhury (1990) employs a computable general equilibrium model to evaluate the resource allocation effects and income distribution implications of various tax policies (including trade taxes) in Bangladesh. To assess equity aspects, he assumes four household classes and a government. Investment and savings are featured. In a full employment market situation, capital is assumed to be sector specific featuring the short-run nature of the model. Imports and domestic goods are assumed to be imperfect substitutes. The `crucial' part of this model, the external sector, is characterized by the presence of tariffs, exchange controls and the dual exchange rate system, and, unlike Lewis (1986), the uniform premium rate (due to exchange controls) across all seven sectors. He concludes that the twin objective of efficiency and equity is best served by a judicious package of various taxes rather than by one individual tax system.

To provide the intellectual and empirical support for the introduction of a value-added tax (VAT) system in place of sales taxes and excise duties in Bangladesh, Mansur and Khondoker (1991a), on behalf of the National Board of Revenue (NBR), carried out computable general equilibrium experiments to evaluate the revenue effects of alternative VAT rates. The model used is broadly along the lines of the World Bank's (1989b) Revenue Estimation Model. Establishing the superiority of the computable general equilibrium approach over the heuristic approach and the static input-output approach, they estimate revenue-neutral and revenue-augmenting VAT rates.

To evaluate the effects of exchange rate, trade and other sectoral policies particularly on agricultural development in a general equilibrium framework, Salma (1992) constructed an ORANI-type computable general equilibrium model. Her model is characterized by a multi-product agricultural sector, explicit treatment of import rationing, foodgrain rationing, and a multiple foreign exchange system. She recognizes both fix- and flexi-price rationing elements in Bangladesh's import control mechanisms and defines the scarcity premium as comprising (though not specifying explicitly as in case of Lewis 1986, Hossain 1989) sector-specific import scarcity premiums and a uniform foreign exchange premium. This is plausible in the absence of rent-seeking activities, with controlled official and secondary exchange rates (or the exogenously fixed exchange rate premium), and binding quantity restrictions through import licenses. Effectively, the model contains three exchange rates: the official, the secondary and the black market rate. It is the sector-specific import scarcity premium or black market exchange rate which clears the external sector.

The computable general equilibrium models developed and used since the early 1980s differ with respect both to model specification and focus. The present computable general equilibrium model, CGE-B89, is close to the ORANI-type model used by Salma (1992) as far as the model specification and solution technique are concerned. Both are based on ORANI and its fiscal extension by Dee (1989). Both treat imports and domestic goods as imperfect substitutes. CGE-B89, however, differs from that of Salma (1992) in a number of ways. Whereas Salma erected her model to assess the effects of policy changes on agricultural growth, CGE-B89 was created to evaluate the impacts of economic policies on industrial and overall growth in Bangladesh with particular emphasis on household welfare and its decomposition into its components. Salma modelled agriculture as a multi-product industry. CGE-B89 does not treat agriculture as a multi-product industry due to limited estimates of relevant elasticity parameters. Agriculture in Salma's model is disaggregated into several industries in CGE-B89. Each of the total 19 industries in CGE-B89 is considered as a single-product industry. Accommodating the recent developments in import regime it is assumed, in contrast to Salma (1992), that importers who do not have access to sufficient foreign exchange at the official rate to meet their needs obtain the necessary foreign exchange from the secondary exchange market. CGE-B89 endogenously determines the exchange rate premium under a clearing secondary foreign exchange market to contain the base-year external imbalance. A skeleton monetary sector is incorporated in CGE-B89 to clear the secondary exchange market. Following Lewis (1986), CGE-B89 assumes imperfect transformation between domestic exports and domestic goods sold domestically to accommodate the symmetric product differentiation on both export and import sides, the feature not considered in Salma (1992).

Resource reallocation effects are important in assessing trade policies. In this regard, the present exercise to some extent resembles that of Hossain (1989). In examining the general equilibrium resource allocation effects of trade policies in Bangladesh, Hossain (1989) uses a data base for the year 1977. Since then, the composition of trade, and industrial input-output structures have undergone significant changes. A study based on the 1989 economic environment is hence more relevant for present day policy analysis. Differences in modelling, particularly with respect to import and exchange controls and the relationship between domestic goods, imports and exports, add other new dimensions. To avoid the over-specialization problem associated with the assumptions of constant returns to scale, perfect competition and the perfect substitutability between imports and domestic goods, Hossain (1989) modelled capital as sector specific and did not include the market clearing conditions for the capital market. CGE-B89 makes the Armington assumption to avoid overspecialization and accommodate flexibility in treating capital as either sector-specific or mobile by an appropriate selection of exogenous variables. This makes for some long-run simulation possibilities. The inclusion of the Export Promotion Bonus scheme, and detailed government budgeting markedly distinguishes the CGE-B89 model from Hossain's (1989) model. Most importantly, analysis of the resource reallocation effects of trade policies only forms a part of wider policy considerations.

4

CONSTRUCTION OF THE COMPUTABLE GENERAL EQUILIBRIUM MODEL FOR BANGLADESH (CGE-B89)

This chapter constructs a 19-sector neo-classical micro-theoretic computable general equilibrium model for the Bangladesh economy, CGE-B89. Based on this model, it then derives a version of the Harberger's fundamental equation of the applied welfare economics (Harberger 1971), called hereafter the Efficiency Equation.

Features of the CGE-B89 model

As already noted, CGE-B89 belongs to the Johansen (1960) class, and is similar to the standard ORANI model of the Australian economy (Dixon *et al.* 1982) and its fiscal extension (Dee 1989) in structure. To suit this study, the model incorporates behavioural and institutional characteristics, and important economic policies used in the Bangladesh economy. In view of the small manufacturing sector in Bangladesh and to keep the model manageably simple, perfect competition in product markets is assumed and production technology is assumed to exhibit constant returns to scale. Domestic prices affect the supply and demand decisions in the economy. Multi-product industries and multi-industry products are not considered due to a dearth of reliable estimates of relevant parameters. Each of the 19 industries produces only one output using intermediate inputs with two primary factors: labour and capital. The model does not contain equations determining the supplies of primary factors. Only one representative consumer who owns all the primary factors is considered. The government is modelled to collect revenues and spend for current and capital consumption. Any government budget surplus or deficit can be financed by lump-sum subsidies, or taxes. The external sector consists of trade flows of exports and imports.

Any deficit in the balance of trade may be viewed as equal in magnitude to remittances plus unrequited payments including foreign grants.

Following Armington (1969), home goods and imported goods within the same statistical classifications are treated as imperfect substitutes in all uses. Producers and consumers demand for a `composite' good is defined as the Constant Elasticity of Substitution (CES) function of the domestic good and the imported substitute. Elasticities of substitution vary across goods. Small values of such elasticities reflect greater differences between the domestic and imported good, and hence greater difficulty in substituting one for the other in response to changes in their relative prices. This treatment implies that the ratio of imports to domestic goods is a function of the ratio of their prices. A symmetric product differentiation is assumed on the export side: exports are assumed to be different from comparable commodities produced and sold domestically. A constant elasticity of transformation (CET) between exports and domestic sales is assumed. A low elasticity of transformation reflects significant explicit differences (such as quality) and/or adequate barriers preventing the costless reallocation of output between domestic and foreign markets (such as market penetration costs). Producers maximize revenue from selling their total output by dividing sales between export and domestic markets based on the ratio of prices in each market. The economy modelled is regarded as `almost' small open (see Chapter 3) in the sense that Bangladesh's demand cannot influence the world prices of its imports but its exports are differentiated from competing products abroad and hence face finite-elastic downward-sloping demand curves.

The model incorporates some institutional constraints and government policies for market interventions, namely external imbalances, divergence between international and domestic prices, trade taxes, the multiple exchange rate system, foreign exchange rationing at the official exchange rate, the subsidy under the Export Performance

Benefit Scheme and various other tax-subsidy schemes. A skeleton monetary sector is included.

The non-linear equations of the CGE-B89 model are transformed into a non-stochastic system of linear equations involving percentage changes of the variables. Such a model emphasizes the role of relative prices and substitution possibilities in explaining trade flows and the commodity compositions of domestic activity. This model is intended for quantitative comparative static analyses. A given set of values of the rates of changes of the exogenous variables at a particular point of time will give the rates of change in the endogenous variables. This situation without any policy change is the reference equilibrium. The outcome after policy changes, introduced in the form of a different set of values of the exogenous variables, can then be compared to that of the reference equilibrium. It is assumed that the time lag between the two equilibria is sufficient to accommodate all the adjustments ensuing from the hypothetical policy changes. The time path of adjustments cannot, however, be traced.

Modelling of the dual foreign exchange market

Exchange controls are central to the trade-oriented CGE-B89 model. The economy maintains two exchange rates: the official rate and the secondary (or Wage Earners' Scheme) rate, both usually expressed as taka (the domestic currency) per unit of US dollar. Bhuyan and Rashid (1993b:10) consider that the secondary exchange rate reflects the scarcity value of foreign exchange. Observing the functioning of the secondary exchange market, they also believe that Bangladesh follows a relatively flexible exchange rate policy (p.18). Nevertheless, exchange controls operate.

The exchange control regime has two core aspects: compulsory surrender of foreign exchange earned from exports at the official exchange rate, and foreign exchange rationing at the official exchange rate. To encourage exports, however, an

Export Performance Benefit Scheme was implemented in 1986 (following numerous previous similar schemes in, see Chapter 2 for details). Under this Scheme, exporters are given cash subsidies based on the Export Performance Benefit entitlement rates, and the differential between the official exchange rate and the secondary (Wage Earners' Scheme) rate. Entitlement rates are officially determined proportions of gross export earnings on which subsidy is given. These rates are commodity specific.

Authorities allocate foreign exchange at the official rate to import a proportion of import requirements. Other imports are through the secondary exchange market. In line with the observation by Bhuyan and Rashid (1993b), it is assumed that the secondary market clears. The working of the dual exchange market can be depicted in the short-side disequilibrium model presented in Figure 4.1.

Figure 4.1 corresponds to the repressed deficit case considered by Desai and Bhagwati (1979), which appears to be appropriate for an economy that attempts to avoid excessive trade deficit problems (Martin 1989:16). The disequilibrium model can be linked to de Melo and Robinson's (1989) simple model of a small country with one sector and differentiated goods (see Appendix A4.1). Their analysis could be extended to an `almost' small country.

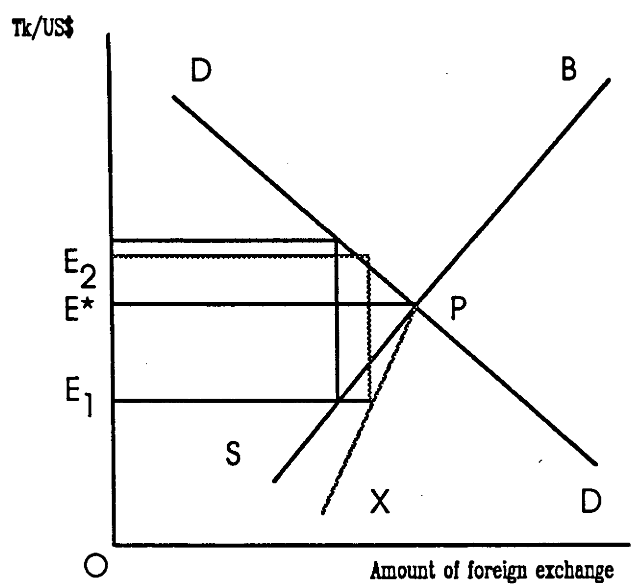
The stylized facts of exchange control policies are embodied in Figure 4.1. Both demand for and supply of foreign exchange are drawn to be price responsive. The line DD represents the demand for the foreign currency at each price of foreign exchange. Given the imperfect substitutability between imports and comparable domestically produced goods, the demand for foreign exchange can be derived from the various import demands at various relative prices (Appendix A4.1). It therefore represents the outcome of both production and consumption decisions - as the domestic price of imports rises, households substitute domestically produced goods for imports, while domestic production increases. The diagram does not contain the behaviour of the domestic money supply, of aggregate expenditure, or of other related variables.

The SPB line has a comparable interpretation. It shows the supply of foreign currency at each level of the official exchange rate. It also shows the marginal cost of producing one dollar worth of exports. Given the production possibility frontier between domestic sales and exports, the supply curve of foreign exchange can be derived from various aggregate export levels at different relative prices with respect to the official exchange rate (Appendix A4.1). The kinked line XPB in Figure 4.1 presents the supply of foreign exchange under the Export Performance Benefit Scheme.

The supply side which represents the short-side of the market determines the scarcity value of the foreign exchange or the secondary exchange rate. Without the short-side of the market, the equilibrium exchange rate would have been E* which lies between the official exchange rate E_1 and the secondary exchange rate E_2. Under the Export Performance Benefit subsidy Scheme, the supply curve of the foreign exchange at the official rate, SPB, shifts to the right over that portion of the curve for which foreign exchange remains a shortage. This is because, as long as the official exchange rate stays below the equilibrium exchange rate E*, foreign exchange commands a scarcity premium. Subsidy under the Export Performance Benefit Scheme raises revenue over the marginal cost of one dollar worth of exports, and hence exporters have incentives to increase their exports and thus augment the supply of foreign currencies. The effect of the Export Performance Benefit Scheme is to increase the supply of foreign exchange and to drive the secondary exchange rate down. The incentive to exporters under the Export Performance Benefit Scheme depends, as noted in Chapter 2, on the Export Performance Benefit entitlement ratios and the foreign exchange scarcity premium. While the latter has been declining over the years, the government has been trying to bring more commodities under the increasing Export Performance Benefit rates.

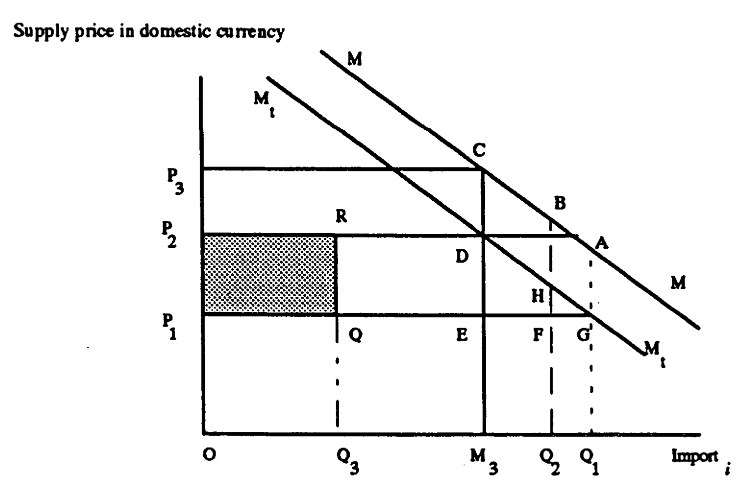
The effects of maintaining exchange controls are, *inter alia*, an implicit tax on exports (E^*-E_1) and an implicit tax on imports through the secondary exchange market (E_2-E^*) with the relative size of these taxes depending on the relative slopes of the supply and demand curve (Martin 1989:19). By increasing Export Performance Benefit rates and/or devaluing the official exchange rate, the gap between the secondary exchange rate and the official exchange rate can be narrowed, and either or both rates can be brought closer to the equilibrium exchange rate, E*, thereby reducing the implicit taxes on either or both exports and imports. Also, the changes in tariffs, domestic money supply and nominal wages affect the secondary exchange rate.

Figure 4.1 **Short-side model of the foreign exchange market featuring the Export Performance Benefit Scheme**



As discussed in Chapter 2, imports of some commodities namely, rice, wheat, fertilizer are allowed entirely at the official exchange rate. For other commodities, importers do not have access to sufficient foreign exchange at the official rate to meet their needs, and they obtain the necessary foreign exchange from the secondary exchange market. The exchange rationing at the official exchange rate may be viewed as premium rationing (Martin 1989:19). For the latter group of imports, the premium inclusive import price rather than the import price at the controlled official exchange rate, will directly affect levels of imports for consumption and production at the margin (Sicular 1988). Whoever gets the allocation of foreign exchange at the official rate receives a lump-sum transfer. This will affect income distribution and thereby the volume of imports indirectly at the margin. As far as a single consumer is concerned, this indirect effect *via* income distribution can be ignored. The equilibrium configuration in the import market of a particular commodity is illustrated in Figure 4.2.

Figure 4.2 **Partial equilibrium configuration in the import market of a particular commodity**



The horizontal axis in Figure 4.2 measures the import quantity while the vertical axis measures the supply price of imports in domestic currency. The MM curve represents the import demand for the commodity. When a tariff is imposed, the import demand curve moves to M_tM_t. It is assumed that importers pay tariffs on *cif* prices evaluated at the official exchange rate. So given world prices of imports, an official exchange rate and an *ad valorem* tariff rate, the total tariff paid per unit of imports remains fixed as is reflected by the parallel shift of the MM curve due to tariffs. P_1 is the world price at the official exchange rate, and P_2 is the world price at the secondary exchange rate.

Three different configurations can be contemplated. First, situation at Q_1 where the entire import is allowed at the official exchange rate, the world price at the official exchange rate (Q_1G) plus tariff (GA) determines the basic price per unit of imports (Q_1A, the price realized by Bangladeshi importers before indirect taxes other than tariffs are imposed; see Equation 4.20 in this chapter; and Chapter 5 for definitions of various prices). Secondly, situation at Q_2 where the importers do not have sufficient foreign exchange at the official exchange rate to meet the entire demand for imports. But the demand for imports is such that no additional import is made through the secondary exchange market. Importers earn scarcity premium equal to FH per unit. In such case, the *cif* world price at the official exchange rate (Q_2F) plus scarcity premium (FH) plus tariff (HB) determines the basic price per unit of imports (Q_2B). Lastly, situation represented at M_3. In this case, OM_3 is the total imports, of which OQ_3 amount of imports is allowed at the official exchange rate under the foreign exchange rationing system. The rest, Q_3M_3 amount of imports, is done through the secondary exchange market. The basic price per unit of imports, in this case, is M_3C (or OP_3) of which DC is the tariff, and M_3D is the world price at the secondary exchange rate. Clearly it is the price at the secondary exchange rate that influences imports at the margin. Imports at the official rate generate rents equal to P_1QRP_2. Such rents are assumed to be redistributed without efficiency loss.

Monetary sector

The CGE-B89 focuses on the real side of the economy, but contains a skeletal monetary sector. This enables the secondary exchange market to clear. An added advantage of this inclusion is that it allows linkages between the real and monetary aggregates and permits analysis of the effects of changes in the money supply on economic variables. The model does not, however, attempt to capture the monetary approach to the balance of payments.

An illustrative simple model

As an expositional device this section sets out a simplified version of the CGE-B89 model, which differs from the actual model in the following respects: (i) in the simple model official exchange rate, E_1 taka per dollar and the secondary rate, E_2 taka per dollar, are unified and fixed, so that E_1 equals E_2, and is exogenously fixed; (ii) in the simple model all foreign currency border prices of traded goods are exogenously given; (iii) unlike the actual model, the simple model treats all traded and domestically produced (and consumed) goods as homogenous; (iv) the only taxes in the simple model are border taxes.

The economy is modelled to produce and consume T traded goods and N non-traded goods. It contains a single representative consumer. Any government budget surplus or deficit is assumed to be balanced at the margin by lump-sum subsidies or taxes. For every good (or factor), *i*, net imports (that is imports, M_i, minus exports, X_i) must equal private consumption (C_i), plus government consumption (G_i), plus total investment (I_i), minus net output, Y_i (that is gross output minus intermediate usage), or minus the endowment in the case of a factor:

(1) $$M_i - X_i = C_i + G_i + I_i - Y_i \qquad \text{for all } i$$

Let F denote the trade deficit, measured in foreign currency:

(2) $$F = \sum_i M_i \Gamma_i - \sum_i X_i \Gamma_i$$

where Γ_i is the foreign currency border price of good *i* if it is traded, and $X_i = M_i = 0$ if good *i* is non-traded.

Each of the identities in set (1) above can be converted into an equation by replacing net output and consumption by the supply and demand equations which determine them in terms of domestic prices and household utility, U. If to this set of equations we add the balance of payment constraint, equation (2) above, we have 1 more equation than the number of goods and factors in the model. We also have one more endogenous variable than the number of goods and factors in the model: there is one endogenous variable corresponding to each good or factor (the price if it is non-traded; the level of net imports if it is traded), and in addition, the household's utility, U, is endogenous. In a general equilibrium model, all endogenous variables are simultaneously determined, but it is helpful, as an expositional device, to think of the above set of equations as determining the price of every non-traded good (with net imports set to zero, by definition), the level of net imports of every traded good (with the domestic price exogenously given by the world price, the official exchange rate and the *ad valorem* import duty or export tax) and the utility of the household.

The compensated demand equations, $C_i(\mathbf{P},U)$, have the property that $\sum_i^{N+T} P_i C_i(\mathbf{P},U) = E(\mathbf{P},U)$, where $E(\mathbf{P},U)$ is aggregate nominal consumption expenditure function; P_i is the domestic price of *i*th good with $P_i = E_1.(\Gamma_i - t_i^X)$ for export and $P_i = E_1.(\Gamma_i + t_i^M)$ for import, t_i^X and t_i^M being the legislated rate of tax on *i*th exported good and the rate of tariff on imported good *i* respectively. Using this property together with equations (1) and (2), we can get

$$(3) \qquad E = \sum_i P_i Y_i - \sum_i P_i G_i - \sum_i P_i I_i + E_1[F + \sum_i \Gamma_i X_i t_i^X + \sum_i \Gamma_i M_i t_i^M]$$

Since government expenditure has been excluded from the household utility function it produces no *measured* benefits in the model; and since one purpose of the simulations is to measure the welfare effects of the relevant policies, all elements of government expenditure were therefore held constant in real terms. Since the model is a one-period model, investment also produces no *measured* benefits; for this reason all elements of investment, including private investment and inventory investment, were also held constant in real terms. Finally, since foreign debts and credits do not produce any *measured* effects on utility in a one-period model, the trade deficit was also assumed to remain constant in terms of US$. As the interest payments on foreign debt are exogenous, this implies that the current account deficit in US$ is also treated as exogenous.

Since equation (3) can be derived from the balance of payments constraint (equation 2) and the supply and demand balances for each good (equation 1), there is no need to impose the national budget constraint, equation (3), as a separate equation. Net outputs, imports and exports determined by the set of equations in (1) and (2) together with the exogenously given values of government expenditures, total investment expenditures, rates of trade taxes, exchange rates and trade deficit in foreign currency, will determine E, the aggregate nominal consumption expenditure.

The closure of the neoclassical version of the actual model, in which the supply of aggregate labour is exogenously given, can now easily be understood by relaxing the simplifying counterfactual assumptions made in the preceding description of the simplified model.

(i) *The secondary exchange rate differs from the official rate.* For any traded good *i*, it is assumed that a fraction α_i can be bought (by domestic importers) or must be sold (by domestic exporters) at the official exchange rate of E_1 taka per US$, and a fraction $(1-\alpha_i)$ is traded at the secondary exchange rate of E_2 taka per US$. For some imported goods, for example essential foodstuffs and fertilizer $\alpha_i=1$; for all other importables $\alpha_i=0$ (see Equations 4.20). In the case of exports, $(1-\alpha_i)$ is the share of export proceeds which exporters are allowed to retain for sale in the secondary market, and α_i is the share which they must surrender at the official exchange rate. The assumed values of $(1-\alpha_i=R_i)$ for exports are reported in Table 5.1. In the absence of import duties and export taxes, the ratio of the domestic price of good *i* to its border prices is $[\alpha_i E_1 + (1-\alpha_i)E_2]$. Import duties, export taxes, and import duty rebates on imported inputs used by exporters complicate this expression but do not change the essential point. The ratio of the domestic price of every traded good to its border price in foreign currency depends only on the two exchange rates and certain exogenous variables, namely *ad valorem* tax and tariff rates, and the α_i. If import duties and export taxes are levied on the border price converted at the official exchange rate we have for imports: $P_i=\Gamma_i[\alpha_i E_1 + (1-\alpha_i)E_2 + E_1.t^M_i]$; and for exports: $P_i=\Gamma_i[\alpha_i E_1 + (1-\alpha_i)E_2 - E_1.t^X_i]$; where t^M_i and t^X_i are the legislated rate of import and export tax. Equation (3) now takes the following form:

$$(4) \qquad E = \sum_1^{T+N} P_i Y_i - \sum_1^{T+N} P_i G_i - \sum_1^{T+N} P_i I_i + E_2[F + \sum_1^{T} \Gamma_i X_i \tau_i^X + \sum_1^{T} \Gamma_i M_i \tau_i^M]$$

where τ_i^X is the "full" rate of export tax on *i* if it is an export, and τ_i^M is the `full' rate of duty of tax on *i* if it is an import. These `full' tax rates are defined as: $\tau_i^X = \frac{E_2\Gamma_i - P_i}{E_2\Gamma_i} = (1-\lambda)t_i^X + \lambda\alpha_i$ and $\tau_i^M = \frac{P_i - E_2\Gamma_i}{E_2\Gamma_i} = (1-\lambda)t_i^M - \lambda\alpha_i$ where $\lambda = \frac{E_2 - E_1}{E_2} \geq 0$, is a measure of the premium on foreign exchange in the secondary market. The `full' tax rates differ from the legislated rates of export taxes and import duties because of the differences between the official and secondary exchange rates. Identity (4) is transformed to derive the Harberger's fundamental equation of applied welfare economics (Harberger 1971) or what would be called the Efficiency Equation for the model (equation 4.55 or 4.56).

Allowing for the existence of exchange controls introduces one additional endogenous variable: the secondary exchange rate (note that the official exchange rate is treated as exogenous in the actual model, just as it was in the expositional model). The additional equation needed to close the system is the money market equilibrium condition: the money supply is set exogenously and the demand for money is determined by a simple quantity theory.

(ii) *Foreign currency export prices are endogenous.* Domestic exports are differentiated from comparable commodities produced overseas. The foreign currency prices of exports are assumed to vary inversely with the quantities exported. For all imports, the foreign currency prices are assumed exogenous. This complication therefore adds one equation and one endogenous variable for every export with an endogenous border price. The assumed export elasticities are reported in section `Elasticities and miscellaneous parameter files' in Chapter 5 (pp.162-3).

(iii) *Domestic taxes.* In the actual model it is necessary to distinguish between the domestic prices facing consumers and producers. Correspondingly, identity (4) contains terms measuring the revenue from domestic taxes. The treatment of this issue is very straightforward.

(iv) *Armington specification.* In the above, we refer to goods and factors without discussing whether they are domestic or foreign. In the actual model the specification is slightly more complicated. Following Armington (1969), home goods and imported goods within the same statistical classification are treated as imperfect substitutes.

(v) *The Neoclassical and Keynesian closure.* Leisure does not appear explicitly in the model. In the neoclassical closure the aggregate demand for labour is exogenously fixed. This is equivalent to assuming an exogenous supply of labour, and labour demand equal to labour supply. In the neoclassical closure, leisure is therefore held constant. In the Keynesian closure, the money wage is held constant and the aggregate demand for labour is allowed to vary endogenously. There is certainly no reason to think that money wages are really exogenous in Bangladesh in the long run; however in the very short run there probably is some nominal wage rigidity, so the results of the Keynesian closure are not without any practical relevance. However, the results of the Keynesian closure are presented mainly for illustrative purposes. The neoclassical results can be obtained from the Keynesian results, detailed in the `Simulation designs' section in Chapter 5.

Structure and specification of the CGE-B89 model equations

The CGE-B89 model consists of a set of equations to explain how prices and quantities change following a change imposed on the system incorporating the institutional and behavioural constraints. It also contains equations to explain key components of government revenue, government spending and hence the government's budgetary position. The complete model in percentage change form, unless otherwise stated, is presented in Appendix A4.2 to A4.4. The equations specified in Appendix A4.2 belong to nine broad groups.

Input demands
Transformation in production and supply of outputs
Final demands
Zero pure profit conditions
Market clearing
External trade balance
Monetary sector
Government budget
Miscellaneous.

As is well known, computable general equilibrium models have a strong neoclassical microeconomic foundation. The relevant structural equations of CGE-B89 are derived or outlined in levels in the text and presented in percentage change form, unless otherwise specified, in Appendix A4.2. Because of the considerable detail included, the notation required to describe the equations is unavoidably complex. The notation followed in presenting the equations of CGE-B89 observe the following conventions.

(i) Variable names in lower case letter(s) represent variables in percentage change form. Corresponding names in upper case letter(s) represent the variables in the level form. For example,

$$x = (dX/X).100$$

where x denotes percentage change of the corresponding variable X.

(ii) The model uses superscripts and subscripts quite extensively to distinguish variables by their use and source of origin. Subscripts and superscripts of the variables, coefficients and parameters of the model are defined as follows.

Superscripts

0 = basic price
1 = current production
2 = investment
3 = household consumption
4 = export
5 = government consumption

Subscripts

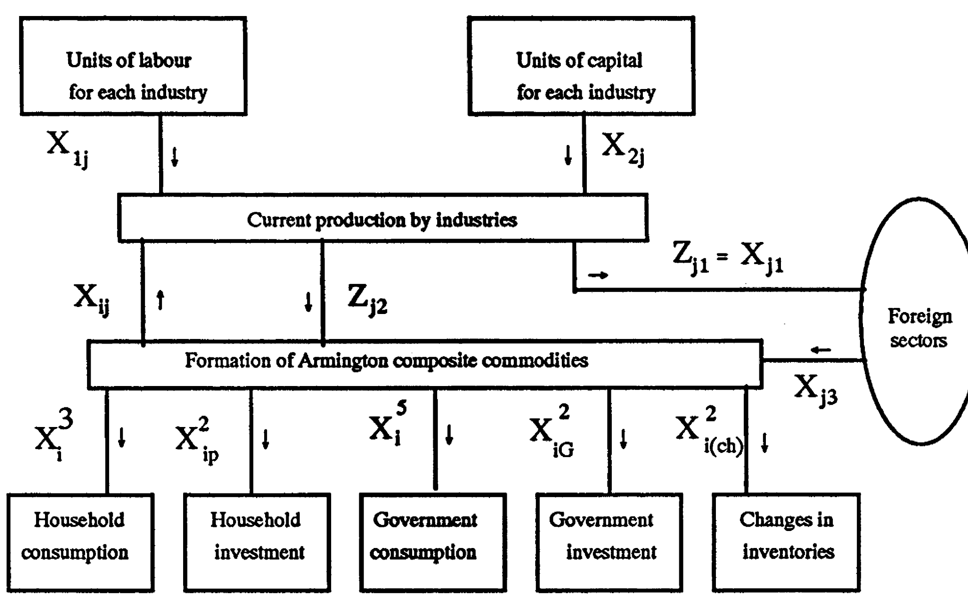
$i = 1,2,...,g$, g commodities
$s = 1$ (export sales)
  = 2 (domestic)
  = 3 (imports)
$j = 1,2,...,g$ g industries/ sectors
$v = 1$ (labour), 2 (capital)

P = private
G = government/ public
ch= inventory

To illustrate, $X^1{}_{isj}$ is the amount of intermediate input *i*, *i*=1,2,...,*g*, from source *s*, *s*=2,3, used in industry *j*, *j*=1,2,...,*g*, and in lower case letter, $x^1{}_{isj}$, is the percentage change in the demand for intermediate input *i*, *i*=1,2,...,*g*, from source *s*, *s*=2,3, by industry *j*, *j*=1,2,...,*g*.

(iii) Equations are derived (or outlined) and presented, for convenience, with superscripts and subscripts running the full range of options. In many cases, however, the data base contains zero entries so that the relevant variable will simply drop out of the model. For instance, the variable $X^3{}_{is}$, *i*=1,2,...,*g*; *s*=2,3, denotes the full set of

Figure 4.3 **Commodity and factor flows, the core of the CGE-B89 model**



Note: The arrows indicate the direction of commodity or factor flows. The X's indicate the demands which are to be satisfied by each flow.

possibilities for household consumption of domestic and imported goods. For a number of combinations of *i* and *s* the good so defined will not be consumed by household. Hence, the relevant components of $X^3{}_{is}$ will not exist in the numerically specified model.

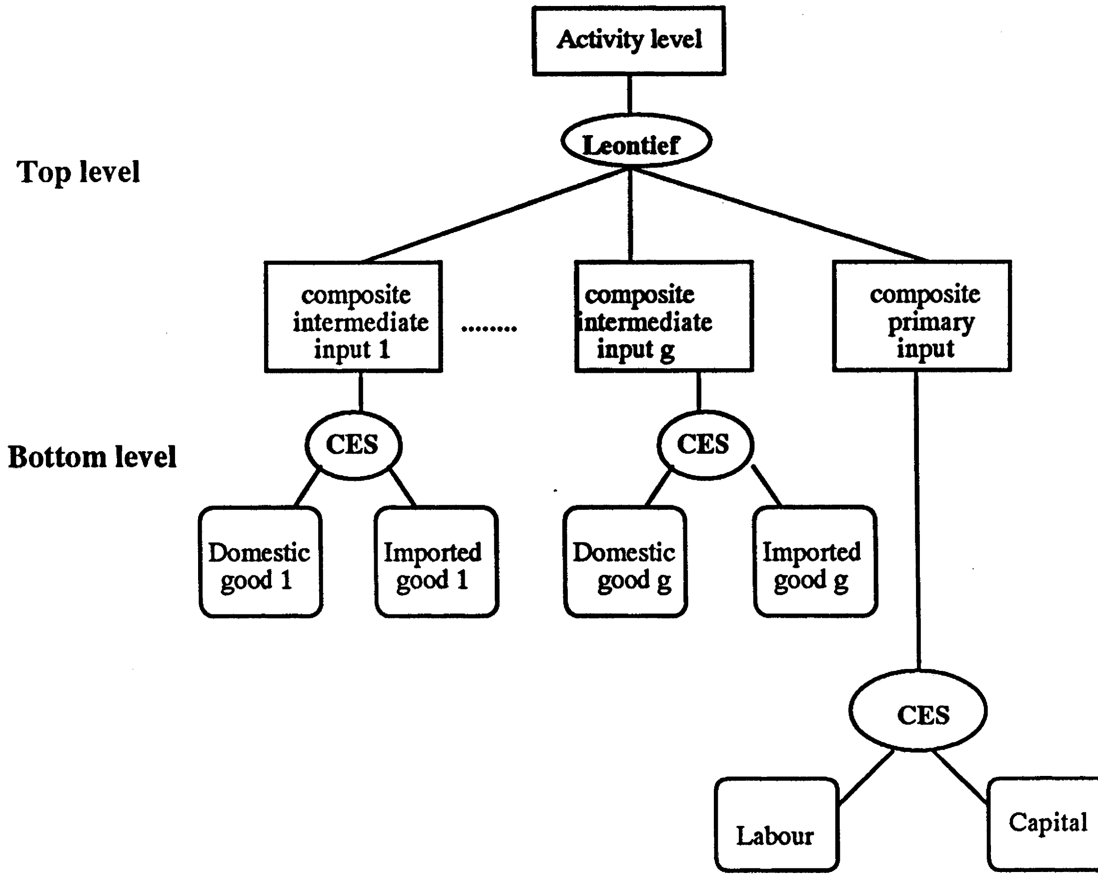
Figure 4.3 illustrates the commodity and factor flows, the core of the CGE-B89 model. Some of the notations to be used later are also introduced for a quick reference. The arrows show the directions in which the commodities and factors flow. All X's denote the demands which are to be satisfied by each flow.

Input demands

It is assumed that each industry, given constant returns to scale production technology and a competitive market situation, chooses intermediate inputs from domestic and foreign sources, and combines these with labour, and capital, to minimize costs of producing a given level of output. The underlying assumption is that all producers in industry j are competitive and efficient. In other words, single producers cannot influence the prices of inputs and output, and they operate on the production frontier where cost is the minimum.

Sectoral production technology is of nested form (Figure 4.4). At the top, output of the industry is specified to depend on the composite primary and intermediate inputs. A Leontief type production function allows no substitution possibilities between different composite intermediate inputs or between composite intermediate inputs and composite primary factor used. At the bottom, intermediate inputs from domestic sources and comparable imported intermediate inputs are CES-aggregated to obtain the composite intermediate input quantities. Such aggregation is based on the Armington (1969) assumption that domestic inputs are imperfect substitutes for imported inputs. Also, a CES composite primary factor involving labour and capital is constructed.

Figure 4.4 **Flow-chart of the production technology**



Under such behavioural and institutional constraints the optimizing problem of the jth industry is to choose composite intermediate and primary input levels, $X1_{ij}$, i=1,2,...,g+1, intermediate input levels from domestic and imported sources, $X1_{isj}$, i=1,2,...,g, s=2,3, and primary factor inputs (labour and capital), X_{vj}, v=1,2, to minimize total costs

$$TC_j = \sum_{i=1}^{g} \sum_{s=2}^{3} P1_{isj}X1_{isj} + \sum_{v=1}^{2} P_{vj}X_{vj} \qquad j=1,2,...,g \tag{4.1}$$

subject to

$$Z_j = \text{Leontief}(X1_{ij}), \qquad j=1,2,...,g \tag{4.2}$$

$$X1_{ij} = \text{CES}(X1_{isj}) \qquad i=1,2,...,g;\ j=1,2,...,g;\ s=2,3 \tag{4.3}$$

$$X1_{g+1,j} = \text{CES}(X_{vj}) \qquad j=1,2,...,g;\ v=1,2 \tag{4.4}$$

where industry activity level, Z_j, and prices, Ps, are treated as exogenous variables. $P1_{isj}$ is the purchaser price of each unit of intermediate input *i*, *i*=1,2,...,*g*, from source *s*, *s*=2,3, used by industry *j*, *j*=1,2,...,*g*, and P_{vj} is the price of a unit of labour (v=1) and capital (v=2) to industry *j*. Of the total (*g*+1) composite inputs, the first *g* inputs refer to composite intermediate inputs aggregated by Equation (4.3), and (*g*+1)*th* input refers to the composite primary input aggregated by Equation (4.4).

The above cost minimization problem of the industry can be solved in two stages. First, with Equations (4.2) and (4.3) the industry is assumed to choose $X1_{i2j}$ and $X1_{i3j}$ for each *i*, *i*=1,2,...,*g*, to minimize

$$\sum_{s=2}^{3} P1_{isj}X1_{isj} \qquad i=1,2,...,g;\ j=1,2,...,g; \tag{4.5}$$

subject to

$$A1_{ij}.Zj = CES_S(X1_{isj}) \quad i=1,2,...,g;\ j=1,2,...,g;\ s=2,3 \tag{4.6}$$

In other words, the industry chooses the cost minimizing combination of imported and domestic intermediate inputs of good *i* to obtain the effective intermediate input of good *i*, $A1_{ij}.Zj$, in order to sustain the activity level *Zj*. Note that $A1_{ij}$ is input coefficients denoting the amount of effective intermediate input *i* used to produce one unit of output in industry *j*.

Secondly, industry *j* chooses its primary inputs X_{vj} to minimize

$$\sum_{v=1}^{2} P_{vj}X_{vj} \tag{4.7}$$

subject to

$$A_{vj}.Zj = CES_V(X_{vj}) \qquad j=1,2,...,g;\ v=1,2 \tag{4.8}$$

In other words, industry *j* chooses the combination of labour and capital to minimize the costs of providing the effective input, $A_{vj}.Zj$, of primary factors required to sustain the activity level Zj. Again, A_{vj} is the technical coefficient denoting the primary input requirement per unit of output *j*.

Solutions to these two sets of problems will give the input demands of the *j*th industry as functions of relative prices and industry activity level. All input demand functions are homogeneous of degree zero in prices. Consequently, demand for intermediate inputs from various sources and for primary inputs will move proportionately with output levels provided that the relevant relative prices do not change.

Conversion of these input demand equations into the percentage changes will give Equations (1) and (2) in Appendix A4.2 (For detailed derivation Dixon *et al.* 1982:68-90).

It is recognized that demands for various margins such as transport, wholesale and retail services cannot be satisfactorily handled by treating them as consumer goods, or as arguments in the production function (Dixon *et al.* 1982:106). Explicit modelling of these margins is the best. Nonetheless, non-availability of independent data on margins and the small size of the economy have provoked the modeller to treat all margins, which facilitate the flows of good and services from producers to users, as intermediate inputs. Hence, explicit demand equations for margins which appeared in ORANI are not present in CGE-B89.

Transformation in production and supply of outputs

Exports and domestic goods sold at the domestic market are treated as imperfect substitutes. Export and domestic prices need not be equal. In general, at any given level of activity, Z_j, industry j, j=1,2,...,g, chooses to maximize its revenue by dividing its sales between domestic and export markets. In other words, industry j chooses the sales combination Z_{j1} (exports), and Z_{j2} (domestic sale), to maximize total revenue

$$\sum_{s=1}^{2} P^0_{js} Z_{js} \qquad j=1,2,...,g \qquad (4.9)$$

subject to

$$Z_j = CET(Z_{js}) \qquad j=1,2,...,g; \; s=1,2 \qquad (4.10)$$

where Z_j and P^0_{js} are treated as exogenous variables. P^0_{js} is the basic price of output of industry j, i.e. the after-tax price received by industry j from export (s=1) and domestic sale (s=2).

The solution to the above constrained optimizing problem gives the supply equations of industry j, which in percentage change form are given by Equations (3) in Appendix A4.2 (for derivation details, see Dixon *et al.* 1992: 200-10).

Final demands

Goods and services are produced to meet intermediate input demands and final demands. The latter, final demands, consist of household demand for consumption goods and investment goods, government demand for consumption and investment goods, total inventory demand, and export demand.

Since income distribution is not the concern of this thesis, the economy is modelled as a single representative household. In accordance with conventional demand theory, a consumer may be postulated either to maximize utility or minimize expenditure. The duality property of consumption ensures that at the equilibrium, the commodity consumed under both is the same. Here, the household is assumed to choose commodities from both domestic and imported sources while minimizing expenditures. Goods from domestic sources are imperfect substitutes for comparable imported goods (Armington 1969). Each composite good *i* is constructed using a CES aggregation function. The household's consumption function is assumed to take the form of a linear expenditure system (LES), one of the empirically least challenging specifications. The choice of the LES in this model specification is dictated by the availability of elasticity estimates (explained more in the next chapter on the data base and solution method). Ali (1989), Hossain (1989) and Salma (1992) adopted the LES for their computable general equilibrium models for Bangladesh. The utility function associated with the standard LES is of Stone-Geary or Klein-Rubin functional form:

$$U(X^3)=\prod_{i=1}^{g} (X^3_i-\theta_i)^{\delta i} \qquad (4.11a)$$

where θ_i is the minimum required quantity (or committed quantity) of good *i* with $\theta_i>0$; δ_i is the *i*th parameter with $\delta_i>0$ for all *i* and $\sum_{i=1}^{g} \delta_i=1$; X^3_i is the quantity of composite good *i* aggregated according to a CES trade aggregation function:

$$X^3_i=CES_s(X^3_{is}) \qquad i=1,2,\ldots,g,\ s=2,3 \qquad (4.12)$$

where X^3_{is}, $i=1,2,\ldots,g$, $s=2,3$, are the quantity of good *i* from source *s* ($s=2$, domestic; $s=3$, imported) consumed by household.

Based on this proposition that any positive monotonic transformation of the utility function represents the same preferences of the consumer concerned (Varian 1984:128), a monotonic transformation is carried out such that the marginal utility of income is unity at the base year. The new utility function takes the following form (Appendix A4.6):

$$\tilde{U}(X^3)= \delta_0\prod_{i=1}^{g} [\bar{P}^3_i(X^3_i-\theta_i)]^{\delta_i} \qquad (4.11b)$$

where $\delta_0 = \frac{1}{\prod_{i=1}^{g} \delta_i^{\delta_i}}$, and $\overline{P}^3{}_i$ is the price of composite good i at the base year.

The household demand specification could certainly be improved by implementing a non-additive utility function and a more general aggregation function over domestic and foreign sources than the CES form used here. The additivity property of LES implies that a household's marginal utility for good i is independent of its consumption of good j, for all $i \neq j$. When different commodities are specified such that they are very distinct and remotely substitutable, the LES specification does not seem to be inappropriate.

Household derives its income from returns to primary factors, labour and capital, it owns. Its disposable income, Δ, is defined as:

$$\Delta = \sum_{j=1}^{g} P_{1j}.X_{1j} + \sum_{j=1}^{g} P_{2j}.X_{2j} - L + T^F \qquad (4.13a)$$

where P_{vj} and X_{vj}, for v=1(labour), 2(capital), as defined before, are respectively primary factor prices paid by and quantities employed in industry j; L is the lump-sum tax paid by the household, and T^F is the net foreign income. As discussed later, government collects revenues and spends on current and future consumption. If government revenue falls short of its expenditure, it charges a lump-sum taxes on household to meet the balance. In the opposite case, it pays lump-sum subsidies.

Household spends a part of its total disposable income on various commodities and services for current consumption. The remaining income is spent on investment goods and inventories. Hence, its expenditure on current consumption, C, may be defined as

$$C = \sum_{i=1}^{g} P^3{}_i X^3{}_i \qquad (4.13b)$$

with

$$P^3_i X^3_i = \sum_{s=2}^{3} P^3_{is} X^3_{is} \qquad i=1,2,\ldots,g \qquad (4.14)$$

where P^3_{is}, is the price paid by the household (which may be different from purchaser's prices paid by other users, because of taxes) per unit of good i, i=1,2,...,g, from source s, with s=2 referring to domestic source and s=3 to imports.

Thus the optimizing problem of the representative consumer is to choose the combination of composite commodities, X^3_i, i=1,2,...,g, that minimize expenditure

$$\sum_{i=1}^{g} P^3_i X^3_i$$

subject to the utility function given by (4.11b) and the CES aggregation function (4.12), and the total expenditure on good i defined in (4.14).

The constrained expenditure minimization problem can be split into two constrained optimizing problems. First, given the utility function, the household chooses composite goods, X^3_i, i=1,2,...,g, to minimize total consumption expenditure,

$$\min_{X^3_i} \sum_{i=1}^{g} P^3_i X^3_i$$

subject to the utility function

$$\tilde{U}(X^3) = \delta_0 \prod_{i=1}^{g} [\bar{P}^3_i (X^3_i - \theta_i)]^{\delta i}$$

Second, the household selects a domestic-import mix based on a CES function (4.13) for each ith composite commodity that minimizes expenditure on that composite good,

$$\underset{X^3_{is}}{\text{Min}} \sum_{s=2}^{3} P3_{is}X3_{is}$$

subject to the trade aggregation function:

$$X3_i = CES_s(X3_{is}) \qquad i=1,2,\ldots,g; \; s=2,3.$$

Solution to these constrained expenditure minimization problems gives the set of final demand equations for goods differentiated by source, and for composite goods in the form of

$$X3_{is} = b_{is}{}^{\sigma i}.X3_i[P3_{is}/\sum_{s=2}^{3} P3_{is}]^{-\sigma i} \quad i=1,2,\ldots,g; \quad s=2,3, \qquad (4.15)$$

$$X_i^3 = \theta_i + U\frac{\delta_i}{P_i^3}\prod_{i=1}^{g} P_i^{3\delta_i} \qquad i=1,2,\ldots,g \qquad (4.16)$$

where b_{is} is the constant in the CES aggregation function, σ_i is the elasticity of substitution between imported and domestically produced good *i*.

The linear percentage change form of (4.14) through (4.16) are respectively Equations (6), (4) and (5) in Appendix A4.2.

The second set of household equations specifies household investment demand. Standard theory has not yet been developed to represent household investment demand in Bangladesh. No attempt is made here to construct a rigorous investment model for Bangladesh. Instead, it is assumed that household expenditure on each investment good moves parallel with the aggregate capital stock of the economy. However, the household chooses between domestic and imported sources according to a CES trade-aggregation function so as to minimize expenditure on composite investment good *i*, *i*=1,2,...,*g*. Equations (7) and (8) in Appendix A4.2 represent household investment demand in linear percentage form.

To be consistent with the input-output table, inventory demand equations are also specified. Aggregate effective inventory demand for good *i*, *i*=1,2,...,*g*, is indexed with the total real absorption of the economy. Consistently, the domestic good is differentiated from the imported one and a CES aggregation function is assumed. Equations (13) and (14) in Appendix A4.2 represent the inventory demands in linear percentage change form.

Government demand equations for current consumption are modelled to depend on total real absorption of the economy, and government investment demand equations are specified similarly to those of household investment demand equations. The government also chooses between domestic and foreign sources according to a CES aggregation function. Equations (9) through (12) in Appendix A4.2 represents government current consumption and investment demands. Both kinds of demand can be held to be exogenous or endogenous by assigning an appropriate value to the indexing parameters, $h^5{}_i$ and $h^2{}_i$. Shift variables, $f^5{}_i$ and $f^2{}_i$, are included in the equations. They allow simulations for exogenous shifts in government demands.

Lastly, the rest of the world's (ROW's) demands for exportables are specified. As noted earlier, exports are differentiated from competing products supplied by the rest of the world and hence, face finite-elastic demand. Thus, the free on board (*fob*) foreign currency price of good *i*, *i*=1,2,...,*g*, is specified as an inverse function of the volume of export of good *i*.

$$P^e{}_i = F^4{}_i(X^4{}_i)^{-\gamma_i} \qquad i=1,2,\ldots,g, \qquad (4.17)$$

where $P^e{}_i$ is the *fob* unit price of export of good *i* in foreign currency, $X^4{}_i$ is the volume of exports of good *i*; γ_i is the reciprocal of the foreign elasticity of demand for Bangladesh exports of good *i*. A very low value of γ_i implies very large elasticity characterizing the smallness of the country. To introduce an exogenous shift in foreign demand for exportables, a shift variable $F^4{}_i$ is introduced. Equation(15) in Appendix A4.2 is the percentage change form representation of Equation (4.17) above.

Zero pure profit conditions

Microeconomic theory dictates that perfect competition (free entry and exit) together with the assumption of constant returns to scale guarantees that industry *j* earns zero economic profit, i.e. the value of output is just enough to pay the factors of production. Nevertheless, in the presence of rationed supplies of foreign exchange, inputs or goods, pure profits may exist in the system. But these have no implications for production and consumption decisions (Sicular 1988), and can be ignored in a model which is not concerned with income distributional aspects. These model equations determine equilibrating prices. It is assumed that the number of firms in each industry *j* competing actively is sufficient to eliminate pure profits at the margin.

Constant returns to scale imply that unit cost is independent of activity level and dependent only on input prices. Average cost equals marginal cost. At the equilibrium, marginal cost equals marginal revenue which is equal to average revenue or price under perfect competition. Hence, both costs and revenue per unit of activity are independent of the activity level. Thus the zero pure profit condition, in percentage change form (Equation 16 in Appendix A4.2), implies that the revenue-share-weighted sum of percentage changes in the basic prices of exports and domestic sales, equals the cost-share weighted sum of percentage changes in the relevant purchasers' prices of inputs.

Using level form variables, the zero pure profit conditions in current production are given by

$$\sum_{s=1}^{2} P0_{js}Z_{js}=\sum_{i=1}^{g}\sum_{s=2}^{3} P1_{isj}X1_{isj}+\sum_{v=1}^{2} P_{vj}X_{vj} \qquad j=1,2,...,g \qquad (4.18)$$

Where, as defined before, $P0_{js}$ is the basic price of output of industry *j*, i.e. the price received by industry *j* from export (*s*=1) and domestic sale (*s*=2). Z_{j1}, Z_{j2} are respectively the volumes of exports and domestic sales of industry *j*'s output. The right hand side of Equation (4.18) gives the total costs incurred by industry *j* on account of intermediate and primary input purchases. The quantity variables from both sides of the percentage form of Equation (4.18) can be eliminated (Dixon *et al.* 1982:109-10) leaving the equation in percentage changes in prices only as in Equation (16) in Appendix A4.2.

Another zero profit condition which relates the price per unit of capital to the unit cost is derived from the following equation:

$$\Pi.K=\sum_{i=1}^{g}\sum_{s=2}^{3} P2_{is}X2_{isP}+\sum_{i=1}^{g}\sum_{s=2}^{3} P2_{is}X2_{isG} \qquad (4.19)$$

where Π is the economy-wide unit cost for capital creation. The zero profit condition for capital creation is represented in percentage change form by Equation (17) in Appendix A4.2.

Zero profit or arbitrage conditions for each of the imported goods relate the unit price of imports to the cost of importing (including tariffs, etc.). Based on the three equilibrium configurations discussed earlier (Figure 4.2), three different zero profit conditions for imported goods can be specified:

(i) imports for which foreign exchange rationing at the official rate is not binding

$$P^0_{i3} = P^m_{i3}.E_1 + P^m_{i3}.E_1.T_i^* \qquad i=1,2,...,t_1 \qquad (4.20a)$$

(ii) imports for which foreign exchange rationing is binding, but no additional imports is made through the secondary exchange market

$$P^o_{i3} = P^m_{i3}.(E_1 + SP_i) + P^m_{i3}.E_1.T_i^* \qquad i = t_{1+1}, t_{1+2}, \ldots, t_2 \qquad (4.20b)$$

(iii) imports for which foreign exchange rationing is binding, and importers obtain foreign exchange from the secondary exchange market to meet the demand for imports

$$P^o_{i3} = P^m_{i3}.E_2 + P^m_{i3}.E_1.T_i^* \qquad i = t_{2+1}, t_{2+2}, \ldots, g \qquad (4.20c)$$

where, P^o_{i3} is the price realized by the importers termed as the basic import price; P^m_{i3} is the *cif* foreign currency price of imported good *i*; E_2 and E_1 are the secondary and official exchange rates respectively; T_i^* is the *ad valorem* rate of tariff; and SP_i is the scarcity premium per unit which is less than the exchange rate premium. The second term of the right hand side measures the total tariff per unit of import. Equations (18a-18c) in Appendix A4.2 is the percentage change form of Equation (4.20a-20c) above (Appendix A4.6 for derivation).

In exporting, zero pure profit conditions imply

$$P^0_{i1} = P^e_i.[E_2.R_i + E_1.(1-R_i)](1-ES_i^*) \qquad i = 1,2,\ldots,g \qquad (4.21)$$

where P^0_{i1} is the basic export price per unit, i.e. price per unit received by the exporter in domestic currency; P^e_i is the *fob* foreign currency price of exported good *i*; E_1, E_2 are respectively official and Wage Earners' Scheme exchange rates; R_i is the commodity specific proportion of export earnings on which cash subsidies are given, here called the Export Performance Benefit entitlement ratios; and ES_i^* the *ad valorem* rate of export tax (if, >0) or subsidy (if, <0). As mentioned before, under the Export Performance Benefit Scheme, exporters are given cash subsidies on a certain proportion of total export earnings. The subsidy rate is equal to the differential between the official exchange rate and the secondary rate. In other words, $[E_2.R_i + E_1.(1-R_i)] = E_x$ is the commodity specific export exchange rate. The right hand side of Equation (4.21) is the share-weighted sum of export receipts at the official exchange rate and the Secondary rate adjusted for exports tax or subsidies. The weights are a function of policy variable R_i, i=1,2,...,g, specific to each good. Equation (19) in Appendix A4.2 is the percentage change form representation of Equation (4.21) above (for derivation see Appendix A4.6).

Market clearing equations

This group includes equations which imply that the excess demand for each of the domestically produced goods, and for primary factors of production is essentially equal to zero.

The market clearing conditions for each good i differentiated by markets, domestic and foreign, are given by

$$Z_{i2} = \sum_{j=1}^{g} X^1_{i2j} + X^3_{i2} + X^5_{i2} + X^2_{i2P} + X^2_{i2G} + X^2_{i2ch} \qquad (4.22)$$

$$i=1,2,...,g$$

and

$$Z_{i1} = X^4_i \qquad i=1,2,...,g \qquad (4.23)$$

where Z_{i1}, and Z_{i2} are respectively the quantity of ith output exported and sold domestically; $\sum_{j=1}^{g} X^1_{i2j}$ is the total amount of domestically produced good i used as intermediate inputs across the industries; X^3_{i2}, X^5_{i2} are the quantities of good i consumed by household, and government respectively; X^2_{i2P} and X^2_{i2G} are, respectively, the investment demands for domestically produced good i by household and government; $X^2_{i2(ch)}$ is the inventory demand; and X^4_i the export demand. Imports are not included in the above equation because the model treats imports as a product distinct from domestically produced goods. In percentage change form, Equations (20) and (21) in Appendix A4.2 represent the market clearing conditions specified above.

Equations representing the equality between demand and supply for each of the primary factors of production, viz. labour and capital, are, in levels:

$$\sum_{j=1}^{g} X_{vj}=L \qquad v=1 \text{ (labour)} \qquad (4.24)$$

$$X_{vj}=K_j \qquad v=2 \text{ (capital)} \qquad (4.25)$$

$$\sum_{j=1}^{g} X_{vj}=K \qquad (4.26)$$

Implicit in Equation (4.24) is the assumption that labour is homogeneous and mobile across the industries. Equality of demand and supply of labour does not, of necessity, mean full employment unless supply is set at the full employment level exogenously. No behavioural relationship has been specified to explain the supply of labour. However, assumptions about labour supply are implicit in the model closure (see the next section). With a closure wherein real wages are set exogenously, the model solution gives each industry's demand for labour. It is assumed that there is a sufficient supply of labour to match the demand at the specified wage rate. Alternatively, if in the closure, the supply of labour is set exogenously, the model projects the real wage at which such labour is demanded by industries.

Equation (4.25) equates demand for and supply of capital in each industry. Capital can be industry-specific in the short-run when K_j is considered exogenous to the model. This assumption of non-shiftability of capital in the short run is unlikely to distort model results significantly except in simulations of policies which would produce very rapid changes in the output of some industries (Dixon *et al.* 1982:123).

Equation (4.26) simply equates the total demand for capital to the total supply of capital. When converted into percentage change form these give Equations (22), (23) and (24) in Appendix A4.2, respectively.

External trade balance

Equation (25) of Appendix A4.2 computes percentage change in the total volume of import of good *i* as the share-weighted sum of percentage changes in various end uses of *i*th import: uses as intermediate inputs by industry, as current and capital consumption by household and government, and as inventory. Aggregate foreign currency values of imports and exports in percentage change forms are defined in Equations (26) and (27) of Appendix A4.2, respectively. The difference between the aggregate value of imports and exports in foreign currency units defines the balance of trade (BOT) deficits in units of foreign currency. Theoretically, BOT can be zero in the base year. So, instead of percentage change form, the first difference of BOT has been used in Equation (28) of Appendix A4.2.

Monetary sector

As discussed before, a simple monetary sector is modelled. Demand for money is specified as

$$M^D = P \cdot GDP^r \qquad (4.27)$$

the supply-demand equality is established in the following way

$$M^S = P \cdot GDP^r \qquad (4.28)$$

where, M^S and M^D are respectively supply of and demand for money; P is the GDP deflator; GDP^r is the real gross domestic product.

Equation (4.28) above equates the supply of, and demand for, money which, when expressed in the percentage change form, gives Equation (29) in Appendix A4.2.

Government budget

The government is modelled to collect revenues and spend them through current and capital consumption. It imposes a lump-sum non-distortionary taxes on the households to the extent its aggregate expenditure exceeds its aggregate revenue. Specification of the government budget is important as it affects welfare of the households (also see Efficiency Equation later). But the model contains the specification of the government budget to a minimum as is necessary for the evaluation of the effects of different policy changes on government revenues and expenditure associated with policies modelled above. Changes in revenues and expenditure, due to changes in allocation of inputs and outputs, are specified at the base-year rates and prices as these are only relevant for the decomposition of welfare effects (see Efficiency Equation derived later).

Public revenue

Table 4.1 lists the sources of, and the corresponding value for, government revenue the year 1988-89. The breakdown of government revenue in the table does not correspond to the actual breakdown in the annual government budget. The Table 4.1 breakdown matches aggregate government receipts with the base year to be able to explain the public revenue implications of various policy changes.

Government revenue is collected from trade taxes, commodity taxes (excise and sales taxes combined) and miscellaneous source which lumps together all other sources including direct taxes, interest receipts, profits of the government-owned financial intermediaries and industries, net proceeds from the sale of public utilities, land and property taxes.

Table 4.1 **Breakdown of public revenue, 1989** (million taka)

Category	
Import duties	18480
Commodity taxes (sales plus excise) by end use	
intermediate use	10627.44
investment	-352.64
consumption	8105.20
Export duties	0
Miscellaneous (including taxes and non-taxes)	55911
Aggregate public revenue	**92771**

Sources: Bangladesh, Government of, 1991. Input-Output Table: 1988-89, mimeo, National Board of Revenue, Dhaka; Mansur, A.H. and Khondker, B.H., 1991. Bangladesh: some estimates for tax potential, mimeo, National Board of Revenue, Dhaka: Tables 3, 4, and 5; Bangladesh Bank, 1991. *Economic trends*, Dhaka.

Equations (30) through (35) in Appendix A4.2 specify the individual items of public revenue identified in Table 4.1 in percentage changes due to changes in allocations of inputs and outputs at the base-year rates and prices. Equation (30) in Appendix A4.2 specifies the percentage change of total tariff revenues at the given tariff rates and prices. Revenues raised from import duties depend on import volumes, X_{i3}, foreign currency *cif* price of imports, P^{m}_{i3}, official exchange rate, E_1, and the tariff rate levied on each commodity import, T_i^*. Now, the change in aggregate tariff revenue due to the change in X_{i3} only is given, in levels, by

$$dR_t = \sum_{i=1}^{g} P^{m}_{i3}.E_1.T_i^* dX_{i3} \tag{4.29}$$

Equations (31) to (33) in Appendix A4.2 describe revenues from commodity taxes differentiated by end use, that is, by intermediate inputs, investment goods used both by households and government, and current consumption goods consumed by both household and the government. The changes in revenues are due to changes in quantities of goods used at the base-year tax rates and prices. Commodity taxes include both sales taxes and excise duties. Since 1983, sales taxes have been levied only on imports and excise duties only on selective domestically produced goods in Bangladesh. Revenues from commodity taxes differentiated by end uses are specified identically. In each case, revenue is approximated by the product of the relevant tax rate and the value of taxable goods (price times quantity) both from domestic and imported sources. In levels, the changes in revenues at the base-year tax rates and prices are

revenue from commodity taxes on intermediate inputs

$$dR_1^{se} = \sum_{i=1}^{g} \sum_{s=2}^{3} \sum_{j=1}^{g} P0_{is}.G1_{isj}{}^{*}dX1_{isj}. \tag{4.30}$$

revenue from commodity taxes levied on investment goods

$$dR_2^{se} = \sum_{i=1}^{g} \sum_{s=2}^{3} P0_{is}.G2_{is}{}^{*}(dX2_{isP} + dX2_{isG} + dX2_{is(ch)}) \tag{4.31}$$

revenue from commodity taxes levied on consumption goods

$$dR_3^{se} = \sum_{i=1}^{g} \sum_{s=2}^{3} P0_{is}.G3_{is}{}^{*}(dX3_{is} + dX5_{is}) \tag{4.32}$$

Change in revenue income from export taxes, R_t^{exp}, is specified as follows

$$dR_t^{exp} = \sum_{i=1}^{g} Pe_i.[E_2.R_i + E_1.(1-R_i)].ES_i{}^{*}dX4_i. \tag{4.33}$$

Equation (34) in Appendix-A4.2 represents Equation (4.33) above in percentage change form. It is quite possible that instead of taxing, the government may actually be paying subsidies to a particular industry in various forms. In such cases, the tax variable turns into a subsidy variable, and rather than being a revenue raiser, it will be a part of public expenditure.

Finally, other government revenue, which encompasses all the miscellaneous sources not explained so far in the model, is modelled to vary in line with real GDP. The percentage change form version of this sundry category of government revenue is given by Equation (35) in Appendix A4.2. A zero value of the indexing parameter in the equation keeps the miscellaneous revenue fixed at the base-year level.

The percentage change in total public revenues at the base-year prices and tax rates is defined as the base-year share-weighted sum of the percentage changes of all tax and non-tax revenues defined so far, and is presented in Equation (36) in Appendix A4.2.

Public spending

On the expenditure side, the government spends on current consumption and investment. It also pays subsidies on exports under the export performance benefits schemes. All other expenditures including (domestic and foreign) debt servicing, food subsidies, defence expenditure, are lumped together into miscellaneous expenditure.

Table 4.2 **Breakdown of public spending, 1989** (million taka)

Item	
Current consumption expenditure	39440
Investment expenditure	0
Subsidies to exporters under Export Performance Benefit scheme	499
Other public expenditure	93311
Aggregate public spending	**133250**

Sources: Bangladesh, Government of, 1991. Input-Output Table: 1988-89, mimeo, National Board of Revenue, Dhaka; Bangladesh, Government of, 1989. *Annual Budget 1989-90*, Ministry of Finance, Dhaka.

Equations (37) through (40) in Appendix A4.2 specify the percentage changes in expenditures listed in Table 4.2 due to changes in quantities of consumption, investment and trade. The changes are evaluated at the base-year prices and rates. Equation (37) in Appendix A4.2 defines the percentage change in the aggregate public consumption expenditure (G^{e5}) due to changes in goods and services consumed by government from domestic and imported sources, X^5_{is}, i=1,2,...,g, s=2,3, at the base-year prices. In levels, the equation takes the following the form

$$dG^{e5}=\sum_{i=1}^{g}\sum_{s=2}^{3} P^3_{is}.dX^5_{is} \tag{4.34}$$

Equation (38) in Appendix A4.2 expresses the percentage change in the aggregate public capital spending, G^{e2}, on investment due to changes in quantities of investment goods from domestic and imported sources, X^2_{isG}, at purchasers' price, P^2_{is}. In levels

$$dG^{e2}=\sum_{i=1}^{g}\sum_{s=2}^{3} P^2_{is}.dX^2_{isG} \tag{4.35}$$

Government provides subsidies to exporters under the Export Performance Benefit (XPB) Scheme. The change in such subsidies due to change in export volume only is, in levels,

$$dG^{XPB} = (E_2-E_1)\sum_{i=1}^{g} P^e_iR_i.dX^4_i. \tag{4.36}$$

where G^{XPB} is the public spending on export subsidy under the Export Performance Benefit Scheme; P^e_i and X^4_i are respectively the *fob* foreign currency price and quantity of exported good i; R_i is the commodity-specific proportion on which the subsidy is provided; and E_2 and E_1 are the secondary and official exchange rate, respectively. The percentage form expressions of Equations (4.36) above is given by Equations (39) in Appendix A4.2.

Other public expenditure, G_{mis}, includes all other public expenditures not specified until now and is assumed to move parallel to real GDP. However, a shift variable is also included to make a provision for shifting this omnibus category and thus, total public expenditure exogenously. Equation (40) in Appendix A4.2 specifies G_{mis} in percentage change form.

The various components of public spending are added to yield aggregate public spending. Equation (41) in Appendix A4.2 defines the percentage change in aggregate public spending as the base-year weighted sum of percentage changes in all the spending categories defined so far.

Government borrowing requirement

The difference between government total expenditure and total revenue at the base-year rates and prices defines the net budgetary position of the government sector in real terms. The gap between aggregate spending and aggregate revenue is defined as a government borrowing requirement, GB. Equation (42) in Appendix A4.2 defines this. It is quite possible that the government budget defined above is balanced, i.e. GB=0. So, as in the case of the balance of trade (BOT) equation, the first difference of GB rather than the percentage change is put on the left hand side of Equation (42) in Appendix A4.2. When dGB>0, government imposes lump-sum taxes on the households, and when dGB<0, government pays lump-sum subsidies to the households so as to keep the government net borrowing requirement at the base-year level.

Miscellaneous

The final set of Equations ranging from (43) to (54) in Appendix A4.2 involves important macroeconomic identities, various prices and price indices and the like. These equations are specified under the following sub-headings for convenience.

Prices, price indices, and returns to factors

Equations (43) to (45) in Appendix A4.2 establish linkages between purchasers' (or producers') and basic prices through policy variables, namely, tax or subsidy variables. While trade and transport margins are not explicitly considered, taxes or subsidies on purchases of goods and services produce the wedge between these two sets of prices. In levels they are:

purchasers' prices of intermediate inputs from domestic and imported sources

$$P^1_{isj}=P^0_{is}(1+G^1_{isj}{}^*) \qquad i=1,...,g;\ s=2,3;\ j=1,...,g \qquad (4.37)$$

purchasers' prices of investment goods from domestic and imported sources

$$P^2_{is}=P^0_{is}(1+G^2_{is}{}^*) \qquad i=1,...,g;\ s=2,3 \qquad (4.38)$$

purchasers' prices of consumption goods from domestic and imported sources

$$P^3_{is}=P^0_{is}(1+G^3_{is}{}^*) \qquad i=1,...,g;\ s=2,3; \qquad (4.39)$$

where G^*'s are *ad valorem* commodity tax rates by end uses.

The GDP deflator and consumer price index are endogenously determined. The latter in percentage change form is given, as in Equation (52) of Appendix A4.2, by the share-weighted sum of percentage changes of all prices of commodities, whether produced domestically or imported, consumed by household. Derivation of the GDP deflator is described under important macro-aggregates sub-heading below.

Rate of return to capital in industry j, R_j, $j=1,2,...,g$, is defined as follows

$$R_j=(P_{vj}/\Pi) - d_j \qquad j=1,2,...,g,\ v=2\text{(capital)} \qquad (4.40)$$

where P_{2j} and Π are the rental price of a unit of capital in industry j and average cost of capital respectively, d_j is the industry-specific rate of depreciation, values of which are technologically determined, and thus is exogenous to the model. Equation (46) in Appendix represents in percentage change the Equation (4.40) above.

Equation (47) in Appendix A4.2 indexes industry-specific wages, p_{1j}, to the consumer price index, ε^3, and allows exogenous shifts in wages by changing the shift variables, f^1 and f^1_j. With f^1 and f^1_j set exogenously, $h^1_j=0$ implies no wage indexation. Nominal wages in industries remain unchanged. When h^1_j is set to one, with f^1 and f^1_j set exogenously, the case for full wage indexation occurs. Real wages remain fixed in industries. Also, one of the shift variable can be made endogenous to the relevant labour demand variable set exogenously. The equation is derived from the following level form flexible wage setting equation

$$P_{vj} = P^0_{vj}.(CPI)^{h_{1j}}.F^1.F^1_j \qquad j=1,2,\ldots,g;\ v=1 \qquad (4.41)$$

where F^1 and F^1_j are economy-wide and industry-specific shift terms; h^1_j is the indexing parameter.

Important macro-aggregates

Real and nominal GDP, and aggregate real absorption are defined in percentage change form in Equations (48), (50) and (51), respectively in Appendix A4.2. Both real and nominal GDP are measured from the expenditure side. Hence, nominal GDP is given as the sum of

household current consumption expenditure at purchaser's price,
household investment expenditure at purchaser's price,
government current consumption expenditure at purchaser's price,
government investment expenditure at purchaser's price,
total expenditure on inventory demand,
value of exports at *fob* price, and
negative value of imports at the *cif* price.

In percentage change form, Equation (50) in Appendix A4.2 gives nominal GDP. Conversion of nominal GDP so defined into percentage change form gives quantity and price sets. Taken separately, they give the real GDP and GDP deflator respectively as in Equations (48) and (49) of Appendix A4.2.

Total nominal absorption is simply the nominal GDP defined above minus the trade balance. Thus, it is given by the sum of current consumption and investment expenditure by household, current consumption and investment expenditure by government, and expenditure on inventories. Manipulating the nominal absorption, as in the case of nominal GDP, gives the real absorption in percentage form as in Equation (51) of Appendix A4.2.

Equation (54) in Appendix A4.2 defines the exchange rate (or the Wage Earners' Scheme) premium in the percentage change form.

The model specified above also satisfies the following identity

$$\frac{dV}{\lambda} \equiv dU \equiv dE \equiv dY^R$$

where dV is change in indirect utility; λ is the marginal utility of expenditure; dU is the change in direct utility; dE $[=\sum_{i=1}^{t}\sum_{s=2}^{3} P_{is}^{3} dX_{is}^{3}]$ the change in household consumption evaluated at the base-year prices; and dY^R is the household's additional real income spent on current consumption. It may be recalled that the sources of household income are factor payments, exogenous foreign exchange inflow. Household's disposable income equals its total income minus the lump-sum tax payment which is to contain the government borrowing requirement to the base-year level. Part of its disposable income is spent on investment and inventories. That is, dY^R $[= d\Pi + dA + dT - dG - dI_h - dI_s]$ where $d\Pi$ is the change in value-added evaluated at the base-year factor price; dA is the exogenous inflow of foreign exchange evaluated in domestic currency; dT gain from the terms of trade improvement; dG lump-sum taxes to contain the government budget deficit in real terms; dI_h and dI_s are changes in household's real expenditure on investment and inventories. The identity will be satisfied while the Efficiency Equation is derived.

Derivation of the Efficiency Equation

Under the appropriate closure (discussed later), the simulation of the CGE-B89 model for any exogenous change yields directly the change in utility of the household which, at a unitary marginal utility of income, measures the change in welfare (defined as the change in utility divided by the marginal utility of income). The welfare effect of any exogenous change can be disaggregated into its components by Harberger's fundamental equation of applied welfare economics (Harberger's 1971, equation 6). Because the CGE-B89 model has incorporated a number of distortions and structural features of the economy, it is necessary to extend the equation to allow for intermediate goods, terms of trade effects, indirect taxes on consumption and intermediate inputs, production subsidies, exchange controls and wage rigidity (for simulations allowing changes in involuntary Keynesian unemployment). The new equation, to be called the Efficiency Equation, provides the basis for decomposing the aggregate welfare effect, due to a change in exogenous variables in the CGE-B89 model, into its direct and indirect components. Some behavioural relations driven from consumption and production optimization, the market clearing conditions, the balance of trade identity and various price relations defined earlier are used to derive the equation.

Consumption side

The indirect utility function and the budget constraint of the household can be written as

$$V = V(C, P^3_{is}) \qquad (4.42)$$

$$C=\sum_{i=1}^{t}\sum_{s=2}^{3} X^3{}_{is}P^3{}_{is} \tag{4.43}$$

where C is the total expenditure on current consumption; $P^3{}_{is}$ and $X^3{}_{is}$ are respectively the purchaser price, quantity of good i=1,2,...,t from source s=2 (domestic),3(imported). Applying Roy's identity to the total differential of (4.42) yields

$$dV = \frac{\partial V}{\partial C}dC - \frac{\partial V}{\partial C}\sum_{i=1}^{t}\sum_{s=2}^{3} X_{is}^{3}\, dP_{is}^{3} \tag{4.44}$$

Substituting (4.44) into the total differential of (4.43) gives

$$dU = \sum_{i=1}^{t}\sum_{s=2}^{3} P_{is}^{3}\, dX_{is}^{3} \tag{4.45}$$

where, by definition, $dU = \frac{dV}{\lambda}$, U denoting the monetary measure of welfare; and $\lambda = \frac{\partial V}{\partial C}$ the marginal utility of expenditure. Equation (4.45) measures the change in welfare as the change in aggregate consumption evaluated at the base-year purchaser prices.

Production side

For simplicity, if the economy is assumed to have only one industry which produces only one output, the profit function can be written

$$\pi(P,\mathbf{W}) = \max \quad Pf(\mathbf{L}) - \mathbf{W}\cdot\mathbf{L} \tag{4.46}$$

where P is the price of output produced according to the technology $Y = f(\mathbf{L})$; **W** is the vector of prices of factors, **L**.

The first-order conditions for the single output profit-maximization problem are

$$PDf(\mathbf{L}^*) = \mathbf{W} \tag{4.47}$$

or

$$P\frac{\partial f(\mathbf{L}^*)}{\partial L_i} = W_i \qquad i = 1,2,..,n \qquad (4.48)$$

Substituting (4.48) into the total differential of the production function yields

$$P\mathrm{d}Y = \sum_{i=1}^{n} W_i L_i \qquad (4.49)$$

For multi-industry economy Equation (4.49) becomes

$$\sum_{j=1}^{t} P_j \mathrm{d}Y_j = \sum_{i=1}^{n} W_i \sum_{j=1}^{t} L_{ij} \qquad (4.50)$$

The CGE-B89 equivalent of the above equation is

$$\sum_{j=1}^{g}\sum_{s=1}^{2} \mathrm{P}^{o}_{js}\mathrm{dZ}_{js} = \sum_{j=1}^{g}\sum_{s=2}^{3}\sum_{i=1}^{g} \mathrm{P}^{1}_{isj}\mathrm{dX}^{1}_{isj} + \sum_{j=1}^{g}\sum_{v=1}^{2} \mathrm{P}_{vj}\mathrm{dX}_{vj} \qquad (4.51)$$

where the notations are as usual; upper case variables are in levels. Equation (4.51) allows for intermediate inputs (X^{1}_{isj}) and relates to the zero pure profit conditions given by Equation (4.18).

The supply-demand equality in the real sector of the economy

Because of the product differentiation assumption, the set of excess demand equations in CGE-B89 consists of market clearing conditions for domestic goods and those for imports. Using the market clearing equations (4.22) and (4.23) for domestic goods the following equation can be obtained

$$\sum_{j=1}^{g}\sum_{s=1}^{2} \mathrm{P}^{o}_{js}\mathrm{dZ}_{js} = \sum_{j=1}^{g}\sum_{i=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{1}_{i2j} + \sum_{j=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{3}_{j2} + \sum_{j=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{5}_{j2} + \sum_{j=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{2}_{j2P} +$$
$$\sum_{j=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{2}_{j2G} + \sum_{j=1}^{g} \mathrm{P}^{0}_{j2}\mathrm{dX}^{2}_{j2(CH)} + \sum_{j=1}^{g} \mathrm{P}^{0}_{j1}\mathrm{dX}^{4}_{j} \qquad (4.52)$$

The market clearing condition for aggregate import gives

$$\sum_{j=1}^{g} P_{j3}^{0} dX_{j3} = \sum_{j=1}^{g}\sum_{i=1}^{g} P_{j3}^{0} dX_{i3j}^{1} + \sum_{j=1}^{g} P_{j3}^{0} dX_{j3}^{3} + \sum_{j=1}^{g} P_{j3}^{0} dX_{j3}^{5} + \sum_{j=1}^{g} P_{j3}^{0} dX_{j3P}^{2} +$$
$$\sum_{j=1}^{g} P_{j3}^{0} dX_{j3G}^{2} + \sum_{j=1}^{g} P_{j3}^{0} dX_{j3(CH)}^{2} \qquad (4.53)$$

The balance of trade and other price equations:

The totally differentiating the balance of trade deficits gives

$$dBOT = \sum_{t=1}^{M} P_{t3}^{m} dX_{t3} - \sum_{t=1}^{X} P_{t}^{e} dX_{t}^{4} \quad + \quad \sum_{t=1}^{M} X_{t3} dP_{t3}^{m} - \sum_{t=1}^{X} X_{t}^{4} dP_{t}^{e} \qquad (4.54)$$

The Efficiency Equation

Using equations (4.45), (4.51), (4.52)-(4.54), and various purchaser and basic prices defined earlier (Equations 4.20a-4.20c, 4.21, 4.37-4.39), the Efficiency Equation can be shown to take the following form

$$\begin{aligned}
dU \;=\; & E_1 dBOT + \sum_{j=1}^{g}\sum_{v=1}^{2} P_{vj} dX_{vj} \\
& - \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{js}^{5} - \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{jsP}^{2} - \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{jsG}^{2} - \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{js(CH)}^{2} \\
& + \sum_{j=1}^{g}\sum_{s=2}^{3}\sum_{i=1}^{g} P_{js}^{0} G_{isj}^{1} dX_{isj}^{1} + \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} G_{js}^{3} dX_{js}^{3} \\
& + E_1 \sum_{t=1}^{M} P_{t3}^{m} T_t^{*} dX_{t3} + (E_2 - E_1) \sum_{t=1}^{M} P_{t3}^{m} dX_{t3} \\
& + \sum_{t=1}^{X} P_t^{e} \{E_2 R_t + E_1(1 - R_t)\} ES_t^{*} dX_t^{4} - (E_2 - E_1) \sum_{t=1}^{X} P_t^{e} R_t dX_t^{4} \\
& + E_1 \left(\sum_{t=1}^{X} X_t^{4} dP_t^{e} - \sum_{t=1}^{M} X_{t3} dP_{t3}^{m} \right)
\end{aligned} \qquad (4.55)$$

Ignoring the industry-source-commodity notations, and using rather simple notations for variables, the Efficiency Equation can be rewritten as

$$
\begin{aligned}
dU = {} & E_1\, dF + W\, dL \\
& - P^0\, dC_g - P^0\, dI_g - P^0\, dI_h - P^0\, dI_s \\
& + P^0 \alpha\, dZ + P^0 \beta\, dC_h \\
& + E_1 P^m \chi\, dM + (E_2 - E_1) P^m\, dM \\
& + E_x P^e \theta\, dX + (E_2 - E_1) P^e \phi\, dX \\
& + E_1 (X\, dP^e - M\, dP^m)
\end{aligned} \qquad (4.56)
$$

where U, E_1 and E_2 are, as before, utility of the household, the official exchange rate and the secondary exchange rate respectively; F is the balance of trade deficit in US dollars; W is the price of primary factor L; P^0 is the basic price; C_g and I_g are government current consumption and investment demands; I_h and I_s are private investment and inventory demands; Z the intermediate input demands; C_h is household consumption demand; P^m and P^e are respectively world price of imports (M) and exports (X); and α and β, are respectively rate of tax on intermediate input and household consumption; χ and θ are respectively tariff rate and export tax rate; E_X is the export exchange rate which is a weighted average of the two exchange rates, E_1 and E_2; and ($-\phi$) is the export subsidy rate under the Export Performance Benefit Scheme.

Hence, Equation (4.56), or equivalently Equation (4.55), decomposes the changes in household welfare (household utility divided by the marginal utility of expenditure) into various components involving the distortions and structural features captured in CGE-B89, namely changes in net foreign capital inflow, rigidity in primary input prices, government consumption and other final uses, taxes on intermediate and final goods, tariffs, implicit taxes on imports, explicit and implicit export taxes, and market power for exports (changes in the terms of trade).

- The first term on the right hand side of the Equation 4.56, E_1 dF (or E_1 dBOT in Equation 4.55), measures the benefit of the change in the balance of trade or net foreign capital inflow. When the balance of trade is fixed exogenously at the base-year level, the term reduces to zero.

- The second term, (WdL) or $\sum_{j=1}^{g}\sum_{v=1}^{2} P_{vj} dX_{vj}$ in Equation 4.55, measures the change in aggregate value-added due to changes in the amount of primary factors of production, labour and capital, at exogenously fixed factor prices. If full employment is assumed, the labour component of the term reduces to zero. Similarly, if aggregate capital stock is assumed to be fixed, value-added to capital at the initial rental rates remains fixed, and the capital component of the term reduces to zero.

- The term (P^o dC_g + P^o dI_g+ P^o dI_h+ P^o dI_s) in Equation 4.56, or the equivalent term

$$\sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{js}^{5} + \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{jsG}^{2} + \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{jsP}^{2} + \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} dX_{js(CH)}^{2}$$

in Equation 4.55, measures the increase in final demands other than the household final consumption, namely government consumption, government investment, private investment and inventories evaluated at the base-year basic prices. If the amounts of these final demands are fixed exogenously at the base-year levels, the term reduces to zero. The change in welfare, dU, depends on the changes in household consumption (Equation 4.45). Increases in other final demands imply a reduced availability of commodities for household consumption. This is reflected by the negative sign pre-assigned to this component of the welfare change measure equation.

- The term ($P^o \alpha$ dZ + $P^o \beta$ dC_h) which denotes

$$\sum_{j=1}^{g}\sum_{s=2}^{3}\sum_{i=1}^{g} P_{js}^{0} G_{isj}^{1} dX_{isj}^{1} + \sum_{j=1}^{g}\sum_{s=2}^{3} P_{js}^{0} G_{js}^{3} dX_{js}^{3}$$

in Equation 4.55, measures the changes in government revenue from sales and excise taxes at the fixed tax rates (α, β or G's,) and prices (P's) due to changes in material input demands in production and consumption demands by household for commodities from both domestic and imported sources.

- The term [$E_1 P^m \chi\, dM + (E_2 - E_1) P^m dM$] which represents

$$E_1 \sum_{t=1}^{M} P_{t3}^{m} T_t^{*} dX_{t3} + \left(E_2 - E_1\right) \sum_{t=1}^{M} P_{t3}^{m} dX_{t3}$$

in Equation 4.55, measures the sum of changes in tariff revenue and changes in implicit taxes on imports (associated with the dual exchange rate regime), evaluated at the exogenously fixed tariff rates and base-year exchange rates, due to changes in imports. Imports made through the secondary exchange market pay implicit import taxes.

- Changes in export taxes, and export subsidies (negative taxes) associated with the Export Performance Benefit Scheme, evaluated at the initial rates and exchange rates, due to change in export volumes are measured by [$E_X P^e \theta\, dX + (E_2 - E_1) P^e \phi\, dX$] in Equation 4.56 or equivalently,

$$\sum_{t=1}^{X} P_t^{e} \left\{E_2 R_t + E_1 (1 - R_t)\right\} ES_t^{*} dX_t^{4} - \left(E_2 - E_1\right) \sum_{t=1}^{X} P_t^{e} R_t dX_t^{4}$$

in Equation 4.55.

- The last component on the right hand side which measures the terms of trade effect is [$E_1 (X\, dP^e - M\, dP^m)$] in Equation 4.56 or

$$E_1 \left(\sum_{t=1}^{X} X_t^{4} dP_t^{e} - \sum_{t=1}^{M} X_{t3} dP_{t3}^{m} \right)$$

in Equation 4.55. In case where the economy is the world prices taker for its imports, the term reduces to ($E_1 X\, dP^e$) or $E_1 \sum_{t=1}^{X} X_t^d dP_t^e$.

The Efficiency Equation, which is an extension of Harberger's or what Bacha and Taylor (1971) coined as the Harberger-Schydlosky-Fontaine fundamental equation of applied welfare economics (Harberger 1965, 1971, Schydlowsky 1968, and Fontaine 1969) to capture the distortions modelled in CGE-B89, thus measures the change in welfare arising from any exogenous change that reallocates resources as the sum of the direct impact of the change and the indirect gains (or losses) from alleviating (or exacerbating) distortions in all other markets.

For example, the direct effect on welfare of a costless increase in foreign exchange availability of US$1, due to increased foreign aid for example, is the value of US$1 at the official exchange rate (taka 32.14) evaluated by the term $E_1\, dF$ (or equivalently, E_1 dBOT in Equation 4.55). The indirect effects equal the sum, across all distorted markets, of the change in every distorted activity multiplied by the excess of marginal social benefit of that activity over its marginal social cost. In the case of tariffs (T_i^*, one of the distortions modelled), the marginal social benefit of an extra unit of imports is domestic price, while the marginal social cost is the world *cif* import price, P_{t3}^m (if the world price is exogenously given). Therefore the gap between the marginal social benefit and marginal social cost is the amount of the tariff, and the indirect benefit of additional foreign aid in alleviating tariff distortions is the tariff times the rise in imports due to the increased foreign aid availability, $E_1 \sum_{t=1}^{M} P_{t3}^m T_t^* dX_{t3}$ or equivalently ($E_1.P^m.\chi.dM$). In the case of Keynesian unemployment, the indirect benefit is the difference between wage (the marginal social benefit) and the disutility of labour (the marginal social cost, assumed to be zero in the model) times the change in employment, (WdL) or equivalently $\sum_{j=1}^{g} P_{1j}dX_{1j}$, ν=1 (labour). The other indirect benefits (or costs) are accruing from other distortions, namely indirect taxes, government consumption, terms of trade changes and exchange controls.

It is to be noted that the Efficiency Equation above is expressed in levels. But the CGE-B89 model results are in percentage changes. To evaluate the equation using the model results, which are in percentage changes, hence requires some manipulation of the right-hand-side terms of Equation (4.55) above. For example, the benefit from the reduction in involuntary Keynesian unemployment can be evaluated as follows:

$$\sum_{j=1}^{g} P_{vj}dX_{vj} = \frac{1}{100}\sum_{j=1}^{g} P_{vj}X_{vj} \sum_{j=1}^{g} B_{vj}x_{vj} \qquad \nu=1\text{(labour)} \tag{4.57}$$

where $\sum_{j=1}^{g} P_{vj}X_{vj}$ is the base-year aggregate value-added to labour (ν=1); $\sum_{j=1}^{g} B_{1j}x_{1j}$ is the percentage change in aggregate employment, B_{1j} being the industry j's share in the base-year aggregate value-added and x_{1j} being the percentage change in employment by industry j. The model simulations provide values for x_{1j}. Similarly, each of the right-hand-side terms, except ΔBOT, of Equation (4.55) can be evaluated.

Closing the model

The CGE-B89 model specified above and presented in Appendix A4.2 contains E(=$4g^2+34g+27$) equations involving V(=$6g^2+47g+32+t_2-t_1$) variables. As the number of variables exceeds the number of equations, D(=V-E) variables have to be set exogenously to solve the model. One of the advantages of the ORANI-type model is that it allows considerable freedom in choosing between exogenous and endogenous categories of variables even though any arbitrary selection of exogenous variables is not compatible with it (Dixon *et al.* 1982:5,148). The choice of exogenous variables is subject to the specific purpose of the model user. However, there are a few rules of thumb.

The structure of the model sometimes requires a set of variables to be exogenous. For example, the foreign currency prices of imports are externally determined. Another set of variables, identified as policy parameters, can be treated as exogenous. Examples are, trade taxes, production and consumption taxes, subsidies, and the official exchange rate. Some variables which are specified endogenously within the model, will require exogenous counterparts. For example, if the wage is to be determined endogenously, the level of employment has to be set exogenously, and vice versa. The relationship between the rate of return on capital and the capital stock of industry is similar. Thus the list of exogenous variables can be extended to obtain a sufficient number of exogenous variables in order to simulate the computable general equilibrium model. At least one nominal variable should be in the exogenous category.

The possible selections of exogenous variables characterizing different possible model closures are reported in Appendix A4.5.

The first variable in the list is the import prices in US dollars. The model can not explain the foreign supply of domestic imports. Foreign currency import prices are hence taken as exogenous.

The second exogenous variable are the powers of tariff (one plus tariff rate). The model does not contain equations specifying the endogenous determination of tariff protection. It is, however, possible to endogenize some or all tariffs to see the rates or level of tariff protection required to maintain the current or certain level of domestic production of the relevant sectors. Tariff and production levels can be swapped as exogenous variables.

Thirdly, all power of export taxes (ie. one minus the export tax rate) are placed in the exogenous category. To determine the rate of tax (or subsidy) to sustain a given level of exports of a particular commodity, export volumes can be swapped with the corresponding power of export tax (or subsidy) rate in the exogenous list. The model then allows exports to be exogenously determined and estimates the corresponding power of export tax (or subsidy) endogenously following a policy change.

As the model does not consider equations that can explain the mechanisms through which the Export Performance Benefit ratios are determined, these ratios are set exogenously.

The fixity of industry capital stocks characterizes the short run adjustment process. Note that investment can take place in the economy. However, short-run implies a time period not long enough to allow existing capital to be augmented. The fixity of sector specific capital has important implications for short-run supply elasticity. The larger the size of the fixed capital stocks in relation to the variable factors, the more inelastic will be the supply response of that industry. With fixed sector-specific capital, rates of return to industry capital are endogenous. For a long term adjustment process, a more plausible alternative is to set the rates of return exogenously, and the industry capital stocks endogenously. The rationale is that with the economic changes, changes in the relative profitability of different sectors would initially register as changes in relative rates of return to the capital used in each sector. The consequent capital reallocation among sectors would drive, in the long run, rates of return to the exogenously set levels.

Another set of exogenous variables are the powers of commodity taxes on final goods, investment goods and intermediate inputs. With exogenous setting of these variables the model can be simulated to explain the government budgetary position. If, however, the purpose of the simulation is to determine the rates of commodity and/or income taxes given the government budgetary position, then the tax variables can be swapped with the relevant variables in the endogenous list.

The next set of exogenous variables contains the official exchange rate and the aggregate money supply. The model contains two exchange rates: the official, and the Wage Earners' Scheme exchange rates. The official exchange rate is considered to be determined exogenously by the monetary authority of the government. The secondary Wage Earners' Scheme rate is, however, endogenously determined. The inclusion of the money market guarantees that the secondary exchange market clears. Recall that the foreign exchange premium, also called the Wage Earners' Scheme premium, is also defined in Equation (53) in Appendix A4.2. In fact, a number of selections of two exogenous variables among these four variables can be contemplated.

Either utility or the balance of trade deficit (BOT) can be chosen as exogenous. In CGE-B89 model, utility measures the welfare of the households. When utility is held fixed it implies that the hypothetical policy change induces changes in endogenous variables which are required to maintain the base-year welfare level. The fixed balance of trade often characterizes a long-run closure. Nevertheless, the balance of trade can be held fixed in the short run if the simulation experiment is designed for a one-period analysis of the permanent effects of a permanent policy change. A fixed balance of trade with no investment corresponds to a unitary marginal propensity to consume. An endogenously determined surplus (or a fall in the deficit) of the balance of trade corresponds to a marginal propensity to consume less than one. As the CGE-B89 model did not specify saving-investment relation of the economy, the surplus implies a waste for one-period analysis of permanent policy change. The simplest way to model a unitary marginal propensity to consume is to consider a fixed balance of trade.

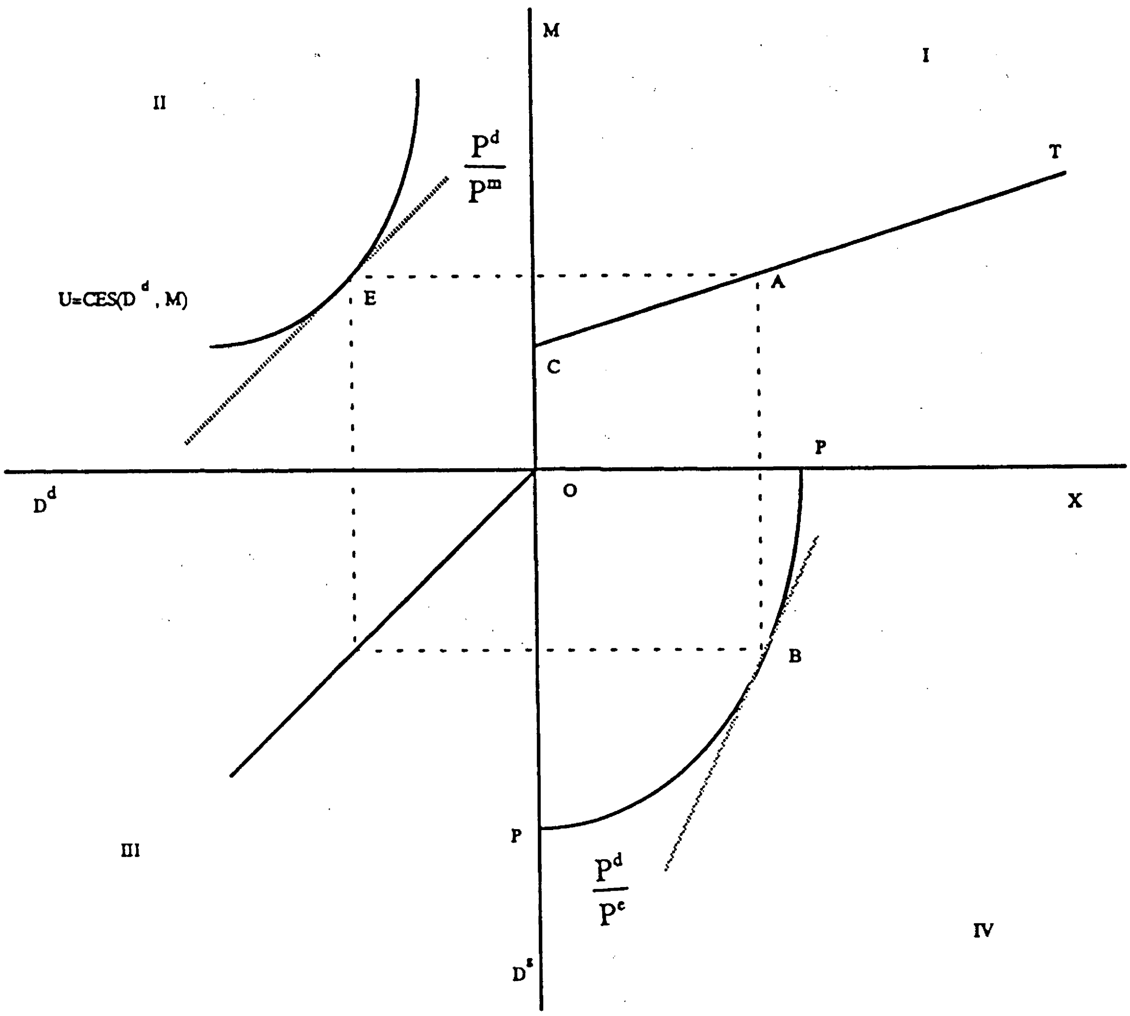
Next, industry and economy-wide wage shift variables are set exogenously. A zero value for the indexing parameter together with the exogenous setting of these shift terms (see Equation 52 in Appendix A4.2) sets the industry specific nominal wage rate as fixed. This allows the aggregate employment to be demand determined. Alternatively, the aggregate employment can be fixed exogenously. This will require the economy-wide wage shifter (i.e., the nominal wages) to be enodogenously determined.

The rest of the exogenous variables are various shift parameters and scarcity premium for some imports.

Appendix A4.1 The CGE-B89 model: a graphical presentation

The general equilibrium model, CGE-B89, can be illustrated using the single-sector differentiated-trade model in Figure A4.1. It is similar to that of de Melo and Robinson (1989). The four-quadrant diagram captures the essential features of CGE-B89, the computable general equilibrium model developed in Chapter 4. In quadrant I, the base-year current account situation is represented by the CAT line. The slope of the line measures the economy's international terms of trade and the intercept, OC, features the exogenous net foreign transfers (including remittances and foreign grants). This, in effect, measures the balance of trade deficits in the base-year. The concave production possibility frontier PP graphed in quadrant IV shows the Constant Elasticity of Transformation (CET) between domestically produced goods sold in the domestic markets (D^S) and domestic goods sold in the overseas markets (X). Quadrant III has a 45^o line simply indicating that domestic goods supplied to the domestic market are available for demand. It defines equilibrium in the domestic goods market, that is $D^S = D^d$. In quadrant II, the indifference curves, representing different levels of community welfare, are graphed. Such curves can also be viewed as the 'iso-good' curves generated from the domestic-import Constant Elasticity of Substitution (CES) aggregation function. Domestic demand for domestic goods are measured along the OD^d axis and demand for imports is measured along the OM axis. Initially, equilibrium is achieved with production at B, and consumption at E. The equilibrium price ratios, $\frac{P^d}{P^m}$ and $\frac{P^d}{P^e}$, are given by the slopes of the tangent to the indifference curve in quadrant II and the tangent to the production possibility frontier in quadrant IV. For convenience, purchasers' prices are not distinguished from the basic prices. In other words, no consumption taxes are assumed. Note that the basic prices for the CGE-B89 are defined in Equations 4.18, 4.20a-4.20c and 4.21 in Chapter 4. The relative prices based on these equations, in effect, define the inverse of the import exchange rate and the export exchange rate, respectively.

Figure A4.1 **Graphical presentation of equilibrium in an 'almost' small economy**



For various export exchange rates, the supply schedule of foreign exchange can be generated from quadrant IV. In equilibrium, domestic market always clears. The fixed money supply clears the secondary exchange market. Changes in exports affect the international terms of trade of the economy ('almost' small economy assumption). The fixed balance of trade determines imports at the new international terms of trade. Imports together with domestic supplies determine welfare level. If welfare is held constant instead, it will determine imports. Supply of exports, hence the terms of trade, together with imports determine the balance of trade of the economy in this case.

This simple general equilibrium model can be used to trace effects of various policy changes including devaluation, tariff reduction. In a general equilibrium, relative prices determine the production and demand. The domestic price responsiveness to exogenous changes in policies crucially depends on the trade shares and trade-substitution and transformation elasticities. de Melo and Robinson (1985) have derived expressions for the domestic price response elasticities with respect to changes in both export and import prices in domestic currency (sector subscripts are omitted to save on notation):

$$E^m = (\sigma - \varepsilon^d)S^m / [S^e\Omega + (1-S^e)\varepsilon^s + \varepsilon^d + S^m(\sigma-\varepsilon^d)] \quad (A6.1)$$

$$E^e = (\Omega - \varepsilon^s)S^e / [S^e\Omega + (1-S^e)\varepsilon^s + \varepsilon^d + S^m(\sigma-\varepsilon^d)] \quad (A6.2)$$

where E^m and E^e are the domestic price response elasticities with respect to the domestic currency price of imports and exports respectively; S^e is the value share of exports in total production; S^m is value share of imports in the total purchases; σ and Ω are the elasticities of substitution and transformation for the CES and CET trade aggregation functions; ε^s and ε^d are the price elasticity of supply of and demand for composite goods with $\varepsilon^s>0$ and $\varepsilon^d>0$.

Note that the change in the domestic currency price of imports and exports may originate from a change in their world prices, a change in the exchange rates, or a change in the trade taxes or subsidies. With differentiated trade, the small country assumption of trade theory implies that with given exchange rate and trade taxes the domestic currency prices of exports and imports are fixed. However, the price of domestically sold domestic goods is still autonomous and linked to the prices of exports and imports through the two types of trade aggregation functions (de Melo and Robinson 1985:105). With high trade substitution and transformation elasticities, the link is rather weak. In such a case, the domestic price of domestically sold good depends significantly on the import and export shares as well as on demand and supply conditions in the domestic market. Clearly, under the assumption of perfect substitution and transformation, ie. with $\sigma, \Omega \rightarrow \infty$, $E^e = E^m = 1$. The domestic price system loses its independence, and we are back to the traditional trade theoretic model. E^e and E^m can assume different values ranging from any negative to any positive values, depending on the different parameter configurations in Equations (A6.1) and (A6.2). With $\sigma > \varepsilon^d$, any decrease in the domestic currency import prices will cause a fall in the domestic price of the domestic good. With $\sigma > \varepsilon^d$ and $\Omega > \varepsilon^s$, any change in export prices will induce change in the domestic price of the domestically sold domestic good in the same direction.

Appendix A4.2 Equations of the CGE-B89 model (All variables except GB and B are in percentage change form)

Identifier	Equation	Subscript	Number	Description
I. Input demands				
(1)	$x^1_{isj} = z_j - \sigma^1_{ij}.(p^1_{isj} - \sum_{s=2}^{3} S^1_{isj}.p^1_{isj})$	i=1,..,g	$2g^2$	Demands for intermediate inputs
		j=1,..,g, s=2,3		by source
(2)	$x_{vj} = z_j - \sigma_{vj}.(p_{vj} - \sum_{v=1}^{2} S_{vj}.p_{vj})$	v=1,2	2g	Demands for primary factors
		j=1,...,g		
II. Transformation in production and supply of outputs				
(3)	$z_{js} = z_j + \sigma^T_j.(p^0_{js} - \sum_{s=1}^{2} H^0_{js}.p^0_{js})$	j=1,...,g	2g	Commodity supplies by industry to
		s=1,2		domestic and overseas markets
III. Final demands				
(4)	$x^3_{is} = x^3_i - \sigma^3_i.(p^3_{is} - \sum_{s=2}^{3} Q^3_{is}.p^3_{is})$	i=1,..,g	2g	Household demands for commodities by
		s=2,3		source
(5)	$x^3_i = \varepsilon_i.[\,u + \sum_{i=1}^{g} \delta_i\, p^3_i - p^3_i\,]$	i=1,..,g	g	Household demands for commodities
				undifferentiated by source
(6)	$p^3_i = \sum_{s=2}^{3} Q^3_{is}.p^3_{is}$	i=1,...,g	g	Price of commodities
				undifferentiated by source to household
(7)	$x^2_{ip} = k$	i=1,..,g	g	Private investment demands undifferentiated by source
(8)	$x^2_{isp} = x^2_{ip} - \sigma^2_{ip}.(p^2_{is} - \sum_{s=2}^{3} Q^2_{isp}.p^2_{is})$	i=1..,g	2g	Private investment demands
		s=2,3		by source

Appendix A4.2 Equations of the CGE-B89 model (*Continued*)

Identifier	Equation	Subscript	Number	Description
(9)	$x^5{}_i = a^r \cdot h^5{}_i + f^5{}_i$	i=1,...,g	g	Government consumption demands undifferentiated by source
(10)	$x^5{}_{is} = x^5{}_i - \sigma^5{}_i.(p^3{}_{is} - \sum_{s=2}^{3} Q^5{}_{is}.P^3{}_{is})$	i=1,...,g s=2,3	2g	Government consumption demands by source
(11)	$x^2{}_{iG} = k.h^2{}_i + f^2{}_i$	i=1,...,g	g	Government investment demands undifferentiated by source
(12)	$x^2{}_{isG} = x^2{}_{iG} - \sigma^2{}_{iG}.(p^2{}_{is} - \sum_{s=2}^{3} Q^2{}_{isG}.P^2{}_{is})$	i=1,...,g s=2,3	2g	Government investment demands by source
(13)	$x^2{}_{i(ch)} = a^r \cdot h^{ch}{}_i + f^{ch}{}_i$	i = 1,...,g	g	Inventory demands undifferentiated by source
(14)	$x^2{}_{is(ch)} = x^2{}_{i(ch)} - \sigma^2{}_{i(ch)}.(p^2{}_{is} - \sum_{s=2}^{3} Q^2{}_{is(ch)}.P^2{}_{is})$	i = 1,...,g s = 2,3	2g	Inventory demands by source
(15)	$p^e{}_i = -\gamma_i.x^4{}_i + f^4{}_i$	i=1,...,g	g	Export demands
IV. Zero pure profit conditions				
(16)	$\sum_{s=1}^{2} H^0{}_{is}.p^0{}_{is} = \sum_{i=1}^{g} \sum_{s=2}^{3} H^1{}_{isj}.p^1{}_{isj} + \sum_{v=1}^{2} H_{vj}.P_{vj}$	j=1,...,g	g	Zero pure profits in domestic production
(17)	$\pi = \sum_{i=1}^{g} \sum_{s=2}^{3} H^2{}_{isp}.P^2{}_{is} + \sum_{i=1}^{g} \sum_{s=2}^{3} H^2{}_{isG}.P^2{}_{is}$		1	Zero pure profits in capital creation
(18a)	$p^0{}_{i3} = p^m{}_{i3} + \phi_1 + t_i$	i=1,...,t_1	t_1	} Zero pure profits in importing
(18b)	$p^0{}_{i3} = p^m{}_{i3} + \phi_1 + S_{tax}(i).t_i + S_{prem}(i).sp_i$	i=(t_1+1),...,t_2	(t_2-t_1)	
(18c)	$p^0{}_{i3} = p^m{}_{i3} + \phi_1 + S_{tax}(i).t_i + S_{prem}(i).(\phi_2 - \phi_1)$	i=(t_2+1),...,g	(g-t_2)	
(19)	$p^e{}_i + S^1{}_i.\phi_2 + (1-S^1{}_i).\phi_1 + (S^1{}_i - SAL_i(1-S^1{}_i)).\alpha_i + es_i = p^0{}_{i1}$	i=1,...,g	g	Zero pure profits in exporting

Appendix A4.2 Equations of the CGE-B89 model (*Continued*)

Identifier	Equation	Subscript	Number	Description
V. Market Clearing				
(20)	$z_{i2} = \sum_{j=1}^{g} B^{1}{}_{i2j}.x^{1}{}_{i2j} + B^{2}{}_{i2p}.x^{2}{}_{i2p} + B^{2}{}_{i2G}.x^{2}{}_{i2G} + B^{2}{}_{i2(ch)}.x^{2}{}_{i2(ch)} + B^{3}{}_{i2}.x^{3}{}_{i2} + B^{5}{}_{i2}.x^{5}{}_{i2}$	i=1,...,g	g	Supply of goods for domestic market equals demand for domestic goods
(21)	$z_{i1} = x^{4}{}_{i}$	i=1,...,g	g	Export supply equals export demands
(22)	$l = \sum_{j=1}^{g} B_{vj}.x_{vj}$	v=1	1	Aggregate employment
(23)	$k_j = x_{vj}$	v=2, j=1,..,g	g	Equilibrium in capital market
(24)	$k = \sum_{j=1}^{g} B_{vj}.\ x_{vj}$	v=2	1	Aggregate capital stock
VII. External trade balance				
(25)	$x_{i3} = \sum_{j=1}^{g} B^{1}{}_{i3j}.x^{1}{}_{i3j} + B^{2}{}_{i3p}.x^{2}{}_{i3p} + B^{2}{}_{i3G}.x^{2}{}_{i3G} + B^{2}{}_{(i3)ch}x^{2}{}_{i3(ch)} + B^{3}{}_{i3}.x^{3}{}_{i3} + B^{5}{}_{i3}.x^{5}{}_{i3}$	i=1,..,g	g	Import volume
(26)	$m = \sum_{i=1}^{g} M_{i3}.(p^{m}{}_{i3} + x_{i3})$		1	Value of aggregate imports in foreign currency
(27)	$e = \sum_{i=1}^{g} E_{i1}.(p^{e}{}_{i} + x^{4}{}_{i})$		1	Value of aggregate exports in foreign currency
(28)	$100.\Delta B = A_1.m - A_2.e$		1	balance of trade deficit (in foreign currency)

Appendix A4.2 Equations of the CGE-B89 model (*Continued*)

Identifier	Equation	Subscript	Number	Description
VII. Monetary Sector				
(29)	$ms = gdp^p + gdp^r$		1	Supply equals demand for money
*VIII. Government Budget (real)**				
(30)	$r_t = \sum_{i=1}^{8} ST_i x_{i3}$		1	Tariff revenue
(31)	$r_1^{se} = \sum_{i=1}^{8} \sum_{s=2}^{3} \sum_{j=1}^{8} RR^1_{isj}.x^1_{isj}$		1	Revenue from tax on intermediate goods
(32)	$r_2^{se} = \sum_{i=1}^{8} \sum_{s=2}^{3} RR^2_{is}.[R^2_{isp}.x^2_{isp} + R^2_{isG}.x^2_{isG} + R^2_{isch}.x^2_{isch}]$		1	Revenue from tax on investment goods
(33)	$r_3^{se} = \sum_{i=1}^{8} \sum_{s=2}^{3} SSEX_{is}.[EX^3_{is}.x^3_{is} + EX^5_{is}.x5_{is}]$		1	Revenue from tax on consumption goods
(34)	$r_t^{exp} = \sum_{i=1}^{8} SET_i.x^4_i$		1	Revenue from export taxes
(35)	$r_{mis} = h^1_e.gdp^r$		1	Revenue from other sources
(36)	$g^r = R^1.r_t + R^2.r1^{se} + R^3.r_2^{se} + R^4.r_3^{se} + R^5.r_t^{exp} + R^6.r_{mis}$		1	Total revenue earnings (real)
(37)	$g^{e5} = \sum_{i=1}^{8} \sum_{s=2}^{3} S^5_{is}.x^5_{is}$		1	Government consumption expenditure (real)
(38)	$g^{e2} = \sum_{i=1}^{8} \sum_{s=2}^{3} S^2_{isG}.x^2_{isG}$		1	Government capital expenditure (real)

Appendix A4.2 Equations of the CGE-B89 model (*Continued*)

Identifier	Equation	Subscript	Number	Description
(39)	$g^{XPB} = \sum_{i=1}^{g} SRS_i \, x^4_i$		1	Subsidy to exporters under Export Performance Benefit Scheme
(40)	$g_{mis} = h^{1g}.gdp^r + f_g$		1	Other government expenditure
(41)	$g^e = GE_1.g^{e5} + GE_2.g^{e2}$ $GE_3.g^{XPB} + GE_4.g_{mis}$		1	Total government expenditure
(42)	$100\,\Delta GB = GE.g^e - GR.g^r$		1	Government borrowing requirement (real)
IX. Miscellaneous				
(43)	$p^1_{isj} = p^0_{is} + g^1_{isj}$	i=1,...,g j=1,..,g s=2,3	$2g^2$	Price of intermediate inputs by source
(44)	$p^2_{is} = p^0_{is} + g^2_{is}$	i=1,...,g s=2,3	2g	Price of investment goods by source
(45)	$p^3_{is} = p^0_{is} + g^3_{is}$	i=1,...,g s=2,3	2g	Price of consumption goods by source
(46)	$r_j = Q_j.(p_{vj} - \pi)$	j=1,...,g v=2	g	Industry rate of return
(47)	$p_{vj} = h^1_j.\varepsilon^3 + f^1 + f^1_j$	j=1,...,g v=1	g	Wage setting
(48)	$gdp^r = SG^3\sum_{i=1}^{g}\sum_{s=2}^{3} S^3_{is}.x^3_{is} + SG^{2p}\sum_{i=1}^{g}\sum_{s=2}^{3} S^2_{isp}.x^2_{isp}$ $+ SG^5\sum_{i=1}^{g}\sum_{s=2}^{3} S^5_{is}.x^5_{is} + SG^{2G}\sum_{i=1}^{g}\sum_{s=2}^{3} S^2_{isG}.x^2_{isG}$ $+ SG^{2ch}\sum_{i=1}^{g}\sum_{s=2}^{3} S^2_{is(ch)}.x^2_{(is)ch} + SG^4\sum_{i=1}^{g} S^4_{i1}\, x^4_i$ $- SG^m\sum_{i=1}^{g} M_{i3}.x_{i3}$		1	Real GDP

Appendix A4.2 Equations of the CGE-B89 model (*Continued*)

Identifier	Equation	Subscript	Number	Description
(49)	$gdp^p = SG^3 \sum_{i=1}^{g} \sum_{s=2}^{3} S^3_{is}.p^3_{is} + SG^{2p} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{isp}.p^2_{is}$		1	GDP deflator
	$+ SG^{2G} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{isG}.p^2_{is} + SG^5 \sum_{i=1}^{g} \sum_{s=2}^{3} S^5_{is}.p^3_{is}$			
	$+ SG^{2ch} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{is(ch)}.p^2_{(is)} + SG^4 \sum_{i=1}^{g} E_{i1}.(p^e_i + \phi_1)$			
	$- SG^m \sum_{i=1}^{g*} M_{i3}.(p^m_{i3} + \phi_1)$			
(50)	$gdp = gdp^r + gdp^p$		1	Nominal GDP
(51)	$a^r = RA^3 \sum_{i=1}^{g} \sum_{s=2}^{3} S^3_{is}.x^3_{is} + RA^{2p} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{isp}.x^2_{isp}$		1	Aggregate real absorption
	$+ RA^{2G} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{isG}.x^2_{isG} + RA^5 \sum_{i=1}^{g} \sum_{s=2}^{3} S^5_{is}.x^5_{is}$			
	$+ RA^{2ch} \sum_{i=1}^{g} \sum_{s=2}^{3} S^2_{is(ch)}.x^2_{(is)ch}$			
(52)	$\varepsilon^3 = \sum_{i=1}^{g} \sum_{s=2}^{3} S^3_{is}.p^3_{is}$		1	Consumers' price index
(53)	$c = \sum_{i=1}^{g} \sum_{s=2}^{3} S^3_{is}.x^3_{is}$		1	Real aggregate household consumption
(54)	$d = PRS_2.\phi_2 - PRS_2.\phi_1$		1	Exchange rate premium.
TOTAL			$4g^2 + 34g + 27$	

Note: *In real terms; that is, all government revenue and expenditure changes are at the base-year prices and tax (or subsidy) rates.

Appendix A4.3 **The CGE-B89 model variables (Except for GB and B, all are in percentage change form)**

Variables	Subscript Range	Number	Description
a^r		1	Real aggregate absorption
c		1	Real aggregate household consumption
d		1	Exchange rate premium
e		1	Foreign currency value of exports
es_i	i=1,...,g	g	One minus *ad valorem* export tax rate or one plus *ad valorem* export subsidy rate or power of export tax (or subsidy)
f^1		1	Economy-wide wage shifter
f^1_j	j=1,...,g	g	Industry-specific wage shifter
f^2_i	i=1,...,g	g	Shift term in government capital expenditure
f^4_i	i=1,...,g	g	Shift term in export demands
f^5_i	i=1,...,g	g	Shift term in government current expenditure
f_g		1	Shift term in other government expenditure
g^1_{isj}	i=1,...,g j=1,...,g s=2,3	$2g^2$	One plus (minus) *ad valorem* tax (subsidy) rate on sale of intermediate goods
g^2_{is}	i=1,...,g s=2,3	2g	One plus (minus) *ad valorem* tax (subsidy) rate on sale of investment goods
g^3_{is}	i=1,...,g s=2,3	2g	One plus (minus) *ad valorem* tax (subsidy) rate on sale of consumption goods
g^e		1	*Aggregate government expenditure
g^{e2}		1	*Government capital expenditure

Appendix A4.3 **The CGE-B89 model variables** (Except for GB and B, all are in percentage change form)

Variables	Subscript Range	Number	Description
g^{e5}		1	*Government consumption expenditure (real)
g^{r}		1	*Total government earnings (real)
g^{XPB}		1	*Subsidy under Export Performance Benefit (XPB) Scheme
g_{mis}		1	*Other expenditure
gdp		1	Nominal GDP
gdp^{p}		1	GDP deflator
gdp^{r}		1	Real GDP
k		1	Aggregate capital stock
k_j	j=1,...,g	g	Industry capital stock
l		1	Aggregate employment
m		1	Foreign currency value of imports
ms		1	Money supply
$p^0{}_{js}$	j=1,...,g s=1,2,3	3g	Basic prices of exports (s=1), domestic sales (s=2) and imports (s=3)
$p^1{}_{isj}$	i=1,...,g j=1,...,g s=2,3	$2g^2$	Purchasers' price of intermediate input for current production, by source
$p^2{}_{is}$	i=1,...,g s=2,3	2g	Prices paid for investment goods
$p^3{}_{i}$	i=1,...,g	g	Purchasers' price for consumer goods by type (not by source)
$p^3{}_{is}$	i=1,...,g s=2,3	2g	Purchasers' price for consumer goods by type and source

Appendix A4.3 **The CGE-B89 model variables** (Except for **GB** and **B**, all are in percentage change form)

Variables	Subscript Range	Number	Description
p^e_i	i=1,...,g	g	Foreign currency export prices (*fob*)
p^m_{i3}	i=1,...,g	g	Foreign currency price of imports (*cif*)
p_{vj}	v=1,2 j=1,...,g	2g	Price of primary factors (v=1, labour; v=2, capital) used in industry *j*
r_1^{se}		1	*Revenue from taxes on intermediate goods
r_2^{se}		1	*Revenue from taxes on investment goods
r_3^{se}		1	*Revenue from taxes on consumption goods
r_j	j=1,...,g	g	Industry rate of return
r^t		1	*Tariff revenue
r_t^{exp}		1	*Revenue from export taxes
r_{mis}		1	*Revenue from other sources
sp_i	$i=(t_1+1),..,t_2$	t_2-t_1	Scarcity premium for some imports
t_i	i=1,...,g	g	One plus *ad valorem* tariff rate (power of tariff)
u		1	Household utility (util=taka 1)
x_{i3}	i=1,...,g	g	Total import volume of good *i*
x^1_{isj}	i=1,...,g j=1,...,g s=2,3	$2g^2$	Intermediate input demand for good *i* from source *s*, by industry *j*
x^2_{iG}	i=1,...,g	g	Government (G) investment demand undifferentiated by sources
x^2_{ip}	i=1,...,g	g	Private (p) investment demands undifferentiated by sources
x^2_{isG}	i=1,...,g s=2,3	2g	Government (G) investment demands by sources

Appendix A4.3 **The CGE-B89 model variables** (Except for GB and B, all are in percentage change form)

Variables	Subscript Range	Number	Description
x^2_{isp}	i=1,...,g s=2,3	2g	Private (p) investment demands by sources
$x^2_{i(ch)}$	i=1,...,g	g	Inventory (ch) demands undifferentiated by source
$x^2_{is(ch)}$	i=1,...,g s=2,3	2g	Inventory (ch) demands by source
x^3_i	i=1,...,g	g	Household demands for commodities by type, undifferentiated by source
x^3_{is}	i=1,...,g s=2,3	2g	Household demands for commodities by type and by source
x^4_i	i=1,...,g	g	Export demands
x^5_i	i=1,...,g	g	Government current expenditure on good *i*, undifferentiated by source
x^5_{is}	i=1,...,g s=2,3	2g	Government current expenditure on good *i*, by source
x_{vj}	v=1,2 j=1,...,g	2g	Primary factor demand in industry *j* (v=1, labour; v=2, capital)
z_j	j=1,...,g	g	Industry activity level
z_{js}	j=1,..,g s=1,2	2g	Supply of individual commodities for overseas (s=1) and domestic (s=2) markets
α_ι	i=1,...,g	g	XPB entitlement rates (percentage change in R_i)
ε^3		1	Consumers price index
ϕ_1		1	Official exchange rate
ϕ_2		1	Secondary market exchange rate

Appendix A4.3 **The CGE-B89 model variables** (Except for GB and B, all are in percentage change form)

Variables	Subscript Range	Number	Description
π		1	Unit cost of capital creation
ΔB		1	Change in the balance of trade deficit in foreign currency (not in percentage change form)
ΔGB		1	*Government borrowing requirement (real, and not in percentage change form)

Total $6g^2 + 47g + 32 + t_2 - t_1$

Note: * In real terms; that is, the value is evaluated at the base-year prices and tax (subsidy) rates.

Appendix A4.4 Coefficients and parameters of the CGE-B89 model

Equation	Coeff	Range	Description	Relevant data files and method of computation
(1)	σ^1_{ij}	i=1,...,g j=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* for use in current production in industry *j*.	Elasticity files
	S^1_{isj}	i=1,...,g j=1,...,g s=2,3	Share of purchaser price value of good *i* from source s in industry *j*'s total use of i as input to current production	Input-output data files. The *ij*th elements of matrices A, H, N_{tD}, N_{tM} are summed. Next the *ij*th element of A and N_{tD} are summed. S^1_{i2j} is the ratio of the second sum to the first, and $S^1_{i3j} = 1 - S^1_{i2j}$.
(2)	σ_{vj}	j=1,...,g v=1,2	CES parameter reflecting degree of substitutability between primary factors.	Elasticity files
	S_{vj}	j=1,...,g v=1,2	Share of primary factor *v* in total factor payment in industry *j*.	Input-output data files. S_{1j} (or S_{2j}) is the ratio of *j*th element in U (or V) to sum of *j*th elements in matrices U and V.
(3)	σ^T_j	j=1,...,g	CET parameter reflecting the degree of transformation between domestic sales and exports.	Elasticity files
	H^0_{js}	j=1,...,g s=1,2	Share of domestic sale (or export) in total sale by industry *j*	Input-output data files. H^0_{j2} is the ratio of the *i*th element of $(\sum_{j=1}^{g} A_j+B+C+D+E+F)$ to the *i*th element of $(\sum_{j=1}^{g} A_j+B+C+D+E+F+G)$, and $H^0_{j1} = 1 - H^0_{j2}$.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(4)	σ^3_i	i=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* consumed by household.	Elasticity files.
	Q^3_{is}	i=1,...,g s=2,3	Share of purchaser price value of good *i* from source *s* in total household consumption of good *i*.	Input-output data files. First, the *i*th elements in B, I, O_{tD}, and O_{tM} are added. Next the *i*th elements of only B and O_{tD} are summed. Q^3_{i2} is the ratio of the second sum to the first, and Q^3_{i3} is equal to $(1 - Q^3_{i2})$.
(5)	ε_i	i=1,...,g	One minus the ratio of the committed to total consumption expenditure by household	Miscellaneous parameter file.
	δ_i	i=1,...,g	Expenditure-share weighted expenditure elasticities	Miscellaneous parameter file
(8)	σ^2_{iP}	i=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* for use by household for investment.	Elasticity files
	Q^2_{isP}	i=1,...,g s=2,3	Share of purchaser price value of good *i* from source *s* in total household purchase of *i* for investment.	Input-output data files. First, the *i*th elements in C, J, P_{tD}, and P_{tM} are added. Next the *i*th elements of only C and P_{tD} are summed. Q^2_{i2P} is the ratio of the second sum to the first. Q^2_{i3P} is equal to $(1 - Q^2_{i2P})$.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(9)	h^5_i	i=1,...,g	Indexing parameter in government consumption demand for good *i*.	Default value is 0.00.
(10)	σ^5_i	i=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* used by government for final consumption.	Elasticity files
	Q^5_{is}	i=1,...,g s=2,3	Share of purchaser price value of good *i* from source *s* in total government final consumption of good *i*.	Input-output data files. First, the *i*th elements in E, L, R_{tD}, and R_{tM} are added. Next the *i*th elements only E, and R_{tD} are summed. Q^5_{i2} is the ratio of the second sum to the first. $Q^5_{i3} = 1 - Q^5_{i2}$
(11)	h^2_i	i=1,...,g	Indexing parameter in government investment demand function.	Default value is 0.00.
(12)	σ^2_{iG}	i=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* used by government for investment.	Elasticity files
	Q^2_{isG}	i=1,...,g s=2,3	Share of purchaser price value of good *i* from source source *s* in total government purchase of *i* for investment.	Input-output data files. First, the *i*th elements in F, M, S_{tD}, and S_{tM} are added. Next the *i*th elements of F and S_{tM} are summed. Q^2_{i2G} is the ratio of the second sum to the first. Q^2_{i3G} is equal to $(1 - Q^2_{i2G})$.
(13)	h^{ch}_i		Indexing parameter in inventory demands	Default value is 0.00

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(14)	$\sigma^2_{i(ch)}$	i=1,...,g	Elasticity of substitution between domestic and foreign sources of good *i* for inventory demand.	Elasticity files.
	$Q^2_{is(ch)}$	i=1,...,g s=2,3	Share of purchaser price value of good *i* from source source *s* in total inventory demand for good *i*.	Input-output data files. $Q^2_{i2(ch)}$ is the ratio of the ith element of $(D+Q_{tD})$ to the ith element of$(D+K+Q_{tD}+Q_{tM})$. $Q^2_{i3(ch)} = 1 - Q^2_{i2(ch)}$.
(15)	γ_i	i=1,...,g	Reciprocal of the foreign elasticity of demand for Bangladesh export of good *i*.	Elasticity files (see pp.162-3)
(16)	H^0_{is}	i=1,...,g s=1,2	see Equation 3	
	H^1_{isj}	i=1,...,g s=2,3 j=1,2,..,g	Share of purchaser-price value of input *i* from source *s* in total cost of industry *j*	Input-output data files. First column sum of elements in A, H, N_{tD}, N_{tM}, U, and V.is done to get the total cost of industry *j*. Next the *ij*th elements of A and N_{tD} are added. Dividing the second sum by the first gives H^1_{i2j}. H^1_{i3j} is the sum of *ij*th elements of Hand N_{tM} expressed as a fraction of total cost of industry *j*.
	H_{vj}	v=1,2 j=1,...,g	Share of primary factor *v* in total cost of industry *j*.	Input-output data files. H_{1j} (or H_{2j}) is the *j*th element in vector U (or V) divided by the total cost of industry j. computed above.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(17)	H^2_{isP}	i=1,...,g s=2,3	Share of purchaser-price value of good *i* from source *s* bought by household in total cost of capital creation in the economy.	Input-output data files. First all the elements in C, J, P_{tD}, P_{tM}, F, M, S_{tD}, and S_{tM} are added to get the total cost of capital creation in the economy. Next the *i*th element of C and P_{tD} are added together. Dividing the second sum by the first gives H^1_{i2P}. H^1_{i3P} is the ith element of $(J+P_{tM})$ expressed as a fraction of total cost of capital creation.
	H^2_{isG}	i=1,...,2 s=2,3	Share of purchaser-price value of good *i* from source *s* bought by government in total cost of capital creation in the economy.	Input-output data files. The *i*th elements in F and $S_{tD}$are added. Dividing the sum by the total cost of capital creation gives H^2_{i1G}. H^2_{i2G} is the sum of M and S_{tM} expressed as a fraction of total cost of capital creation.
(18)	$S_{tax}(i)$	i=1,..,g	Ratio of only tariff inclusive- to tariff plus premium inclusive value of imports of good *i*	Input-output files. The sum of the *i*th elements of matrices H, I, J, K, L, and M gives the both tariff and premium inclusive value of ith import. $S_{tax}(i)$ is the ratio of *i*th element of (H+I+J+K+L+M-Z2) to the first sum.
	$S_{prem}(i)$	i=1,..,g	Ratio of only premium inclusive value of imports to both tariff and premium inclusive value of imports. of good *i*	Input-output files. The ith element of (H+I+J+K+L+M-Z1) defines the only premium inclusive value of ith import. $S_{prem}(i)$ is the ratio of this ith element to the both tariff and premium inclusive value of ith import of good i defined above.
(19)	S^1_i	i=1,...,g	The base-year value of $R_i.E_2/[R_i.E_2 + (1-R_i).E_1]$	Miscellaneous data files. Recall that R_i is the Export Promotion Bonus entitlement rates, E_2 is the secondary exchange rate, and E_1 is the official exchange rate. Table 5.1 in Chapter 5 gives the Bonus rates.
	SAL_i	i=1,...,g	The base-year value of Ri/(1-Ri)	Table 5.1 in Chapter 5.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(20)	B^1_{i2j}	i=1,...,g j=1,...,g	Share in the total domestic sales of the ith domestic good used as input in the current production by industry *j*.	Input-output data files. B^1_{i2j} is the *ij*th element of A divided by the *i*th row of (A+B+C+D+E+F+G), the total direct uses of the *i*th domestic good plus the *i*th scarcity premium.
	B^2_{i2P}	i=1,...,g	Share of the total domestic sales of domestic good *i* absorbed by household for investment.	Input-output files. B^2_{i2P} is the *i*th element of C divided by the sum of total direct uses of the *i*th domestic good.
	B^2_{i2G}	i=1,...,g	Share of the total domestic sales of domestic good *i* absorbed by government for investment.	Input-output files. B^2_{i2G} is the *i*th element of F divided by sum of the total direct uses of the *i*th domestic good
	$B^2_{i2(ch)}$	i=1,...,g	Share of the total domestic sales of domestic good *i* absorbed as inventory.	Input-output files. B^2_{i2ch} is the *i*th element of D divided by sum of the total direct uses of the *i*th domestic good
	B^3_{i2}	i=1,...,g	Share of the total domestic sales of domestic good *i* absorbed by household for consumption.	Input-output files. B^3_{i2} is the *i*th element of B divided by sum of the total direct uses of the *i*th domestic good
	B^5_{i2}	i=1,...,g	Share of the total domestic sales of domestic good *i* absorbed by government for consumption.	Input-output files. B^5_{i2} is the *i*th element of E divided by sum of the total direct uses of the *i*th domestic good
(22)	B_{vj}	j=1,...,g v=1	Share of industry *j*'s labour in total labour employment.	Input-output files. It is the *j*th element in U divided by row sum of vector U.
(24)	B_{vj}	j=1,...,g v=2	Share of industry *j*'s capital use in total capital use of the economy	Input-output files. It is the *j*th element in V divided by sum of all the elements in V.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(25)	$B^1{}_{i3j}$	i=1,...,g j=1,...,g	Share of the total of *i*th import at the importers' price absorbed by *j*th industry as an input into current production.	Input-output data files. The *ij*th element of H divided by the *i*th row of (H+I+J+K+L+M), the total import of good *i*.
	$B^2{}_{i3P}$	i=1,...,g	Share of the total of *i*th import at the importers' price absorbed by household for investment.	Input-output files. The ith element of J divided by the total import of good *i*.
	$B^2{}_{i3G}$	i=1,...,g	Share of the total of *i*th import at the importers' price absorbed by government for investment.	Input-output files. *i*th element of M divided by the total sales of imported good *i*.
	$B^2{}_{i3(ch)}$	i=1,...,g	Share of the total of *i*th import at the importers' price absorbed as inventory.	Input-output files. ith element of K divided by the total sales of imported good i.
	$B^3{}_{i3}$	i=1,...,g	Share of the total of *i*th import at the importers' price absorbed by household for consumption.	Input-output files. *i*th element of I divided by the total sales of imported good i.
	$B^5{}_{i3}$	i=1,...,g	Share of the total of *i*th import at the importers, price absorbed by government for consumption.	Input-output files. *i*th element of L divided by the total sales of imported good i.
(26)	M_{i3}	i=1,...,g	Share of good *i* in foreign currency cost of total imports	Input-output data files. The domestic currency *cif* value of total imports is given by the sum of all elements in H, I, J, K, L, M, $-Z_1$, and $-Z_2$. M_{i3} is the ratio of ith element in $(H+I+J+ K+L+M-Z_1-Z_2)$ to total *cif* domestic currency value of imports. The domestic currency based ratio is the same as foreign currency based ratio

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(27)	E_{i1}	i=1,...,g	Share of total export earnings accounted for by exports of good *i*.	Input-output data files. The total *fob* export earnings is given by the sum of all elements in G, T_{tX} and $-T_{tX+1}$. E_{i1} is the ratio of the *i*th element of $(G+T_{tX}-T_{tX+1})$ to total export earnings. The ratio is equivalent to foreign currency based ratio.
(28)	A_1		Base-year *cif* value of aggregate imports in US$.	US$ 4280.43 million.
	A_2		Base-year *fob* value of aggregate exports in US$.	US$967.47 million.
(30)	ST_i	i=1,...,g	Share of tariff on *i*th import in total tariff revenue.	Input-output data files. ST_i is the ratio of *i*th element in Z_1 to the sum of all the elements in Z_1.
	S_i	i=1,...,g	Ratio of tariff inclusive value of *i*th imports to tariff . on ith import.	Input-output data files. S_i is the ratio of ith element in $(H+I+J+K+I+M-Z_2)$ to the ith element in Z_1.
(31)	RR^1_{isj}	i=1,...,g j=1,...,g s=2,3	Share of tax on *i* from source *s* paid by industry *j* in aggregate taxes on intermediate inputs.	Input-output data files. ijth element of N_{tD} for s=2 (or N_{tM} if s=3) divided by the sum of all elements in $(N_{tD}+N_{tM})$.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(32)	RR^2_{is}	$i=1,\ldots,g$ $s=2,3$	Share of tax on *i* from source s paid by household and government on capital goods in aggregate taxes on capital goods.	Input-output data files. *i*th element of $P_{tD}+Q_{tD}+S_{tD}$ for s=2 (or $P_{tM}+S_{tM}$ if s=3) divided by the sum of all elements in $(P_{tD}+Q_{tD}+S_{tD}+P_{tM}+Q_{tM}+S_{tM})$.
	R^2_{isP}	$i=1,\ldots,g$ $s=2,3$	Household share in total tax on *i* from source *s* on capital goods.	Input-output data files. *i*th element of P_{tD} for s=2 (or P_{tM} for s=3) divided by the *i*th element in $P_{tD}+Q_{tD}+S_{tD}$ for s=2 (or $P_{tM}+Q_{tM}+S_{tM}$ for s=3).
	R^2_{isG}	$i=1,\ldots,g$ $s=2,3$	Government share in total tax on *i* from source *s* on capital goods.	Input-output data files. *i*th element of S_{tD} for s=2 (or S_{tM} for s=3) divided by the ith element in $P_{tD}+Q_{tD}+S_{tD}$ for s=2 (or $P_{tM}+Q_{tM}+S_{tM}$ for s=3).
	R^2_{isch}	$i=1,\ldots,g$ $s=2,3$	Inventory share in total tax on *i* from source *s* on capital goods.	Input-output data files. *i*th element of Q_{tD} for s=2 (or Q_{tM} for s=3) divided by the *i*th element in $P_{tD}+Q_{tD}+S_{tD}$ for s=2 (or $P_{tM}+S_{tM}$ for s=3).
(33)	$SSEX_{is}$	$i=1,\ldots,g$ $s=2,3$	Share of consumption tax on *i* from source *s* in total consumption tax.	Input-output data files. Sum of all elements in O_{tD}, O_{tM}, R_{tD} and R_{tM} gives the total of consumption tax. $SSEX_{i2}$ is obtained by dividing *i*th element in $O_{tD}+R_{tD}$ by the total consumption tax. $SSEX_{i3}$ is the ratio of *i*th element in $O_{tM}+R_{tM}$ to the total consumption tax.
	EX^3_{is}	$i=1,\ldots,g$ $s=2,3$	Share of consumption tax on good *i* from source *s* in total tax on *i* from source *s* paid by household	Input-output data files. EX^3_{i2} is *i*th element in O_{tD} divided by *i*th element in $(O_{tD}+R_{tD})$. EX^3_{i3} is the *i*th element in O_{tM} divided by *i*th element in $(O_{tM}+R_{tM})$.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
	EX^5_{is}	i=1,...,g s=2,3	Share of consumption tax on *i* from source s purchased by government in total consumption tax on i from s.	Input-output data files. EX^5_{i2} is *i*th element in R_{tD} divided by ith element in $(O_{tD}+R_{tD})$. EX^5_{i3} is the ith element in R_{tM} divided by ith element in $O_{tM}+R_{tM}$.
(34)	SET_i	i=1,...,g	Share of tax on exported good *i* in aggregate export taxes	Input-output data files. *i*th element of T_{tX} divided by the sum of all elements in T_{tX}.
(35)	h^1_e		indexing parameter	Default value is 0.00
(36)	R^1		Share of tariff revenue in aggregate government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
	R^2		Share of commodity taxes on intermediate inputs in total government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
	R^3		Share of commodity taxes on capital goods in aggregate government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
	R^4		Share of commodity taxes on consumption goods in aggregate government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
	R^5		Share of export tax in total government revenue	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
	R^6		Share of other revenue in aggregate government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(37)	S^5_{is}	i=1,...,g s=2,3	Share of aggregate government consumption accounted for by consumption of good *i* from source *s*.	Input-output data files. *i*th element of $E+R_{tD}$ for s=2 ($L+R_{tM}$, for s=3) divided by sum of all elements of $(E+L+R_{tD}+R_{tM})$.
(38)	S^2_{isG}	i=1,...,g s=2,3	Share of aggregate public investment accounted for by investment in good *i* from source *s*.	Input-output data files. *i*th element of $F+S_{tD}$ for s=2 ($M+St_M$ for s=3) divided by sum of all elements of $(F+M+S_{tD}+S_{tM})$.
(39)	SRS_i	i=1,...,g	Share of subsidy under the XPB Scheme on export of *i* in aggregate subsidy under the XPB Scheme.	Input-output data files. *i*th element in T_{tX+1} divided by the sum of all elements in T_{tX+1}.
(40)	h^1g		Indexing parameter to link government miscellaneous expenditure with real GDP.	Default value 0.00.
(41)	GE_1		Share of government current consumption expenditure in total government expenditure.	Government budget file. Calculated directly from government expenditure account in Table 4.2 of Chapter 4.
	GE_2		Share of government capital expenditure in total government expenditure.	Government budget file. Calculated directly from government expenditure account in Table 4.2 of Chapter 4.
	GE_3		Share of subsidy under the XPB Scheme in aggregate government expenditure.	Government budget file. Calculated directly from government expenditure account in Table 4.2 of Chapter 4..

Appendix A4.4 Coefficients and parameters of the CGE-B89 model *(continued)*

Equation	Coeff	Range	Description	Relevant data files and method of computation
	GE_4		Share of miscellaneous expenditure in aggregate government expenditure.	Government budget file. Calculated directly from government expenditure account in Table 4.2 of Chapter 4.
(42)	GE		Base-year aggregate government expenditure.	Government budget file. Calculated directly from government expenditure account in Table 4.2 of Chapter 4.
	GR		Base-year aggregate government revenue.	Government budget file. Calculated directly from government revenue account in Table 4.1 of Chapter 4.
(43)	Q_j	j=1,...,g	Ratio of gross (before depreciation) to net (after depreciation) rate of return in industry *j*.	Miscellaneous parameter files.
(44)	h^1_j	j=1,...,g	Indexing parameter linking nominal wage with the CPI.	User specific. Default value is 0.00.
(48)	SG^3		Share of aggregate household consumption in real GDP at market prices.	Input-output data files. Sum of all elements in $(B+I+O_{tD}+O_{tM})$ divided by GDP, where GDP is $(B + I + O_{tD} + O_{tM} +$ $C + J + P_{tD} + P_{tM} +$ $D + K + Q_{tD} + Q_{tM} +$ $E + L + R_{tD} + R_{tM} +$ $F+M+S_{tD}+S_{tM}$ $G + T_{tX} - T_{tX+1} -$ $(H + I + J + K + L+M - Z_1 - Z_2))$.
	S^3_{is}	i=1,..,g s=2,3	Share of aggregate household consumption accounted for by consumption of good *i* from source *s*.	Input-output data files. *i*th element of $B+O_{tD}$ for s=2 $(I+ O_{tM}$ if s=3) divided by $(B + O_{tD} + I + O_{tM})$.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
	$SG^2{}_P$		Share of aggregate private investment in real GDP at market prices.	Input-output data files. Sum of all elements in (C + J+P_{tD} + P_{tM}) divided by nominal GDP defined above.
	$S^2{}_{isP}$	i=1,...,g s=2,3	Share of aggregate private investment accounted for by purchase of good *i* from source *s*.	Input-output data files. *i*th element of C + P_{tD} for s=2 (J + P_{tM} if s=3) divided by (C + J + P_{tD} + P_{tM}).
	SG^5		Share of government total current consumption in real GDP at market prices.	Input-output data files. Sum of all elements in (E + L + R_{tD}+R_{tM}) divided by nominal GDP.
	$SG^2{}_G$		Share of aggregate public investment in real GDP at market prices.	Input-output data files. Sum of all elements in (F + M+S_{tD}+S_{tM}) divided by nominal GDP.
	$SG^2{}_{(ch)}$		Share of aggregate inventory demand in real GDP at market prices.	Input-output data files. Sum of all elements in (D+K Q_{tD}+Q_{tM}) divided by nominal GDP.
	$S^2{}_{is(ch)}$	i=1,...,g s=2,3	Share of aggregate inventory demand accounted for by purchase of good *i* from source *s*.	Input-output data files. *i*th element of D+Q_{tD} for s=2 (K+Q_{tM} if s=3) divided by (D+K+Q_{tD}+Q_{tM}).
	SG^4		Share of aggregate export in real GDP at market prices.	Input-output data files. Sum of all elements in G + T_{tX} - T_{tX+1} divided by nominal GDP.
	SG^m		Share of aggregate import in real GDP at market prices.	Input-output data files. Sum of all elements in (H + I + J + K + L+M - Z_1 - Z_2) divided by GDP.

Appendix A4.4 **Coefficients and parameters of the CGE-B89 model *(continued)***

Equation	Coeff	Range	Description	Relevant data files and method of computation
(51)	RA^3		Share of aggregate household consumption in total real absorption at market prices.	Input-output data files. sum of all elements in $(B + I + O_{tD} + O_{tM})$ divided by total absorption. Total absorption is given by the sum of all elements in $(B + I + O_{tD} + O_{tM} +$ $C + J + P_{tD} + P_{tM} +$ $D + K + Q_{tD} + Q_{tM} +$ $E + L + R_{tD} + R_{tM} +$ $F + M + S_{tD} + S_{tM})$
	$RA^2{}_P$		Share of private investment in aggregate absorption.	Input-output data files. *i*th element of $(C + J + P_{tD} + P_{tM})$ divided by total absorption.
	$RA^2{}_G$		Share of public investment in aggregate absorption.	Input-output data files. *i*th element of $(F + M + S_{tD} + S_{tM})$ divided by total absorption.
	RA^5		Share of aggregate government consumption in total absorption.	Input-output data files. sum of all elements in $(E + L + R_{tD} + R_{tM})$ divided by total absorption.
	$RA^2{}_{(ch)}$		Share of aggregate inventory demand in aggregate absorption.	Input-output data files. *i*th element of $(D+K+Q_{tD}+Q_{tM})$ divided by total absorption.
(52)	$S^3{}_{is}$	i=1,2,...,g s=2,3	see Equation 48	
(53)	$S^3{}_{is}$	i=1,2,...,g s=2,3	see Equation 48	
(54)	PRS_2		Reciprocal of the exchange rate premium for base-year	42.74

Appendix A4.5 List of exogenous variables (except for ΔB all variables are in percentage change form)

Variables	Subscript range	Number	Description
p^m_{i3}	i=1,...,g	g	Foreign currency price of imports
t_i	i=1,...,g	g	One plus *ad valorem* tariff rate
es_i	i=1,...,g	g	One plus (minus) *ad valorem* export tax (subsidy) rate
α_i	i=1,...,g	g	XPB entitlement rates
k_j (or r_j)	j=1,...,g	g	Industry capital stock (or industry rate of return)
g^3_{is}	i=1,...,g s=2,3	2g	One plus (minus) *ad valorem* tax (subsidy) rate on sale of consumption goods
g^2_{is}	i=1,...,g s=2,3	2g	One plus (minus) *ad valorem* tax (subsidy) rate on sale of investment goods
g^1_{isj}	i=1,...,g s=2,3 j=1,...,g	$2g^2$	One plus (minus) *ad valorem* tax (subsidy) rate on sale of intermediate goods
ϕ_1 (or d)		1	Official exchange rate (or the exchange premium rate)
ms		1	Domestic money supply
u (or ΔB)		1	Utility (or balance of trade deficit)
f_1 (or l)		1	Economy-wide wage shifter (or aggregate employment)
f^1_j	j=1,...,g	g	Industry wage shifter
f^5_i	i=1,...,g	g	Shift term in government current expenditure
f^2_i	i=1,...,g	g	Shift term in government capital expenditure
f^4_i	i=1,...,g	g	Shift term in export demand
f_g		1	Shift term in other government expenditure
sp_i	$i=(t_1+1),..,t_2$	t_2-t_1	Scarcity premium for some imports

Total **$= 2g^2 + 13g + 5 + (t_2 - t_1)$**

Appendix A4.6 Derivation of the percentage change form of Hicksian demands, importers' and exporters' prices

(1) Transformation of Stone-Geary utility function and derivation of the percentage change form of Hicksian demands

The direct utility function that provides the Linear Expenditure System (LES) for the household is:

$$U(X^3) = \prod_{i=1}^{g} (X_i^3 - \theta_i)^{\delta_i} \qquad (A4.6.1)$$

where θ_i is the minimum required consumption or committed consumption of good i with $\theta_i>0$; δ_i is the ith parameter with $\delta_i >0$ for all i, and $\sum_{i=1}^{g} \delta_i = 1$; X^3 is the vector of Armington composite commodity X_i^3 defined as

$$X_i^3 = CES(X_{is}^3) \qquad i=1,2,..,g; \quad s=2,3 \qquad (A4.6.2)$$

The indirect utility function associated with (A4.6.1) is:

$$V(P,C) = \frac{C - \sum_{i=1}^{g} P_i^3.\theta_i}{\delta_0 \prod_{i=1}^{g} P_i^{3\delta_i}} \qquad (A4.6.3)$$

where P_i^3 is the price of ith composite commodity; C is the total expenditure; and $\delta_0 = \frac{1}{\prod_{i=1}^{g} \delta_i^{\delta_i}}$. The indirect utility function can be transformed to write:

$$\tilde{V}(P,C) = V(P,C)\, [\delta_0 \prod_{i=1}^{g} \bar{P}_i^{3\delta_i}] = [C - \sum_{i=1}^{g} P_i^3.\theta_i].\prod_{i=1}^{g} \left[\frac{\bar{P}_i^3}{P_i^3}\right]^{\delta_i} \qquad (A4.6.4)$$

where $\overline{P}_i^3$ is the base year price of good *i*. It is easy to verify the unitary marginal utility of expenditure associated with (A4.6.4) for $(\overline{P}_i^3 = P_i^3)$, ie. $\frac{\delta.\tilde{V}(P,C)}{\delta.C} = 1$.

The relevant expenditure function that can be derived from (A4.6.4) is:

$$C(P,U) = \tilde{V}(P,C).\prod_{i=1}^{g} \left[\frac{P_i^3}{\overline{P}_i^3}\right]^{\delta_i} + \sum_{i=1}^{g} P_i^3\theta_i \qquad \text{(A4.6.5)}$$

or equivalently,

$$C(P,U) = V(P,C).\prod_{i=1}^{g} P_i^{3\delta_i} + \sum_{i=1}^{g} P_i^3\theta_i \qquad \text{(A4.6.6)}$$

The Hicksian demand function for the *i*th composite commodity, from the Shephard's lemma, is:

$$X_i^3 = \theta_i + U\frac{\delta_i}{P_i^3}\prod_{i=1}^{g} P_i^{3\delta_i} \qquad \text{(A4.6.7)}$$

In the percentage change form, Equation (A4.6.7) can be written as:

$$x^3{}_i = \varepsilon_i.[u + \sum_{i=1}^{g} \delta_i p_i^3 - p_i^3] \qquad \text{(A4.6.8)}$$

where ε_i is the ratio of the supernumerary expenditure to the total expenditure on the *i*th commodity, that is

$$\varepsilon_i = \frac{X_i^3 P_i^3 - \theta_i P_i^3}{X_i^3 P_i^3}$$

(2) Derivation of the linear percentage change form of Equation (4.20c)

The zero profit condition in importing is:

$$P^0_{i3} = P^m_{i3}.E_2 + P^m_{i3}.E_1.T^*_i \qquad i=1,2,..g \qquad (A4.6.9)$$

where P^0_{i3} is the importers' price for the ith imported good, P^m_{i3} is the *cif* foreign currency price, E_2 and E_1.are the WES and official exchange rates respectively, and T^*_i is the *ad valorem* rate of tariffs.

Rearranging (A4.6.9) is obtained

$$P^0_{i3} = P^m_{i3}.E_1(1 + T^*_i) + P^m_{i3}.(E_2 - E_1.) \qquad (A4.6.10)$$

Log differentiation of (A4.6.10) gives:

$$p^0_{i3} = A_i\, p^m_{i3} + A_i\phi_1 + A_i\, t_i + B_i\, p^m_{i3} + B_i.d(E_2 - E_1.) / (E_2 - E_1)$$

$$\text{or, } p^0_{i3} = A_i p^m_{i3} + A_i\phi_1 + A_i\, t_i + B_i\, p^m_{i3} + B_i.(E_2.\phi_2 - E_1.\phi_1) / (E_2 - E_1)$$

$$\text{or, } p^0_{i3} = A_i\, p^m_{i3} + A_i\phi_1 + A_i\, t_i + B_i\, p^m_{i3} + B_i.[PRS_2.\phi_2 - (PRS_2 - 1)\phi_1]$$

$$\text{or, } p^0_{i3} = p^m_{i3} + A_i.t_i + \phi_1 + B_i.PRS_2 (\phi_2 - .\phi_1)$$

$$\text{or, } p^0_{i3} = p^m_{i3} + S_{tax}.(i)\, t_i + \phi_1 + S_{prem}(i) (\phi_2 - .\phi_1) \qquad i=1,2,..g$$

(A4.6.11)

where, according to the notation conventon, lower case variables represent the percentage change form of the corresponding upper case variables t_i is percentage change in the power of *ad valorem* tariff, $(1+T^*_i)$.ϕ_2 and ϕ_1 are the percentage changes in the exchange rates,

$$PRS2 = E_2 / (E_2 - E_1)$$

$$S_{tax}.(i)= A_i = [P^m_{i3}.E_1(1 + T^*_i)] / [P^m_{i3}.E_2 + P^m_{i3}.E_1 T^*_i] \quad i=1,2,..g$$

After a slight manipulation, it can be shown that

$S_{tax}.(i) = A_i$ = (*i*th imports at importers' price minus premium on *i*th import)/(*i*th import at importers' price) for all i, $i=1,2,..g$.

$B_i = [\ P^m{}_{i3}.(E_2 - E_1.)] / [\ P^m{}_{i3}.E_2 + P^m{}_{i3}.E_1T^*{}_i\ ]$ $\quad i=1,2,..g$

Clearly, $A_i + B_i = 1$ $\quad i=1,2,..g$

$S_{prem}.(i) = B_i.PRS_2 = [\ P^m{}_{i3}.E_2] / [\ P^m{}_{i3}.E_2 + P^m{}_{i3}.E_1T^*{}_i\ ]$ $\quad i=1,2,..g$

It can be shown that

$S_{prem}.(i)$ = (ith import at the importers price minus tariff on ith import)/ith import at the importers' price for all i $i=1,2,..g$.

(3) Derivation of the linear percentage change form of Equation (4.21)

$$P^0{}_{i1} = P^e{}_i.[E_2\ R_i + .E_1.(1-R_i\ )](1-ES^*{}_i) \qquad i=1,2,..g \qquad (A4.6.12)$$

where $P^0{}_{i1}$ is the exporters' price for the ith exported good, $P^e{}_i$. is the fob foreign currency price, E_2 and.E_1.are WES and the official exchange rates respectively, R_i is the commodity specific proportion of export earnings on which cash subsidies are given, and $ES^*{}_i$ is the ad valorem rate of export tax (when >0) or subsidy (when <0). Log differentiation of (12) gives:

$$p^0{}_{i1} = p^e{}_i + d[\ E_2\ R_i + E_1.(1-R_i)\ ] / [\ E_2\ R_i + .E_1.(1-R_i)\ ] + es_i$$

$$= p^e{}_i + [\ E_2\ R_i\ \alpha_i + E_2\ R_i\ \phi_2 + .E_1.(1-R_i)\phi_1 - E_1.(1-R_i)\alpha_i\ ] /.[\ E_2\ R_i + .E_1.(1-R_i\ )\ ] + es_i$$

$$= p^e{}_i + S^1{}_i\ \alpha_i + S^1{}_i\ \phi_2 + (1-S^1{}_i)\phi_1 - (1-S^1{}_i)SAL_i.\alpha_i + es_i$$

$$= p^e{}_i + S^1{}_i\ \phi_2 + (1-S^1{}_i)\phi_1 + [\ S^1{}_i - (1-S^1{}_i).SAL_i.].\alpha_i + es_i$$

$$i=1,2,..g \qquad (A4.6.13)$$

5

DATABASE, SOLUTION METHOD AND SIMULATION DESIGNS

This chapter constructs the various data files that constitute the base for CGE-B89. It describes solution methods and designs the policy simulations at the end. Model database is organized into three separate sets of files: the input-output data files, elasticity and miscellaneous parameter files, and government budget coefficient files.

Input-output data files

These files contain input-output data on inter-industry flows and final demands required to compute the series of base period structural coefficients which appeared in the model equations in Appendix A4.2, namely, cost, revenue and sales shares. These shares, ideally, describe the strength of inter-industry links in a typical year. The formulae for computing share coefficients are detailed in Appendix A4.4. Figure 5.1 gives a schematic representation of the various input-output data files. A description of the contents of each of the files, the details of the sources of data for these files and the necessary adaptations made, follow thereafter.

All the input-output flow entries in Figure 5.1 are at the basic values. Entry in each cell can be considered as the product of base-year basic price (prices, net of commodity taxes, received by producers) and quantity. When the basic prices are normalized to unity, the entries give the relevant quantities. The first matrix of the first row of matrices, A of order *gxg*, contains the base-period direct flows of domestically produced commodities used as intermediate inputs in the production of domestic industries. For example, the first row in A shows the direct flows of domestically produced commodity 1, valued at the basic prices, used as intermediate inputs into all industries including industry 1. Column vectors B, C, D, E, F, G contain value-flows of domestically produced commodities to final demands of various types, namely household consumption, private investment, inventory, government consumption, government investment and exports, respectively. They describe various sectors' expenditures on different accounts, and export composition of the trade balance, all valued at the basic prices. The row-sum of matrices A, B, C, D, E, F, and G represents the total direct usage of the corresponding domestic commodity. It also represents the value of output of each commodity from the expenditure side.

In model notation

$$A=[P^0_{i2}.X^1_{i2j}]_{gxg}$$
$$B=[P^0_{i2}.X^3_{i2}]_{gx1}$$
$$C=[P^0_{i2}.X^2_{i2P}]_{gx1}$$
$$D=[P^0_{i2}.X^2_{i2(ch)}]_{gx1}$$
$$E=[P^0_{i2}.X^5_{i2}]_{gx1}$$
$$F=[P^0_{i2}.X^2_{i2G}]_{gx1}$$
$$G=[P^0_{i1}.X^4_{i}]_{gx1}$$

where g stands for the number of commodities and industries.

In the second row in Figure 5.1, matrix H and column vectors I, J, K, L, M contain direct flows of imported commodities into the production of domestic industries, household consumption, private investment, inventory, government consumption and government investment, respectively. Hence, they are the import counterparts of A, B, C, D, E, F. All are valued at basic import the prices (P^0_{i3}, defined in Equations 4.20a through 4.20c). The row-sum gives value of the ith good at importers' price. The last two vectors, $-Z_1$ and $-Z_2$, show respectively, the negative of the values of import duty paid and import premium resulting from foreign exchange rationing. As a result, the row-sums of H, I, J, K, L, M, $-Z_1$, $-Z_2$ give the vector of *cif* import values.

Figure 5.1 **Schematic representation of the input-output data files for CGE-B89**

	Domestic industries (current production)	F I N A L D E M A N D S						
		Household consumption	Private investment	Inventory changes	Government consumption	Government investment	Exports	
Domestic commodities	↑ ← g → g ↓ A	← 1 → B	← 1 → C	← 1 → D	← 1 → E	← 1 → F	← 1 → G	Row sums = total direct usage of domestic commodities
Imports	↑ g ↓ H	I	J	K	L	M		-Tariffs $-Z_1$ / - Premia $-Z_2$ / Row sums = total cif imports
Excise duties on domestic flows	↑ g ↓ N_{tD}	O_{tD}	P_{tD}	Q_{tD}	R_{tD}	S_{tD}	T_{tX}	Row sums = total excise duties on each domestic commodity
Sales taxes on imports	↑ g ↓ N_{tM}	O_{tM}	P_{tM}	Q_{tM}	R_{tM}	S_{tM}		Row sums = total sales taxes on each imported commodity
Export premia	↑ g ↓						$-T_{tX+1}$	Row sums = total export premia on each exported commodity
Labour	↑ 1 ↓ U							
Capital	↑ 1 ↓ V							
	Column sum = outputs of domestic industries	Column sum = total household expenditure on consumption	Column sum = total private investment expenditure	Column sum = total changes in inventories	Column sum = total government expenditure on current consumption	Column sum = total government investment expenditure	Column sum = exports at the official exchange rate	

In model notation

$H=[P^0_{i3}.X^1_{i3j}]_{gxg}$

$I=[P^0_{i3}.X^3_{i3}]_{gx1}$

$J=[P^0_{i3}.X^2_{i3P}]_{gx1}$

$K=[P^0_{i3}.X^2_{i3(ch)}]_{gx1}$

$L=[P^0_{i3}.X^5_{i3}]_{gx1}$

$M=[P^0_{i3}.X^2_{i3G}]_{gx1}$

Matrices N_{tD}, O_{tD}, P_{tD}, Q_{tD}, R_{tD} and S_{tD}, in the third row contain the amount of excise duties by end-use, imposed on domestically sold domestic goods. Vector T_{tX} contains the export taxes (or subsidies). Similarly, matrices N_{tM}, O_{tM}, P_{tM}, Q_{tM}, R_{tM} and S_{tM}, in row four contain net sales taxes (sales taxes minus subsidies plus other taxes, if any) by end-use, on the sale of imported commodities. Note that tariffs are included in the valuations of all transactions in H through M. The absence of any entries in the export column of the second and fourth rows of matrices means that no imports are re-exported without being processed in a domestic industry. The only non-zero vector in row five, $-T_{tX+1}$, contains the negative of the export premiums accruing from the Export Performance Benefit Scheme. Thus, the sum of all the *i*th elements in vectors, G, T_{tX}, $-T_{tX+1}$, gives the *fob* export value of good *i* at the official exchange rate, and the sum of all the elements gives the total *fob* export value at the official exchange rate.

The remaining vectors, U and V, specify the components of industry value-added. For example, the row vector U contains industries' expenditures on the purchase of labour input and V contains expenditures on the purchases of capital. The absence of entries on primary factors in columns for final demand reflects the convention that the primary factors are directly required only in current production and not in final demand. In model notations

$$U = [P_{vj}.X_{vj}]_{1xh} \qquad v=1$$
$$V = [P_{vj}.X_{vj}]_{1xh} \qquad v=2$$

The sum of each column in matrix $(A+H+N_{tD}+N_{tM}+U+V)$ equals the total production costs which is also the value of the output of the corresponding industry at factor cost.

All the input-output data files in the format given in the above Figure 5.1 have been created from the Bangladesh input-output table for 1989, supplemented by data from a few other official documents. The input-output table for 1989 was provided by the National Board of Revenue (Bangladesh 1991a). The National Board of Revenue used the input-output table while carrying out computable general equilibrium simulations for the value-added tax reforms (Mansur and Khondker 1991a). The National Board of Revenue updated the 1987 input-output table prepared by the Planning Commission using industry specific price and quantity indices. The table for 1987 with 53 industries was reduced to 47 industries to create the 1989 data using a simple aggregation method. Minor agricultural crops such as pulses, oil seeds, vegetables, potatoes, fruits, and other crops were aggregated into a single industry and named `other crops'.

The 1989 table was, however, inadequate for the present purpose. All transactions in the 1989 table were valued at the purchasers' prices instead of basic prices. Data on exports were valued at *fob* domestic currency prices without any adjustments for the Export Performance Benefit Scheme. Domestic and import flows were not appropriately disaggregated. Values on stock changes were kept separate but those of household consumption and investment, government consumption and investment were lumped together under an aggregate consumption. Gross value-added was not distributed between labour and capital. The following adaptations and modifications were, therefore, carried out.

Exports valued at *fob* domestic currency were modified to incorporate the Export Performance Benefit Scheme. The export premium for good *i* under the Export Performance Benefit Scheme, XP_i, is calculated using the formula

$$XP_i = X_i.R_i.D \qquad i=1,2,..,g$$

Table 5.1 **Export Performance Benefit entitlement rates and other related parameters,** 1989

	R_i	SAL_i	S^1_i
Exportables			
Jute	0.20	0.25	0.20
Tea	0.55	1.22	0.56
Fish	0.90	9.00	0.90
Ready-made garments	0.95	19.00	0.95
Jute textiles	0.40	0.67	0.41
Leather	0.89	8.09	0.89
Forestry	0.20	0.25	0.20
Importables			
Rice	n.a.	n.a.	n.a.
Wheat	n.a.	n.a.	n.a.
Edible oil	n.a.	n.a.	n.a.
Other agriculture	0.40	0.67	0.41
Sugar	n.a.	n.a.	n.a.
Cotton textiles	n.a.	n.a.	n.a.
Paper	0.35	0.54	0.36
Chemicals	0.30	0.43	0.31
Other manufactures	0.40	0.67	0.41

Notes: Ri is the XPB entitlement rate for ith export;

$SAL_i = \frac{R_i}{1-R_i}$; and $S^1_i = \frac{R_i E_2}{R_i E_2 + (1-R_i)E_1}$, where E_1 and E_2 are respectively the official and secondary exchange rate.

Source: Bangladesh, Government of, 1988. *Export Policy 1988-89*, Ministry of Commerce, Dhaka.

where X_i is the domestic currency *fob* export value of good *i* at the official exchange rate, R_i the commodity-specific proportions of the gross *fob* export value on which export subsidy under the Export Performance Benefit Scheme is given, and D is the exchange premium. Data on X_i were drawn from the NBR input-output table. Data on R_i in Table 5.1 were adopted from the *Export Policy 1988-89* (Bangladesh 1988a). The official exchange rate, taka 32.14 per US dollar, and the secondary exchange rate, taka 32.91 per US dollar, give D a value of 0.024.

The negatives of these values for XP_i constitute the vector $-T_{tX+1}$ in Figure 5.1. The export premium, XP_i, added to the corresponding domestic currency *fob* export value minus export taxes (if any) gives the value of *i*th export at the basic export price, P^0_{i1} (see Equation 21 in Chapter 4, and also Figure 5.2), which constitutes the vector G in Figure 5.1.

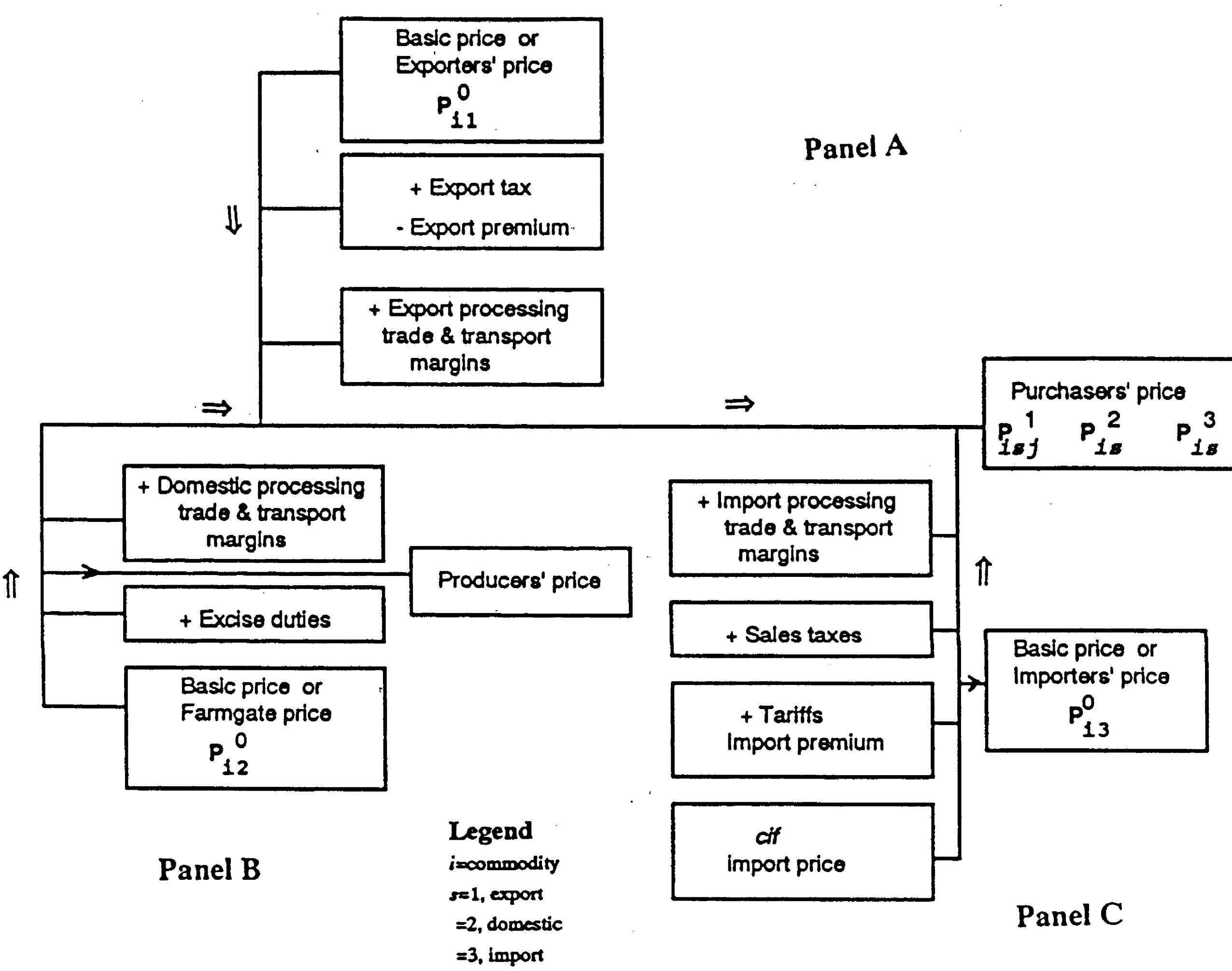
All flows in the input-output table for 1989 are valued at the purchasers' prices. The model, however, recognizes two types of prices - basic and purchasers' prices, and requires all flows in the I-O table to be valued at the basic prices. Purchasers' prices and producers' prices are used synonymously contrary to conventional definitions. Figure 5.2 shows the conventional relationships between basic prices, producers' prices and purchasers' prices. Conventionally, basic prices are defined as the prices net of commodity taxes that would have been received by the producers. Producers' prices are commodity tax inclusive prices, i.e. basic prices plus the commodity taxes. When transactions in an I-O table are valued at producers' prices, commodity taxes are assumed to be paid by producers, and the costs of trade and transport services on purchases of inputs constitute the trade and transport service inputs into the relevant industry. Producers' prices plus margins such as transport and storage services, marine insurance, and wholesale and retail margins define the purchasers' prices. When all transactions in an input-output table are valued at the purchasers' prices, it is assumed that each industry pays the trade and transport costs on all its sales of output and the total of these costs together constitute the trade and transport inputs of the sector. Because the Bangladesh economy is small, trade and transport margins are not modelled. As a result, no distinction is made between producers' and purchasers' prices, and basic prices are taken to differ from purchasers' prices by the amount of net indirect taxes such as sales taxes or excise duties.

Because the model assumes imperfect substitution between domestic and imported goods, the flow matrix has to be disaggregated by source. The Planning Commission prepares the input-output tables without any distinction between domestic and imported sources of supply, but the National Board of Revenue decomposed the 1989 input-output flows, by sources. The decomposition was carried out under the assumption that the import intensity of input use in each industry j is the same across all individual inputs. In other words, the jth industry is assumed to use each input from an imported source at a constant ratio. The ratio being the quotient of the value of total imported intermediate inputs into industry j to the value of total (domestic plus imported) intermediate inputs used in the jth industry.

Such domestic/imported division is not acceptable. The present model recognizes some non-tradables. Inputs supplied by these industries are all domestic. Some industries, notably jute and jute textiles, do not import. Inputs purchased from these industries should be regarded as domestic. A new decomposition of the 1989 input-output table into domestic and imported was undertaken.

The method of decomposition into domestic and imported flows differs from Salma (1992) and Mujeri and Alauddin (1992) for Bangladesh and Hazari (1967) for India. All assume that the total imports of good i are distributed among different uses according to the proportion of total supply (domestic production plus imports) of good i. But, given the data on sector-specific total imported intermediate inputs, this model assumes that the jth industry that uses inputs from both domestic and imported origins, takes the individual inputs from imported sources at a constant ratio. Note that the National Board of Revenue methodology applied the constant import ratio to all inputs, even for goods which were not imported (indicated by total import figures of the NBR input-output table). This model applies the constant import intensity of input use by industry j only to cases where inputs are supplied from both domestic and imported sources. If imports do not exist (non-tradables and tradables with no imports), total input flows enter only into the domestic component of the input-output table.

Figure 5.2 **Relationships between various basic prices and purchasers' prices**



While constructing the average import content ratio of input-use for the *j*th industry, the aggregate value of the imported intermediate inputs used in the *j*th industry, M_j, is taken as the numerator. The denominator is the value of total inputs (both domestic and imported) used in the *j*th industry, T_j, less the value of inputs supplied by the industries with no imports (tradables and non-tradables), OD_j. Average import intensity, m_j, is given by

$$m_j = \frac{M_j}{T_j - OD_j} \qquad j = 1,2,\ldots,g$$

For industry j, m_j is relevant for those inputs which are both domestically supplied and imported. In reality, it is possible that the ith input in the jth industry is entirely imported. However, lack of information rules out such a possibility in this decomposition. All the inputs used from non-importables (tradables with no imports and non-tradables) enter only in the domestic component of the input-output table as they are only of domestic origin. The corresponding flows in the import counterpart of the input-output table are thus zero. Imports so defined include *cif* domestic currency import values, tariffs, scarcity premium, and net sales taxes.

The domestic component of the I-O table at purchasers' prices is obtained by subtracting the import component matrix from the aggregate flow matrix. Flows into the domestic component of the I-O table are at purchasers' prices and include basic values and excise taxes.

Data on good-specific excise duties and sales taxes are used to deflate domestic and imported flows respectively on a *pro rata* basis to arrive at the domestic and import components (of the I-O table) at the basic value. The domestic flows so defined are at the basic value. The imported flows so defined are at the basic import prices which include tariffs and scarcity premium. Both tariffs and scarcity premiums have to be subtracted from relevant import values at basic import prices to arrive at the *cif* import value (see Figure 5.1). The NBR input-output table gives figures on tariff revenues that constitute vector Z_1 in Figure 5.1. The scarcity premium is assumed to exist for all imports except rice, wheat and fertilizer (Chapter 2). It is defined, because of data limitation, according to Equation 4.20c in Chapter 4. First, imports valued at the importers' price were netted of tariffs. The new series contained *cif* imports plus scarcity premiums (in terms of Equation 4.20c, the series corresponded to $X_{i3}.P^m_{i3}.E_2$). These values were multiplied by $(1 - \frac{E_1}{E_2})$ to obtain figures for scarcity premiums which represent vector Z_2 in Figure 5.1. In CGE-B89 notation, the *i*th element of the vector Z_2 is given by

$$X_{i3}*P^m_{i3}*E_2*(1-\frac{E_1}{E_2}) \qquad i=1,2,...,m$$

where E_1 and E_2 are respectively the official and secondary exchange rate; X_{i3} is the volume of *i*th import; and P^m_{i3} is the border price of *i*th import in US dollars.

In the ORANI model, the input-output table is conventionally at basic values and demands for trade and transport and other margins are modelled explicitly, rather than as inputs in the *j*th industry or as consumer goods (Dixon *et al.* 1982:106). In view of the smallness of the country and non-availability of independent margins data, this approach was abandoned in the present exercise. Trade and transport services aggregated in the physical overhead (Appendix A5.1) are treated as intermediate inputs and thus modelled as arguments in the production functions. Ignoring the trade margins between domestic producer prices and consumer prices, leads to a suppression of the share of commercial services, and an upward bias for the strength of the domestic commercial policy (Yeldan and Roe 1991:573). Such caveats have to be kept in mind in analyzing the simulation results.

The 47 industries in the 1989 table have been aggregated into 19 industries for the present model. Appendix A5.1 shows the mapping scheme that has been used for the industry aggregation. The aggregation has been done by simple arithmetic. Each industry is assumed to produce only one distinct good (see Chapter 4). There are thus 19 commodities, also aggregated according to the industry aggregation scheme. The relevant entries in the final demand columns and value-added row are also added to correspond to the newly defined 19 industries and 19 commodities.

The NBR input-output table for 1989 contains values of total absorption, import components of total absorption and changes in stock. Domestic and imported aggregate absorptions thus have to be distributed among household's and government's current consumption and investment. In the absence of recent information, aggregate expenditures have been disaggregated into household consumption, household investment, government current consumption and government investment using the distributional pattern recorded in the previous input-output table of the Planning Commission (Bangladesh 1992a). Private consumption constitutes most of the absorptions, reducing the possible distortionary effects of such a disaggregation. For both domestic and imported absorption, decomposition has been based on the same distributional pattern.

The National Board of Revenue's 1989 input-output table contains industry specific aggregate value-added entries without industry specific distribution between labour and capital. But the 1987 input-output table of the Planning Commission (Bangladesh 1992a) reports industry specific value-added decomposed into total wage and non-wage (called gross operating surplus) categories. For the present purpose, the same distributional pattern was adopted on the assumption that the input intensity and wage-rental ratio have not changed significantly over a period of two years.

Further adjustments and balancing of the I-O data

The NBR input-output table for 1989 was modified to construct the I-O database in the format presented in Figure 5.1. The modified 19×19 inter-industry flow matrix meets the standard adding-up properties. The *j*th column-sum of matrix $(A+H+N_{tD}+N_{tM}+U+V)$ in Figure 5.1 gives the base-period value of output of industry *j* at the basic price, $P^0{}_j.Z_j$, $j=1,2,...,g$. The *i*th row-sums of (A+B+C+D+E+F+G) give the value of total direct usages of the domestically produced commodity *i*, $P^0{}_i.Z_i$,

i=1,2,...,g. These two sums have to be equal. To secure this supply-demand equality, further adjustments were made. The original export data were modified to capture subsidies under the Export Performance Benefit Scheme and to be consistent with Equation 2.41 in Chapter 4. Also some discrepancy persists because no distinction has been made between the producers' prices and purchasers' prices. To maintain the supply and demand equality, the gross operating surplus data were modified. However, all other column and row-sums satisfy the relevant flows in the I-O database presented in Figure 5.1, and can be checked using the complete set of I-O data files for CGE-B89 assembled in Appendix A5.2.

Planning Commission data and estimates differ from those compiled by the Bangladesh Bureau of Statistics (Bangladesh 1990:501). Most of the macro aggregates in the CGE-B89 database seemed to deviate from the periodic estimates by the Bureau. No attempt has been made to reconcile these anomalies.

Elasticity and miscellaneous parameter files

The model equations when expressed in percentage change form, contain numerous elasticities. These include substitution elasticities between domestic and imported goods by end-use, transformation elasticities between domestic sales and exports, substitution elasticities between primary factors in each industry, and export demand elasticities (see Appendices A4.1 and A4.3). Elasticity files accordingly had to be constructed, together with data files for household consumption parameters, indexing and other parameters.

Elasticities of substitution between domestic and imported goods

Domestic/import substitution elasticities are differentiated by end-use, namely current production, household and government consumption and investment, and inventory demand. The absence of estimates of such elasticities restricts one to the assumption that for each good i, the elasticity of substitution between domestic and imported goods is the same, irrespective of end-uses. That is,

$$\sigma^1_{ij}=\sigma^3_i=\sigma^2_{iP}=\sigma^5_i=\sigma^2_{iG}=\sigma^2_{i(ch)}=\sigma_i \qquad i, j = 1,2,..,g$$

Table 5.2 **Elasticity of substitution (σ_i)**

Commodity category	σ_i
Rice	1.8
Wheat	1.8
Tea	1.6
Fish	1.8
Forestry	1.6
Edible oil	1.8
Other agriculture	1.8
Sugar	1.8
Cotton textiles	1.8
Ready-made garments	1.3
Paper	1.3
Leather	1.6
Chemicals	1.2
Other manufactures	1.2

Source: Chowdhury, O.H., 1990. Tax policy analysis in Bangladesh: a computable general equilibrium approach, PhD dissertation, University of the Philippines, Diliman, Quezon City:63

As Bangladesh's major imports are predominantly used in only one end-use category, such a restriction may not seem to be very strong. But estimates of domestic-import substitution elasticity of good i as defined in the modified input-output table are also lacking for Bangladesh. Salma (1992) borrowed these parameter values from Chowdhury (1990) who adopted them, for his CGE model of Bangladesh, from Adelman and Robinson (1978) and Habito (1984). The present model uses these values after adjustments for differences in industry aggregations. Table 5.2 lists the values for the elasticities of substitution between domestic and foreign sources (σ_i) used.

The elasticities of substitution chosen attempt to reflect the structural rigidities and differences in the nature of traded goods within each sector. The main imports of Bangladesh are other manufactures, other agriculture, chemicals and edible oil (Appendix A5.2). For capital goods and highly processed producers goods, there are low substitution possibilities in the domestic market. This is reflected in a low value of substitution elasticity for other manufactures and chemicals. High values of substitution elasticities for other agriculture, edible oil, rice, wheat, sugar and cotton textiles support the hypothesis that primary, semi-processed and lightly manufactured goods have relatively high substitution possibilities in the domestic market.

It is worth noting that even under the Armington composite commodity system, domestic good and import can be complements (or substitutes) if the elasticity of trade substitution is lower (or higher) than the elasticity of demand for the composite good (Dervis *et al.* 1982: chapters 7 and 8, de Melo and Robinson 1989).

In this study, the following assumptions are made to keep government expenditures, private investment expenditures, expenditures on inventories differentiated by source at their base year levels:

$$\sigma^1_{ij}=\sigma^3_i=\sigma_i \qquad i, j = 1,2,..,g$$

$$\sigma^2_{iP}=\sigma^5_i=\sigma^2_{iG}=\sigma^2_{i(ch)}=0 \qquad i = 1,2,..,g$$

Elasticity of substitution between primary factors in each industry

These elasticities are particularly important. They determine, to a large extent, the output responsiveness of each industry to changes in costs and prices. According to the production technology specified in the model, the short-run supply elasticity for industry j, σ_j, is

$$\sigma_j = \sigma_{vj}.(1-S_{fj})/[S_{fj}*H_{xj}] \qquad j=1,2..,g$$

where σ_{vj} is the substitution elasticity between the primary factors in industry j, S_{fj} is the share of fixed factors in total primary factor costs in industry j, H_{xj} is the share of primary factor inputs in industry j's total costs (Dixon *et al.* 1982:309, NCDS 1990:93).

Rahman (1973), Demery and Jahangir (1974), Rushdi (1982), and Bairam (1988) have all estimated the elasticity of substitution among factors of production for Bangladesh using different functional forms. While Rahman (1973), and Demery and Jahangir (1974) have used a constant elasticity of substitution (CES) production function, Rushdi (1982) has used a more flexible translog cost function. Rushdi (1982) assumes substitutability between materials and primary inputs contrary to the Leontief production technology assumed in this model. Bairam (1988) estimated labour-capital substitution elasticities for forty-seven industries in Bangladesh using a variable elasticity of substitution (VES) production function and 1978 input-output data. All these estimates are presented in Table 5.3.

This study does not use the detailed estimates by Bairam (1988), nor does it use the value-added weighted average (1.21) because of the different underlying functional forms. For similar reasons, the model does not use the estimates of Rushdi. While Rahman (1973), Demery and Jahangir (1974) use the CES functional form, they did not provide estimates for all the industries under consideration. Moreover, their estimates of elasticities use old data. Under such circumstances, the present model, as in Salma (1992), assumes a value of 1.00 for σ_{vj} for all j, j=1,2,..,g. In effect, this implies a Cobb-Douglas aggregation, a special case of the CES aggregation, for the

Table 5.3 **Elasticity of substitution between primary factors (σ_{vj})**

	$\sigma_{vj}{}^{a}$	$\sigma_{vj}{}^{b}$	$\sigma_{vj}{}^{c}$	$\sigma_{vj}{}^{d}$
Rice	..	..	..	1.04
Wheat	..	..	..	1.10
Food	0.1853	2.73		
Jute				1.02
Jute processing	1.2421	..	..	..
Tea	0.5225	..	..	1.23
Fish	..	..	..	1.10
Forests	..	..	..	1.04
Edible oil	0.8642	..	..	1.06
Other agriculture[1]	..	..	..	1.02
Sugar	0.6921	..	..	1.05
Cotton textiles[1]	0.9504	..	..	1.08
Ready-made garments	..	..	..	..
Jute textiles	0.7992	..	..	1.10
All textiles	0.7068	2.61	..	..
Paper	0.4337	..	..	2.52
Leather	1.4428	..	..	1.10
Footwear	0.7643	..	..	..
Chemicals	0.3608	1.01	..	1.90
Non-metal products	0.6132	1.52	..	..
Glass	1.3263	..	..	..
Metal	1.2961	1.16	..	1.36
Other manufactures[1]	..	..	..	1.95
All manufacturing	0.6163	1.68	0.146	..
Transport	1.2421	..	..	1.60
Physical overhead[1]	..	..	..	1.43
Social overhead[1]	..	..	..	1.13
Public administration	..	..	..	1.15

Notes: [1]Elasticities for the aggregated industries are the weighted averages of those of the constituent industries. Value-added figures in the 1977-78 I-O Table of the constituent industries are used to calculate the weights.

Sources: [a]Rahman, A.N.M.A., 1973. `Elasticities of substitution in manufacturing industries in Bangladesh: an international comparison', *Bangladesh development studies,* 1(2):173-85; [b]Demery, L. and Jahangir, H., 1974. `Adjustment dynamics and the elasticity of substitution: The case of manufacturing industry in Bangladesh', *Bangladesh development studies,* 2(3):725-32; [c]Rushdi, A.A., 1982. `Factor substitutability in the manufacturing industries of Bangladesh: an application of the translog cost model', *Bangladesh development studies,* 10(2):85-106; [d]Bairam, E.I., 1988. `Capital-labour substitution in sectors of a less developed economy: The case of Bangladesh', *Economic Discussion Papers,* No.8820, University of Otago, Dunedin, N.Z.

primary factors - labour and capital - in the nested production technology assumed in the model.

Transformation elasticities

Empirical estimates of the transformation elasticity between domestic sales and exports are unfortunately very scarce, in general, and probably non-existent for Bangladesh, in particular. Grais *et al.* (1986) assumes the values of 0.5 and 1.5 for Turkey. While well below infinity, as implicit in the model specification, available evidence for the aggregate export supply elasticity ranging between 1.0 and 4.0 (Goldstein and Khan 1985:1087) seems to suggest that the values of transformation elasticities should be higher than assumed by Grais *et al.* (1986:74). Tarr (1989:5-6) cites an estimate of 2.90 for the elasticity of transformation between domestic sales and exports and provides an indication of the possible order of magnitude for manufactured products. Given the difficulties in obtaining estimates, the value of 5.0 is subjectively used in this model as in Martin (1990b:17-8).

Such a high value of transformation elasticity is consistent with the fact that Bangladesh exports mainly agricultural, semi-processed and lightly manufactured goods such as jute, fish, ready-made garments, jute textiles and leather, for which transformation possibilities are high.

Export demand elasticities

Estimates of export demand elasticity are generally low. For Bangladesh, demand elasticities were estimated mostly for aggregate exports and the two main export commodities, namely, raw jute and jute goods (Imam 1970, Nguyen and Bhuyan 1977, Thomas 1979). Shilpi (1990), however, also made an attempt to estimate export demand elasticities for several commodities, including raw jute, jute goods, leather, tea, frozen food and ready-made garments. Elasticities were estimated using simple *ad hoc* log-linear demand functions. Only a limited number of diagnostic statistics were reported. Durbin-Watson statistics clearly demonstrated the presence of autocorrelation or dynamic misspecification in the estimates of at least four export demand equations. Hence the relevant estimates by the ordinary least squares (OLS) method reported might be misleading. Specification of ready-made garments and frozen food assumed unitary price elasticity, the main parameter to be estimated, and hence ignored most relevant price variables.

In the absence of useful estimates, it was assumed that Bangladesh's exports even though differentiated from comparable products supplied by rest of the world, had close substitutes resulting in large price elasticities of world demand. The exceptions were jute and jute textiles. For all export commodities except jute and jute textiles foreign demand elasticities were set at 20.00 as in ORANI (Dixon *et al.* 1982:196). The relevant values for the reciprocal of the export demand elasticities, γ_i were equal to 0.05.

For jute and jute textiles, values for export demand elasticities were available from Imam (1970), Nguyen and Bhuyan (1977), and Thomas (1979). The numerical values for these elasticities range from 0.61 to 1.1 for raw jute and 1.7 to 13.3 for jute goods. However, the model following Salma (1992) takes an elasticity value of -1.00 for jute and -7.00 for jute textiles. So, the relevant values for the parameter γ_i are respectively -1.0 and -0.1429.

Household demand parameters

The model execution requires values of ε_i and δ_i (see Equation 5 in Appendix A4.2). ε_i is defined as the ratio of the supernumerary expenditure to the total expenditure on the *i*th good. In model notation

$$\varepsilon_i = \frac{X_i^3 P_i^3 - \theta_i P_i^3}{X_i^3 P_i^3} \qquad i=1,2,\ldots,g \qquad (5.1)$$

where X^3_i and P^3_i are respectively the quantity of household consumption and price of composite commodity *i*. θ_i is the quantity of the committed consumption of composite commodity *i*.

Parameter δ_i in the Stone-Geary utility function is

$$\delta_i = \Gamma_i . S^3_i \qquad i = 1,2,..,g \qquad (5.2)$$

where Γ_i is expenditure elasticity of household demand for composite commodity *i*; S^3_i is the expenditure share of the *i*th composite commodity.

Estimates of ε_i and δ_i are not readily available. However, they can be estimated using the properties of the linear expenditure system (LES).

In LES, the Marshallian (or uncompensated) demand functions are given by

$$X^3_i P^3_i = \theta_i P^3_i + \delta_i . \sum_{i=1}^{g} (X^3_i P^3_i - \theta_i P^3_i) \qquad i=1,2,..,g \qquad (5.3)$$

and the equation of the Frisch parameter (ω) is

$$-\omega = \frac{\sum_{i=1}^{g} X_i^3 P_i^3}{\sum_{i=1}^{g} (X_i^3 P_i^3 - \theta_i P_i^3)} \qquad (5.4)$$

Equations (5.1) through (5.4) give the following relationship

$$\varepsilon_i = -\frac{\Gamma_i}{\omega} \qquad i = 1,2,\ldots,g \qquad (5.5)$$

Given the values for S^3_i, Γ_i and ω, Equations 5.2 and 5.5 thus provide estimates for δ_i and ε_i respectively. The I-O Table gives the values of the household consumption expenditures at the purchasers' prices, $X^3_i P^3_i$. These values were used to calculate expenditure shares. To obtain estimates of the expenditure elasticity parameters and the appropriate value of the Frisch parameter, an extensive literature search on consumer demand in Bangladesh was undertaken. Though several studies estimated the individual commodity or commodity group demand functions (Mahmud, 1979, Pitt 1983), only a handful of studies of complete household demand systems for Bangladesh were available (Chowdhury 1982, Kennes 1984, Ahmad *et al.* 1985). Kennes (1984) used both the LES and a variant of the Almost Ideal Demand System (AIDS) for nine major commodities, and also much simpler *ad hoc* functional forms for fourteen commodities including the above nine. He found LES elasticity estimates plausible. Theoretical adequacy and plausibility of estimates are assisted by the specification of the functional form of the LES. When compared with the relevant elasticities for main agricultural commodities in Pitt (1983) and Mahmud (1979), LES estimates in Kennes (1984) were found satisfactory. But Kennes' objective (1984) was to estimate food demand systems for Bangladesh and all the manufacturing goods and services were lumped into two commodities - tradable non-agriculture and non-tradable non-agriculture. Such commodity classification was not very suitable for the CGE-B89 model.

Even though the underlying functional form in Chowdhury (1982) is a LES, he first estimated expenditure elasticities for 25 commodities, many more than Kennes (1984) and Ahmad *et al.* (1985), using a simple log-linear functional form. Using these estimates of expenditure elasticities with an estimated Frisch parameter value of -2.541

(Chowdhury, 1981), he estimated the matrix of own- and cross-price elasticities applying Frisch methods (Frisch 1959).

Hossain (1989), Ali (1989) and Salma (1992) used a LES to represent consumer behaviour in their models. Hossain (1989) adapted expenditure elasticities from Lluch, Powell and Williams (1977). He used these expenditure elasticities and a Frisch parameter of -4.0 to calculate price elasticities for his model. Salma (1992) for her CGE model adapted expenditure elasticities from Chowdhury (1982) and also estimated price elasticities using a Frisch formula. The present model draws on the direct LES expenditure elasticity estimates in Kennes (1984) supplemented by estimates in Chowdhury (1982). However, these elasticities were scaled so that the condition of Engel's aggregation holds in the first place

$$\sum_{i=1}^{g} \Gamma_i S^3_i = \sum_{i=1}^{g} \delta_i = 1$$

where, as before, Γ_i is the household expenditure elasticity for good *i*, S^3_i was the household budget share for good *i*. The latter is calculated using the household consumption expenditure data in the I-O database. The expenditure elasticities used for calculating the relevant parameters are in Table-5.4.

The value of the Frisch parameter chosen is -2.541 as in Chowdhury (1981), which is, in absolute terms, less than the value derived from the relationship between per capita GNP and the Frisch parameter in Lluch *et al.* (1977). Using this value of the Frisch parameter together with the household expenditure data from the input-output table, the values for ε_i have been estimated from Equations (5.2), (5.3) and (5.4), and are reported in Table 5.4.

Table 5.4 **Values of the household expenditure elasticities (Γ_i), committed expenditure ($\theta_i P^3{}_i$), and ε_i and δ_i**

	Γ_i	δ_i	Committed expenditure (in mil. taka)	ε_i
Rice	0.433	0.093	118722.89	0.171
Wheat	0.616	0.011	8977.00	0.242
Jute	0.760	0.007	4224.83	0.299
Tea	0.857	0.010	4991.00	0.337
Fish	0.919	0.041	19282.34	0.362
Forestry	0.572	0.015	13572.80	0.225
Edible oil	0.822	0.017	9314.61	0.324
Other agriculture	0.988	0.176	72992.65	0.389
Sugar	0.948	0.022	9591.21	0.373
Cotton textiles	1.391	0.041	8969.15	0.547
Ready-made garments	0.927	0.002	892.90	0.365
Jute textiles	1.391	0.002	492.76	0.547
Paper	1.391	0.013	2770.40	0.547
Leather	0.745	0.001	428.07	0.293
Chemicals	1.391	0.018	3932.20	0.547
Other manufactures	1.391	0.134	29339.17	0.547
Physical overhead	1.315	0.291	71584.18	0.517
Social overhead	1.315	0.030	7322.62	0.517
Public administration	1.315	0.077	19002.87	0.517
Total		**1.00**	**406403.66**	

Sources: Bangladesh, Government of, 1991. *The Input-Output Table: 1988-89*, mimeo, National Board of Revenue, Dhaka; Kennes, W., 1984. *Food Demand Systems for Bangladesh*, Staff Working Paper SOW-84-15, Centre for World Food Studies, Amsterdam; Chowdhury, O.H., 1982. `Complete consumer model: A preliminary estimate for Bangladesh', *The Bangladesh Development Studies*, 10(1):91-104.

Investment coefficient and other indexing parameters

The investment coefficient, Q_j, is the ratio of the gross to net rates of return on fixed investment in industry *j*, and is calculated according to the formula

$$Q_j = \frac{R_j + d_j}{R_j} \qquad j=1,2,..,g$$

where R_j is the *j*th industry's net rate of return averaged over time and d_j is the rate of depreciation of fixed capital in industry *j*.

Table 5.5 **Chosen values for investment coefficients (Q_j)**

Industry	Q_j
Rice	1.33
Wheat	1.33
Jute	1.33
Tea	1.33
Fish	1.33
Forests	1.53
Edible oil	1.33
Other agriculture	1.33
Sugar	1.33
Cotton textiles	1.60
Ready-made garments	1.30
Jute textiles	1.20
Paper	1.40
Leather	1.40
Chemicals	1.40
Other manufactures	1.33
Physical overhead	1.40
Social overhead	1.33
Public administration	1.33

Source: Salma, U, 1992. Agricultural Price Policy in Bangladesh: General equilibrium effects on growth and sectoral income distribution, PhD dissertation, The Australian National University, Canberra.

Data on industry's net rates of return, R_j, are lacking. One convention is to use the opportunity cost of capital as a proxy. Salma (1992) estimated values for Qj taking a value of 5 per cent real interest rate as the proxy for the real opportunity cost of capital and using industry's depreciation data of the macro model of the Third Five Year Plan (Bangladesh 1985). In view of the second order importance of these coefficients in terms of their effects on model results, this model uses estimates of Q_j in Salma (1992) instead of computing them again.

Indexing parameters

The model contains numerous indexing parameters. Depending on the purpose and the relevant closure of the model, appropriate values have to be assigned to these parameters. For the present purpose, a zero value was assigned to h^5_i and h^2_i, for i=1,2,..,g, (see Appendix A4.4) to treat exogenously government consumption and investment expenditures on composite commodity i. Government consumption and investment of composite good i were respectively indexed to the economy's real absorption and total capital stock (Equations 9 and 11 in Appendix A4.2). Also h^1_g was set to zero to keep other public revenue expenditure fixed at the base-year level (Equation 40 in Appendix A4.2). For h^1_j, j=1,2,..,g, a zero value was assigned; this implies no wage-indexation (Equation 47 in Appendix A4.2).

Government budget coefficient files

These files contain data required to specify numerically the set of equations relating to the Government Budget. Data requirements for the computation of the shares of industries or commodities in various tax revenues and government expenditures are met from the input-output data files (Figure 5.1 and Appendix A5.2). Data on the miscellaneous public revenue and expenditures were reported in Tables 4.1 and 4.2. Figure 5.3 gives a schematic picture of the various government budget data files.

Vector $R^t_{(g\times1)}$ of tariffs is the same as vector Z_1 in the I-O data files. Matrix R_1^{se} of the sales taxes and excise duties on intermediate goods contains N_{tD} of order $(g \times g)$ and N_{tM} of order $(g\times g)$ matrices as stored in the I-O data files (Figure 5.1). Matrix R_2^{se} contains indirect taxes (sales and excise taxes) on purchases of investment goods from domestic and imported sources by both household and the government, and hence contains vectors $P_{tD(g1)}$, $P_{tM(g\times1)}$, $Q_{tD(gx1)}$, $Q_{tM(gx1)}$, $S_{tD(g\times1)}$, $S_{tM(g\times1)}$ of the I-O data files. Indirect taxes (sales and excise taxes) on purchases of goods for current consumption from both domestic and imported sources by household and the government were stored in matrix R_3^{se} which contains vectors $O_{tD(gx1)}$, $O_{tM(gx1)}$, $R_{tD(gx1)}$, $R_{tM(gx1)}$ of the I-O data files. Vector $R^{expt}_{(gx1)}$ is the same as vector T_{tX} of export taxes in the I-O data files. Data in Table 4.1 of Chapter 4 were used to calculate the share of each category in total government revenue and specify numerically the total government revenue equation (Equation 36 in Appendix A4.2).

Figure 5.3 **Government budget data files for CGE-B89**

Revenue files	**Expenditure files**
R^t Tariff revenues	G^{e5} Government current consumption
R_1^{se} Indirect taxes on intermediate goods	G^{e2} Government capital consumption
R_2^{se} Indirect taxes on investment goods	G^{XPB} Subsidies under XPB
R_3^{se} Indirect taxes on consumption goods	G_{mis} Miscellaneous expenditures (n.e.s.)
R^{expt} Export taxes	
R_{mis} Miscellaneous revenues (n.e.s)	
Total revenue (GR)	**Total expenditure** (GE)
Government borrowing requirement = GE - GR	

Matrix G^{e5} on government current consumption at the purchasers' prices of both domestic and imported goods contains vectors $E_{(gx1)}$, $L_{(gx1)}$, $R_{tD(gx1)}$, $R_{tM(gx1)}$ of the I-O data files. While matrix G^{e2} on government capital expenditure on goods from both domestic and imported sources contains vectors $F_{(gx1)}$, $M_{(gx1)}$, $S_{tD(gx1)}$, $S_{tM(gx1)}$ of the I-O data files. Vector $G^{XPB}_{(gx1)}$ contains amounts of export subsidies given under the Export Performance Benefit Scheme, and is the same as vector T_{tX+1} in the I-O data files. Figures in Table 4.2 of Chapter 4 were used to compute the share of each category of expenditure in the aggregate government expenditure as appeared in Equation 41 of Appendix A4.2.

Computing solutions for CGE-B89

The Johansen-style solution technique (Johansen 1960) is used to solve the model. All the systems of structural non-linear equations of the model are approximated by the set of simultaneous equations which are linear in percentage changes. The model involves E number of equations containing V number of variables in percentage change form with (E<V). The solution thus relies on a matrix inversion and a matrix multiplication after appropriately setting D (=V-E) number of variables exogenous on the basis of the underlying economic environment.

In matrix notation

$$F(z)=0,$$

where F is a vector of functions represented by the set of E model equations, and z is the vector of variables in percentage change form as in Appendix A4.2. In effect, the model can be written as

$$Az=0,$$

where A is the matrix of coefficients estimated from the model database. For CGE-B89, the order of matrix A is E×V, $E(=4g^2+34g+27)$ being the number of rows and $V(=6g^2+47g+32+t_2-t_1)$ the number of columns. As E<V, D $(=V-E= 2g^2+13g+5+t_2-t_1)$ variables have to be set exogenously to solve the model. Any D number of variables may be set exogenously depending on the purpose of the model (see Chapter 4). Whatever selection of exogenous variables is adopted, vector z has to be split into two vectors *viz.* z_1, a vector of E endogenous variables and z_2, a the vector of D

exogenous variables. The coefficient matrix is also split into two matrices corresponding to exogenous and endogenous variables. Thus the model can be rewritten as

$$A_1.z_1 + A_2.z_2 = 0.$$

The solution to the model is given by

$$z_1 = - A_1^{-1}.A_2.z_2.$$

A given set of values of z_2 will generate a set of values of the endogenous variables, z_1, quantifying the approximate effects of changes in exogenous variables on endogenous variables. The solutions are, of course, given in percentage changes.

Clearly, the model can be solved only if the inverse of matrix A_1, A_1^{-1}, exists; this amounts to the non-singularity of matrix A_1. If the selection of exogenous variables, in other words, the selection of the economic environment is realistic, the above condition typically holds.

The well-known disadvantage of this original Johansen-style solution technique is that it introduces uncontrolled approximation errors ensuing from linearization. Such errors are negligible for small changes in the exogenous variables. For large changes in exogenous variables, however, such a disadvantage of approximation errors can almost be eliminated by multiple-step Johansen solution techniques (Dixon *et al.* 1982:199). The extended Johansen method involves updating the input-output flows and hence re-evaluating cost shares, sales share, and can generate highly accurate solutions.

The principal attractions of such a solution technique are the flexibility it provides in terms of model sizes, model modifications and model applications. The non-linear solution technique (for example, techniques used by Shoven and Whalley

1973, Adelman and Robinson 1978, Dervis *et al.* 1982, Clarete 1984, Clarete *et al.* 1988, 1990, 1991, Ezaki 1987) involves substantial computer time and costs in solving the constrained optimization problem of a large model at each iteration. Any modification requires, in most cases, considerable re-thinking and re-writing of the solution algorithms. The Johansen solution technique, in contrast, places no practical restrictions on model size. It allows maximum scope for such model modifications as changes in the equations, additions and deletions of equations, and switches of variables between the endogenous and exogenous categories. In most cases, modifications and extensions can be carried out by simply manipulating data files, adding new dimensions to the A matrix, and/or re-allocating columns of matrix A between the A_1 and A_2 matrices.

The computer software used for solving the model is GEMPACK version 4.2.02 (Codsi and Pearson 1991) which allows multi-step solutions via updating the database.

Simulation designs

The simulating experiments designed for the study, and conducted in the following three chapters, are

- an exogenous inflow of one million (unit of measurement, throughout) US dollar worth of foreign aid
- a one per cent devaluation of the official exchange rate
- a one per cent increase in money supply
- a one per cent increase in nominal wages
- ten per cent radial (that is, equiproportonal) reduction in tariffs
- ten per cent radial reduction in Export Performance Benefit entitlement rates

The relevant exogenous variables to be changed are respectively the balance of trade deficit (ΔB), official exchange rate (ϕ_1), money supply (ms), economy-wide wage shifter (f_1), power of tariff (t_j), Export Performance Benefit entitlement rate (α_j), (Appendix A4.2 and A4.5). While the details about the simulations are left for the respective chapters, it is noted here that the changes in the above policy variables are assumed to be permanent and credible. As the shocks are very small, a one-step solution technique is to be employed in all cases.

Closures for the policy simulations

In order to compare the effects of various policy changes, identical model closures, which characterize the economic environments, are considered for all policy experiments. A set of 974 exogenous variables is to be chosen. The selection of exogenous variables has been discussed in Chapter 4, and a list of exogenous variables has been presented in Appendix A4.5. This list, however, defines a number of alternative economic environments both for the short run and the long run. This study is restricted to a short-run-one-period analysis of the effects of permanent policy changes. The closures for the policy simulation are selected accordingly.

Two alternatives closures, based on the assumptions about labour market, are considered for each experiments. In one closure, nominal wages are kept exogenously fixed in view of the existence of involuntary unemployment. In this case, changes in the demands for labour will bring about changes in the aggregate involuntary unemployment at fixed nominal wages. This closure is called the sticky-wage or Keynesian closure. The alternative closure in which aggregate employment is assumed to be fixed by the exogenous supply of labour, is called the Neoclassical closure. In this case, nominal wages change in response to policy changes. The experiment with changes in the nominal wages is pertinent to only the Keynesian closure.

Effects of policy changes under the Neoclassical closure can be estimated directly from those of the same policy and nominal wage changes under the Keynesian closure. For example, the impact of a 1 per cent devaluation of the official exchange rate on endogenous variables under the Neoclassical closure is simply the weighted average of the corresponding impact of a 1 per cent devaluation and that of a 1 per cent increase in nominal wages under the Keynesian closure, that is,

$$x_N^{\phi_1} = x_K^{\phi_1} + \frac{l_K^{\phi_1}}{-l_K^{w}} x_K^{w}$$

where $x_N^{\phi_1}$ is the percentage change in endogenous variable X, due to devaluation of the official exchange rate by, for example, 1 per cent (ϕ_1=1) under the Neoclassical (N) closure; $x_K^{\phi_1}$ and $l_K^{\phi_1}$ are respectively the percentage changes in variable X and aggregate employment (l) due to 1 per cent devaluation under the Keynesian (K) closure; and x_K^{w} and l_K^{w} are respectively the percentage changes in variable X and aggregate employment, due to a 1 per cent increase in nominal wages under the Keynesian closure.

Using similar formulae, the effects of changes in other exogenous variables under the Neoclassical closure can also be estimated directly from Keynesian effects. The policy experiments, nevertheless, are conducted under both the closures. These would save series of additional calculations if one or the other assumption about the labour market would seem likely to better reflect the situation in Bangladesh.

In both the closures, capital is treated as industry specific to characterize a short-run. Labour is the only primary factor mobile between sectors. The shift terms, the values of the indexing parameters and the Armington elasticities are so chosen as to keep the real private investment expenditures, real government consumption and investment expenditures, and inventory expenditure at the base-year levels. A rise in government revenue is disposed of by lump-sum subsidies to the households, and a fall in government revenue is met by a non-distorting taxes. The balance of trade deficit is set exogenously. In the first experiment with the exogenous inflow of foreign exchange, the trade deficit is raised exogenously by one million US dollars. In the remaining experiments, it is kept at the base-year level. A fixed balance of trade corresponds to a unitary marginal propensity to consume which is required for a one-period analysis (Chapter 4). The official exchange rate, money supply, powers of tariff, the Export Performance Benefit entitlement rates are changed exogenously. All the export volumes are determined endogenously. This is in keeping with the assumption of product differentiation that the domestic exports are differentiated from the comparable products of the rest of the world. As a result, the power of export taxes (one minus the *ad valorem* export tax rate) are exogenous. The endogenous foreign currency prices of exports are determined inversely with the volume of exports (see Equation 4.17 in Chapter 4). Thus the product differentiation assumption confers market power for Bangladesh exports. The *cif* world import prices in US dollars are set exogenously. Changes in foreign currency export price index thus measure changes in the economy's international terms of trade (TOT).

The powers of commodity taxes by end-use and the remaining shift terms complete the closures for policy simulations (see Appendix A4.5).

Numeraire. The index of *cif* world import prices in US dollars is considered as the numeraire. Other alternative candidates for numeraire were the nominal exchange rate (Dixon *et al.* 1982) and the GDP deflator (Dervis *et al.* 1982). Since a multiple exchange rate regime has been modelled, and the money market has been incorporated in the model, none of these alternatives was used as the numeraire. Johansen (1960), however, used fixed wage as numeraire in his path breaking model. The present model can not fix wage exogenously for all experiments.

Endogenous variables of interest

The above economy-wide policy simulations are to be conducted to estimate and analyse the directions and magnitudes of the resulting changes in important macroeconomic variables such as GDP, consumption, utility, inflation, employment (in the Keynesian case), secondary exchange rate, exports, imports, international terms of trade. Also, in a multi-sectoral setup, these policy changes has important implications at the microeconomic level in the form of inter-sectoral resource reallocation and output adjustments, which are to be examined and analysed. For each simulation, changes in welfare, measured by the change in utility under the assumption of a unitary marginal utility of income, are to be decomposed into its components using the Efficiency Equation derived in Chapter 4.

Interpretation of the simulation results

The simulation results are comparative static in nature. The time path of adjustments is not traced. The solution to an experiment is a set of values which are percentage changes of the base-year magnitudes of the endogenous variables. After a particular policy change the economy converges to a new equilibrium. As the model has been defined in linear percentage form, the model gives solution to the policy changes as percentage deviations of the endogenous variables from their base-year (or the `reference equilibrium') values. The time lag between the two equilibria is assumed to be sufficiently long to accommodate all the adjustments ensuing from the hypothetical policy changes so that the new equilibrium is converged to. The period necessary for restoring the equilibrium varies across industries and depends on whether the solution refers to short run or long term. In the model, a short run is referred to a period short enough not to allow mobility of, and addition to, the existing industrial capital. Cooper *et al.* (1985) indicated that a little less than two year period could accommodate the above phenomena for a typical industry in Australia.

Simulations yield conditional projections, and each simulation tends to be sensitive to a particular closure. It should be emphasized that while paramaterizing the CGE-B89 model, an extensive set of estimates have been used. This lends the model results to be sensitive to a particular set of parameter values. Also, construction of the model has been based on a number of simplifying behavioural assumptions. So, while interpreting the model results, the direction of changes is emphasized. The results are to be used for illustrative and indicative purposes, and not for forecasting purposes.

Appendix A5.1 Commodity/Industry Classification

In CGE-B89, each industry is assumed to produce only one distinct output which is an imperfect substitute for comparable imports. No multi-product industries and multi-industry products are considered. As a result, the number of industries is equal to the number of commodities; the industry classification completely represents commodity classification.

The 47 industries in the NBR Input-Output Table for 1989 are reduced to only 19 sectors in the database for CGE-B89. The aggregation has been done by simple arithmetic sums and thus implies that (i) all the intra-industry flows of and inter-industry flows among the constituent industries represent only intra-industry flows of the newly constituted industries, (ii) all the inter-industry flows into the constituent industries constitute intermediate purchases of the newly constituted industries to which they belong, and (iii) all outflows from the constituent industries represent intermediate sales of the aggregated industries to which they belong.

Under various considerations, many industries in the condensed input-output table have been taken straight from the 1989 NBR input-output table without any modification. Industries in the 1989 input-output table which produce the major exportables, namely, jute, tea, fish, ready-made garments, jute textiles and leather, have been kept as separate industries. Since one of the objectives of the various plans is the attainment of self-sufficiency in food, staple food producing industries, namely rice and wheat, have been considered as separate industries. Large industries such as sugar, paper, chemicals, which are highly protected have been taken from the 1989 original table individually without aggregation. It would be of interest to examine how they perform when protection is withdrawn partially or fully. The government has advanced various export incentives to develop backward linkages of the ready-made garment industry. In this regard, cotton textiles are of particular interest. To administer the various industrial policies such as tariffs and non-tariffs, the government has to incur costs. To see how public administration fares under trade liberalization, public administration has been considered as a separate non-tradable industry. A complete list of industries/commodities is given below in Table A5.1.

While implementing the model, industries/commodities are classified in three broad categories - exportables, importables, and non-tradables. In the presence of intra-industry trade, it is usually very difficult to classify strictly these into exportables and importables. Fortunately, for major exports namely, jute, fish, tea, and jute textiles, there are no imports, hence they can be clearly defined as exportables. Where intra-industry trade exists, exportables and importables are defined on the basis of the observed values of exports and imports in the input-output table. An industry whose export value far exceeds its import value is labelled as exportable. In some instances, earlier input-output tables have been consulted to double check that the choice is not accidental. Examples are, ready-made garments and leather. Intra-industry trade exists in these industries but exports far exceeded imports in both cases. They have thus been classified as exportables. All the industries producing various services (with no exports and no imports) are classified as non-tradables. Importables have thus been defined residually in Table A5.1.

Table A5.1: **Aggregation scheme used with 1989 I-O table**

19-Industry Classification	47-Industry Classification in 1989 I-O table[1]
I Exportables	
1. Jute	Jute: (Production, Processing, and Bailing)
2. Tea	Tea: (Production, Processing, and Blending)
3. Fish	Fish: (Rearing, Catching, and Processing)
4. Ready-made garments	Ready-made garments
5. Jute textiles	Jute textiles:(Jute textiles, carpets, Rugs, Cordage, Ropes, and Twines)
6. Leather	Leather and leather products
7. Forestry	Forestry
II. Importables	
8. Rice	Rice: (growing and processing)
9. Wheat	Wheat:(growing and processing)
10. Edible oil	Edible oil
11. Other agriculture	Other crops, Sugar-cane production, Cotton production and ginning, Raw tobacco production, Salt, Livestock including hides, and skin
12. Sugar	Sugar
13. Cotton textiles	Cloth:Mill, Cloth:Handloom
14. Paper	Paper
15. Chemicals	Chemicals
16. Other manufactures	Fertilizer, Pharmaceutical, Petroleum products, Metal products, Steel and Basic Metal, Machinery, Wood and Wood Products Transport equipment.
III. Non-tradables	
17. Physical overheads	House building, Other construction, Electricity, Gas, Trade, and Transport services, Banking, Insurance, Housing services,
18. Social overheads	Health, and Education services
19. Public administration	Public administration services, Professionals and Others

Note: [1]Names in parentheses are the constituent industries of the 1989 NBR I-O table.

Source: Bangladesh, Government of, 1991. Input-output table: 1988-89, mimeo, National Board of Revenue, Dhaka.

Table A5.2: **Sectoral characteristics of CGE-B89 database,** 1989

	Zj (in mil.taka)	VAj/Zj	Kj/Lj	Ej/Zj	FMj/FDTj	TMj/Zj	IMj/ITj
Exportables							
Jute	9335.94	0.617	0.055	0.340	n.a.	n.a.	0.065
Tea	7784.96	0.729	13.45	0.012	n.a.	n.a.	0.348
Fish	35005.03	0.756	0.433	0.119	n.a.	n.a.	0.092
Forestry	31704.76	0.788	6.024	n.a.	n.a.	n.a.	0.017
Ready-made garments	10713.60	0.312	0.523	0.866	0.156	0.022	0.079
Jute textiles	10203.81	0.442	0.084	0.834	n.a.	n.a.	0.073
Leather	4982.98	0.395	0.723	0.842	n.a.	0.003	0.159
Importables							
Rice	164498.01	0.747	0.772	n.a.	0.002	0.010	0.038
Wheat	6627.54	0.770	0.826	n.a.	0.657	1.158	0.344
Edible oil	11293.30	0.307	2.457	n.a.	0.634	0.809	0.050
Other agriculture	151517.13	0.664	1.398	0.004	0.106	0.104	0.061
Sugar	12454.97	0.332	0.671	n.a.	0.386	0.497	0.019
Cotton textiles	20484.68	0.334	0.126	n.a.	0.223	0.250	0.178
Paper	10820.67	0.150	0.899	0.031	0.320	0.362	0.128
Chemicals	23571.37	0.261	7.822	n.a.	0.433	0.407	0.087
Other manufactures	110582.88	0.308	1.414	0.011	0.800	0.871	0.197
Non-tradables							
Physical overheads	277867.63	0.675	2.095	n.a.	n.a.	n.a.	0.107
Social overheads	27932.04	0.892	0.124	n.a.	n.a.	n.a.	0.323
Public administration	78172.12	0.830	0.535	n.a.	n.a.	n.a.	0.160
Total	1005553.42	0.631	1.119	0.031	0.157	0.163	0.113

Notes: Z_j is sectoral output; VA_j is sectoral value-added; K_j is sectoral value-added to capital; L_j is sectoral value-added to labour; E_j sectoral exports; FM_j is sectoral final imports; FDT_j total final demand for industry *j*th output; TM_j total *j*th import; IM_j imported intermediates; IT_j total value of intermediate inputs used in industry *j*. All values are at the basic prices defined in Chapter 5.

Source: CGE-B89 database

INTERMEDIATE INPUTS FROM DOMESTIC SOURCE AT THE BASIC PRICES, 1988-89

(In million Taka)

	Rice	Wheat	Jute	Tea	Fish	Forestry	Edl_oil	Oth_agri	Sugar	Cottext	Rdmdgar	Juttext	Paper	Leather	Chemicals	Oth_manu	Phy_Over	Sociover	Pub_admn	Total inputs
Rice	10217.22	0.00	0.00	0.00	0.00	0.00	0.00	11856.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.66	0.00	46.61	326.89	22453.38
Wheat	0.00	129.83	0.00	0.00	0.00	0.00	0.00	2571.24	0.00	0.00	0.00	0.00	0.00	0.00	19.12	0.00	0.00	4.15	39.86	2764.20
Jute	2.61	0.00	40.23	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	55.22	0.00	0.00	98.06
Tea	0.00	0.00	0.00	12.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	2.92	24.31	40.38
Fish	0.00	0.00	0.00	0.00	294.65	0.00	0.00	39.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.82	11.38	221.95	618.64
Forestry	2085.08	40.42	1.70	29.24	210.55	1856.33	0.00	742.50	211.15	24.23	0.00	0.00	1439.49	221.82	1728.39	3403.58	2178.59	0.00	0.00	14173.07
Edl_oil	0.00	0.00	0.00	0.00	44.62	0.00	224.07	5956.85	0.00	0.00	0.00	0.00	0.00	0.00	6.62	0.06	0.00	2.26	28.97	6263.45
Oth_agri	15092.52	338.34	1165.19	0.00	0.00	1.34	6043.11	6559.82	5721.95	40.32	0.00	0.23	120.64	20.09	5129.67	3529.92	1.55	38.49	180.36	43983.54
Sugar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2852.61	0.00	0.00	0.00	0.00	16.28	0.00	5.57	52.05	0.00	1.68	26.63	2954.82
Cottext	0.00	0.00	0.00	0.00	95.94	0.00	0.00	0.00	0.00	628.05	2507.29	0.00	0.38	5.08	17.10	162.90	711.95	148.29	716.49	4993.47
Rdmdgar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	214.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	214.06
Juttext	70.03	5.63	0.61	1.48	247.68	0.77	17.63	84.40	65.42	3.18	0.00	54.14	7.71	3.57	1.58	255.98	20.75	8.63	9.82	859.01
Paper	0.00	0.00	0.00	2.16	214.14	0.00	4.41	543.71	2.27	224.30	376.36	49.61	961.74	128.06	385.03	2474.41	358.42	51.87	612.07	6388.56
Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	68.84	13.41	0.84	19.45	0.00	0.00	102.78
Chemicals	53.22	0.18	1.35	0.67	170.96	0.67	31.49	1258.45	164.26	2644.92	0.00	221.67	837.08	558.03	3165.44	5410.12	4025.10	56.43	126.03	18726.07
Oth_manu	7623.60	206.05	251.93	81.78	2237.96	403.57	316.49	4302.30	136.98	4603.52	1380.43	1608.16	607.48	70.94	2005.56	20772.61	42043.18	1424.52	3583.45	93660.51
Phy_Over	3533.98	252.43	1771.07	806.99	3800.05	3659.15	724.46	10104.27	1626.44	2784.11	1249.66	2222.59	1937.95	1369.43	2979.03	22459.24	25274.76	193.01	2669.84	89418.46
Sociover	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	81.04	0.00	0.00	81.04
Pub_admn	782.90	11.32	86.07	414.16	110.60	653.45	24.40	517.46	191.42	60.44	929.09	847.78	1812.75	62.29	172.77	1000.94	2316.27	37.89	2263.06	12295.06
	39461.16	984.20	3318.15	1348.99	7427.15	6575.28	7386.06	47389.45	8119.89	11013.07	6656.89	5004.18	7741.74	2508.15	15629.29	59529.31	77137.74	2028.13	10829.73	320088.56

APPENDIX A5.2 (continued)

INTERMEDIATE INPUTS FROM IMPORTED SOURCE AT THE BASIC PRICES, 1988-89

(In million Taka)

	Rice	Wheat	Jute	Tea	Fish	Forestry	Edl_oil	Oth_agri	Sugar	Cottext	Rdmdgar	Juttext	Paper	Leather	Chemicals	Oth_manu	Phy_Over	Sociover	Pub_admn	Total inputs
Rice	484.28	0.00	0.00	0.00	0.00	0.00	0.00	683.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	6.89	154.15	49.16	1379.79
Wheat	0.00	99.10	0.00	0.00	0.00	0.00	0.00	164.39	0.00	0.00	0.00	0.00	0.00	0.00	2.68	0.00	0.87	13.72	5.99	286.75
Jute	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
Tea	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
Fish	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
Forestry	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
Edl_oil	0.00	0.00	0.00	0.00	10.86	0.00	12.53	351.31	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.03	2.53	7.09	4.12	389.35
Oth_agri	715.37	258.26	189.64	0.00	0.00	0.35	354.25	547.64	0.00	0.00	0.00	0.00	0.00	0.00	700.30	183.25	23.74	79.39	26.42	3078.61
Sugar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	178.10	0.00	0.00	0.00	0.00	7.00	0.00	0.76	22.67	3.59	5.41	3.90	221.43
Cottext	0.00	0.00	0.00	0.00	24.73	0.00	0.00	0.00	0.00	144.12	331.25	0.00	0.00	2.85	2.40	30.01	43.73	32.24	78.52	689.85
Rdmdgar	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
Juttext	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
Paper	0.00	0.00	0.00	15.70	52.67	0.00	0.25	103.78	1.08	50.37	47.45	9.30	406.09	68.40	51.57	587.74	153.86	46.43	305.32	1900.01
Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.34	0.00	0.00	0.12	44.17	2.16	2.89	57.34	0.00	0.00	110.02
Chemicals	2.32	0.13	0.20	4.72	40.50	0.16	1.71	155.66	75.13	507.02	0.00	40.04	340.39	287.06	408.29	2409.92	470.56	21.19	668.28	5433.28
Oth_manu	383.64	166.22	43.90	707.02	617.92	107.47	20.48	828.63	76.18	1432.15	193.69	349.98	352.32	39.64	282.30	11012.81	8357.66	567.75	852.80	26392.56
Phy_Over	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
Sociover	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
Pub_admn	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
	1585.61	523.71	233.74	727.44	746.68	107.98	389.22	3013.23	152.39	2137.00	572.39	399.32	1105.92	442.12	1451.34	14250.91	9120.77	927.37	1994.51	39881.65

APPENDIX A5.2 (continued)
INDIRECT TAXES ON INTERMEDIATE INPUTS FROM DOMESTIC SOURCE, 1988-89

(in million Taka)

	Rice	Wheat	Jute	Tea	Fish	Forestry	Edi_oil	Oth_agri	Sugar	Cottext	Rdmdgar	Juttext	Paper	Leather	Chemicals	Oth_manu	Phy_Over	Sociover	Pub_admn	
Rice	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
Wheat	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
Jute	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
Tea	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.25	0.42
Fish	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
Forestry	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
Edi_oil	0.00	0.00	0.00	0.00	0.02	0.00	0.10	2.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	2.77
Oth_agri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.08	0.03	2.32
Sugar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.50	0.00	0.00	0.00	0.00	0.47	0.00	0.16	1.51	0.00	0.05	0.77	85.46
Cottext	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	2.05	8.18	0.00	0.00	0.02	0.06	0.43	0.82	0.13	0.89	12.89
Rdmdgar	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
Juttext	9.12	0.73	0.08	0.19	32.26	0.10	2.30	10.99	8.52	0.41	0.00	7.05	1.00	0.47	0.21	33.34	2.70	1.12	1.28	111.87
Paper	0.00	0.00	0.00	0.04	3.93	0.00	0.08	9.98	0.04	4.12	6.91	0.91	17.65	2.35	7.07	45.42	6.58	0.95	11.24	117.27
Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	10.28	2.00	0.13	2.90	0.00	0.00	15.35
Chemicals	0.80	0.00	0.02	0.01	2.56	0.01	0.47	18.87	2.46	39.66	0.00	3.32	12.55	8.37	47.47	81.13	60.36	0.85	1.89	280.80
Oth_manu	494.57	12.08	19.25	11.73	291.11	24.47	34.10	202.51	20.38	149.72	115.51	233.62	204.67	4.30	130.69	906.28	2923.18	11.10	261.18	6050.45
Phy_Over	2.43	0.93	0.91	15.11	2.62	2.52	4.96	117.62	9.36	3.93	1.93	23.24	31.18	2.01	82.90	816.34	595.43	0.96	27.85	1742.23
Sociover	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
Pub_admn	4.96	0.05	0.50	0.09	0.67	0.02	0.12	2.59	0.94	0.37	5.63	3.97	12.34	0.35	0.78	5.78	6.87	0.03	10.14	56.20
	511.88	13.79	20.76	27.30	333.48	27.12	42.13	449.88	41.70	200.26	138.16	272.11	279.90	28.15	271.36	1890.36	3598.86	15.30	315.53	8478.03

APPENDIX A5.2 (continued)
SALES TAXES ON INTERMEDIATE INPUTS FROM IMPORTED SOURCE, 1988-89

(in million Taka)

	Rice	Wheat	Jute	Tea	Fish	Forestry	Edi_oil	Oth_agri	Sugar	Cottext	Rdmdgar	Juttext	Paper	Leather	Chemicals	Oth_manu	Phy_Over	Sociover	Pub_admn	Total input
Rice	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
Wheat	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
Jute	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
Tea	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
Fish	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
Forestry	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
Edi_oil	0.00	0.00	0.00	0.00	0.62	0.00	0.71	20.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.14	0.40	0.24	22.18
Oth_agri	0.00	0.00	0.00	0.00	0.00	0.00	2.65	5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.07	1.82	3.03	0.31	13.60
Sugar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.86	0.00	0.00	0.00	0.00	0.39	0.00	0.04	1.26	0.20	0.30	0.22	12.27
Cottext	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.07	0.17	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.04	0.35
Rdmdgar	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
Juttext	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
Paper	0.00	0.00	0.00	1.01	3.38	0.00	0.02	6.67	0.07	3.24	3.05	0.60	26.09	4.40	3.31	37.76	9.89	2.98	19.62	122.09
Leather	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
Chemicals	0.24	0.01	0.02	0.48	4.11	0.02	0.17	15.79	7.62	51.44	0.00	4.06	34.54	29.12	41.42	244.51	47.74	2.15	67.80	551.24
Oth_manu	1.16	0.28	0.23	4.08	32.20	5.00	0.23	13.84	1.92	242.26	3.40	11.01	6.07	2.36	16.72	554.48	445.42	39.76	47.26	1427.68
Phy_Over	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
Sociover	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
Pub_admn	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
	1.40	0.29	0.25	5.57	40.32	5.02	3.78	71.78	9.61	297.01	6.62	15.67	67.09	35.88	61.66	838.10	505.23	48.64	135.49	2149.41
Tot int dem	41560.05	1521.99	3572.90	2109.30	8547.63	6715.40	7821.19	50924.34	8323.59	13647.34	7374.06	5691.28	9194.65	3014.30	17413.65	76508.68	90362.60	3019.44	13275.26	370597.65

APPENDIX A5.2 (continued)
VALUE ADDED AND TOTAL COSTS IN THE 1988-89 INPUT-OUTPUT TABLE (in million Taka)

	Rice	Wheat	Jute	Tea	Fish	Forestry	Edi oil	Oth agri	Sugar	Cottext
Labour	69370.27	2795.67	5460.53	392.77	18458.67	3557.63	1004.43	41944.28	2472.35	6069.57
Capital	53567.69	2309.88	302.51	5282.89	7998.73	21431.73	2467.68	58648.51	1659.03	767.77
Val-added	122937.96	5105.55	5763.04	5675.66	26457.40	24989.36	3472.11	100592.79	4131.38	6837.34
Total costs	164498.01	6627.54	9335.94	7784.96	35005.03	31704.76	11293.30	151517.13	12454.97	20484.68

	Rdmdgar	Juttext	Paper	Leather	Chemicals	Oth manu	Phy Over	Sociover	Pub admn	Total
Labour	2193.19	4163.52	856.40	1142.67	697.99	14113.00	60591.37	22155.30	42273.53	299713.14
Capital	1146.35	349.01	769.62	826.01	5459.73	19961.20	126913.66	2757.30	22623.33	335242.63
Val-added	3339.54	4512.53	1626.02	1968.68	6157.72	34074.20	187505.03	24912.60	64896.86	634955.77
Total costs	10713.60	10203.81	10820.67	4982.98	23571.37	110582.88	277867.63	27932.04	78172.12	1005553.42

APPENDIX A5.2 (continued)
FINAL DEMANDS FROM DOMESTIC SOURCES AT THE BASIC PRICES,1988-89

	HH_Con	HH_Inv	Inventry	Govt_Con	Govt_Inv	Exports	Dom. sales	Total sales
Rice	142812.20	0.00	-767.57	0.00	0.00	0.00	164498.01	164498.01
Wheat	4068.79	0.00	-205.45	0.00	0.00	0.00	6627.54	6627.54
Jute	6027.41	0.00	39.42	0.00	0.00	3171.05	6164.89	9335.94
Tea	7455.19	0.00	199.66	0.00	0.00	89.73	7695.23	7784.96
Fish	30202.67	0.00	20.73	0.00	0.00	4162.99	30842.04	35005.03
Forestry	17517.70	0.00	11.96	0.00	0.00	2.03	31702.73	31704.76
Edi_oil	5032.06	0.00	-2.21	0.00	0.00	0.00	11293.30	11293.30
Oth_agri	106599.30	0.00	255.06	0.00	0.00	679.23	150837.90	151517.13
Sugar	9130.15	0.00	370.00	0.00	0.00	0.00	12454.97	12454.97
Cottext	15433.87	0.00	57.34	0.00	0.00	0.00	20484.68	20484.68
Rdmdgar	1185.85	0.00	37.83	0.00	0.00	9275.86	1437.74	10713.60
Juttext	963.04	0.00	-123.46	0.00	0.00	8505.22	1698.59	10203.81
Paper	4086.42	0.00	5.82	0.00	0.00	339.87	10480.80	10820.67
Leather	507.51	0.00	179.39	0.00	0.00	4193.30	789.68	4982.98
Chemicals	4852.84	0.00	-19.08	0.00	0.00	11.54	23559.83	23571.37
Oth_manu	15481.10	335.39	-57.24	0.00	0.00	1163.12	109419.76	110582.88
Phy_Over	148249.58	40199.59	0.00	0.00	0.00	0.00	277867.63	277867.63
Sociover	15172.67	0.00	0.00	12678.33	0.00	0.00	27932.04	27932.04
Pub_admn	39115.01	0.00	0.00	26762.05	0.00	0.00	78172.12	78172.12
	573893.36	40534.98	2.20	39440.38	0.00	31593.94	973959.48	1005553.42

APPENDIX A5.2 (continued)
FINAL DEMANDS, IMPORT COMPONENT,AT THE BASIC PRICES, 1988-89 (in mil Taka)

	HH_Con	HH_Inv	Inventry	Govt_Con	Govt_Inv	Impotrts(basic)	Tariffs	Scar-Prem	Imports (cif)
Rice	307.86	0.00	-1.65	0.00	0.00	1686.00	0.00	0.00	1686.00
Wheat	7778.00	0.00	-392.74	0.00	0.00	7672.01	0.00	0.00	7672.01
Jute	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Edi_oil	8265.25	0.00	-3.63	0.00	0.00	8650.97	1575.81	165.02	6910.14
Oth_agri	12263.40	0.00	41.47	0.00	0.00	15383.48	568.79	345.54	14469.15
Sugar	5591.55	0.00	226.60	0.00	0.00	6039.58	1111.38	114.95	4813.25
Cottext	4372.02	0.00	65.57	0.00	0.00	5127.44	551.46	106.73	4469.25
Rdmdgar	219.98	0.00	7.02	0.00	0.00	227.00	0.00	5.29	221.71
Juttext	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paper	1839.91	0.00	2.62	0.00	0.00	3742.54	782.20	69.05	2891.29
Leather	9.10	0.00	-102.10	0.00	0.00	17.02	0.00	0.40	16.62
Chemicals	3413.88	0.00	-13.42	0.00	0.00	8833.74	2360.43	150.98	6322.33
Oth_manu	44071.38	29714.28	1557.09	0.00	0.00	101735.31	11529.92	2103.97	88101.42
Phy_Over	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sociover	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pub_admn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	88132.33	29714.28	1386.83	0.00	0.00	159115.09	18479.99	3061.94	137573.16

TAXES ON FINAL DEMANDS IN THE DOMESTIC COMPONENT OF THE 1988-89 I-O TABLE

	HH_Con	HH_Inv	Inventry	Govt_Con	Govt_Inv	On domestic sales	Exp_premium
Rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jute	0.00	0.00	0.00	0.00	0.00	0.00	15.12
Tea	76.63	0.00	2.05	0.00	0.00	79.10	1.17
Fish	0.00	0.00	0.00	0.00	0.00	0.00	87.87
Forestry	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Edi_oil	2.23	0.00	0.00	0.00	0.00	5.00	0.00
Oth_agri	126.35	0.00	0.24	0.00	0.00	128.91	6.45
Sugar	264.05	0.00	10.70	0.00	0.00	360.21	0.00
Cottext	3.94	0.00	-0.04	0.00	0.00	16.79	0.00
Rdmdgar	0.00	0.00	0.00	0.00	0.00	0.00	206.42
Juttext	125.42	0.00	-16.08	0.00	0.00	221.21	80.73
Paper	75.01	0.00	0.11	0.00	0.00	192.39	2.83
Leather	89.20	0.00	13.34	0.00	0.00	117.89	87.54
Chemicals	72.77	0.00	-0.29	0.00	0.00	353.28	0.08
Oth_manu	3543.00	27.84	-98.75	0.00	0.00	9522.54	11.04
Phy_Over	74.79	0.00	0.00	0.00	0.00	1817.02	0.00
Sociover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pub_admn	259.47	0.00	0.00	0.00	0.00	315.67	0.00
	4712.86	27.84	-88.72	0.00	0.00	13130.01	499.26

SALES TAXES ON FINAL DEMANDS IN THE IMPORT COMPONENT OF THE 1988-89 I-O TABLE

	HH_Con	HH_Inv	Inventry	Govt_Con	Govt_Inv	On total imports
Rice	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00
Jute	0.00	0.00	0.00	0.00	0.00	0.00
Tea	0.00	0.00	0.00	0.00	0.00	0.00
Fish	0.00	0.00	0.00	0.00	0.00	0.00
Forestry	0.00	0.00	0.00	0.00	0.00	0.00
Edi_oil	471.06	0.00	-0.21	0.00	0.00	493.03
Oth_agri	432.87	0.00	4.40	0.00	0.00	450.87
Sugar	309.61	0.00	12.55	0.00	0.00	334.43
Cottext	2.19	0.00	0.03	0.00	0.00	2.57
Rdmdgar	0.00	0.00	0.00	0.00	0.00	0.00
Juttext	0.00	0.00	0.00	0.00	0.00	0.00
Paper	118.22	0.00	0.17	0.00	0.00	240.48
Leather	0.00	0.00	0.00	0.00	0.00	0.00
Chemicals	346.37	0.00	-1.36	0.00	0.00	896.25
Oth_manu	1712.02	-328.11	20.82	0.00	0.00	2832.41
Phy_Over	0.00	0.00	0.00	0.00	0.00	0.00
Sociover	0.00	0.00	0.00	0.00	0.00	0.00
Pub_admn	0.00	0.00	0.00	0.00	0.00	0.00
	3392.34	-328.11	36.40	0.00	0.00	5250.04

Source: Bangladesh, Government of, 1991. 'Input-output table: 1988-89', mimeo, National Board of Revenue, Dhaka.

6

FOREIGN AID INFLOW AND ESTIMATION OF THE SHADOW EXCHANGE RATE

In this chapter experiments are carried out to show the effects of an exogenous inflow of foreign aid so that the shadow price of foreign exchange for the economy can be estimated. The effects of foreign aid on the economy and, in particular, on the tradable sector are also demonstrated.

Approaches to shadow pricing the foreign exchange

The shadow price of foreign exchange, or shadow exchange rate, is the marginal social value of a unit of foreign exchange, conventionally measured at domestic prices reflecting marginal utilities in consumption. If the shadow exchange rate is estimated without removing the prevailing policy distortions (Harberger 1968, Schydlowsky 1968, Dasgupta, Marglin and Sen 1972, Jenkins and Kuo 1984), it is called the `second-best' shadow price of foreign exchange.

Fane (1991) explicitly distinguishes two concepts of the shadow price of foreign exchange: the *absolute* and *relative* shadow prices of foreign exchange. The *absolute* shadow price of foreign exchange is defined as the increase in welfare resulting from the costless increase in foreign exchange availability by one unit. The costless increase in foreign exchange availability may arise, for instance, due to increased foreign aid receipts or technical innovations. The ratio of the increase in utility to the marginal utility of income measures the increase in welfare. Hence under the assumption of unitary marginal utility of income, the additional utility due to increased foreign aid receipts of one unit measures the shadow exchange rate. The absolute shadow price under the assumption of unitary marginal utility of income is also called the shadow price of foreign exchange in utility numeraire (Warr, 1980). The *relative* shadow price of foreign exchange is defined as the maximum amount of good *n*, the numeraire, that can be used up in a project which generates a unit of foreign exchange such that the welfare level (which, as noted before, is measured by the utility level under the assumption of unitary marginal utility of income) remains the same. The relative shadow price of foreign exchange can be estimated by the ratio of the absolute shadow price of foreign exchange to the absolute shadow price of the numeraire. When the foreign exchange is taken as the numeraire, as in the case in Sieper (1981), the relative shadow price of foreign exchange (or what Sieper would have called the compensated shadow price of foreign exchange) is always unity.

In the literature on the shadow price of foreign exchange, two different approaches to shadow pricing of foreign exchange are identified: the *traditional* partial equilibrium approach (Harberger 1965 and 1969, Schydlowsky 1968, Fontaine 1969, Bacha and Taylor 1971, Dasgupta, Marglin and Sen 1972, Balassa 1974a, Boadway and Bruce 1984) and the *modern* general equilibrium approach as set out in the surveys of Dreze and Stern (1987) and Squire (1989).

The general equilibrium approach to shadow pricing of foreign exchange is based on a fully specified general equilibrium model. Both the absolute and relative shadow prices of foreign exchange can be measured within the general equilibrium framework. With suitable transformation, the marginal utility of income may be normalized at unity. Then, the absolute shadow price of foreign exchange is the reduced form partial derivative of utility, with respect to a costless increase in foreign exchange availability. This equals the increase in total consumption valued at unchanged consumer prices, due to the costless increase in foreign exchange (Fane 1991:308, equation 3). The relative shadow price of foreign exchange, in the general equilibrium framework, is simply the quotient of the absolute shadow price of foreign exchange to the absolute shadow price of the numeraire.

The traditional partial equilibrium approach to shadow pricing foreign exchange is based on what Bacha and Taylor (1971) coined the Harberger-Schydlowsky-Fontaine formula (see Harberger 1965, 1969, Schydlowsky 1968 and Fontaine 1969). Harberger defines the shadow price of foreign exchange as the

> weighted average of the exchange rate governing exports, and the internal values that a dollar's worth of foreign exchange produces when spent on imports in the various categories. The weights are the fractions in which an extra dollar of net government demand for foreign exchange will be reflected in increased exports on the one hand and in reduced imports of the various categories on the other (1969:83).

The Harberger-Schydlowsky-Fontaine formula for an economy with zero public sector initial net demand for foreign exchange, untaxed exports, only one category of imports and an *ad valorem* tariff at a rate *t* imposed on it, is

$$E_S = \frac{1.\nu + (1+t)(-\eta)}{\nu - \eta} \qquad (6.1)$$

where E_S is the social opportunity cost of foreign exchange; ν and η are, respectively, the elasticities of the private sector's supply of exports and demand for imports; and 1 and (1+t) stand for the ratios of domestic to border prices for exports and imports, respectively (equation 5 in Harberger 1969).

The traditional approach is alleged not to recognise the distinction between the relative and absolute shadow price of foreign exchange. It is alleged that the formula similar to Equation (6.1) is intended for measuring only the absolute shadow price of foreign exchange. Fane (1991), based on the discussion by Tower and Pursell (1987), shows that Equation (6.1) measures the absolute shadow price of foreign exchange if the elasticities, ν and η, are derived from the `general equilibrium supply and demand loci along which the economy adjusts in response to an uncompensated increase in the availability of foreign exchange'. It measures the relative shadow price of foreign exchange with a non-traded good as numeraire if these elasticities are derived from the compensated (Hicksian) schedules. Following the discussion in Tower and Pursell (1987:329), Fane also demonstrates that if all income effects are concentrated on an untaxed non-tradable good taken as the numeraire (i.e. if a quasi-linear utility function is considered which justifies the partial equilibrium analysis), then the absolute shadow price of foreign exchange is equivalent to the relative shadow price of foreign exchange, and the traditional partial equilibrium analysis is equivalent to the modern general equilibrium analysis.

With the appropriate assumptions, either of the above two approaches can be used to estimate the shadow exchange rate for Bangladesh. The modern general equilibrium approach has been adopted here to estimate the absolute shadow price of foreign exchange because a computable general equilibrium model examines the intersectoral adjustments and permits more flexibility, greater transparency and tractability than the partial equilibrium model.

Determinants of shadow exchange rate

In a world with competitive trade equilibrium and without any distortions, the market exchange rate measures the social value of a unit of foreign exchange. Yet numerous distortions including a wide range of trade taxes and subsidies, and quantitative restrictions on a variety of commodities are frequently imposed for many reasons. The exchange rate is also fixed exogenously by the central authority with slow or no adjustments for changes in demand for, and supply of, foreign exchange. Consequently, the market exchange rate fails to reflect the shadow exchange rate of the economy. The shadow exchange rate thus exceeds the official exchange rate. This is the case in Bangladesh.

A number of theoretical papers (Harberger 1965, 1972, Bacha and Taylor 1971, Dasgupta, Marglin and Sen 1972, Balassa 1974a, 1974b, Scott 1974, Boadway 1978, Blitzer, Dasgupta and Stiglitz 1981) have identified various distortions which create divergence between market and shadow exchange rates. Jenkins (1977) and Blitzer *et al.* (1981) emphasise that the wedge between market and shadow exchange rates depends both on the types of distortions prevalent in the economy, and the method that the government uses to finance the purchase of foreign exchange to bridge the trade deficit. Important policy distortions and the method of financing have been taken into account, in stylised form, to estimate the shadow exchange rate for the Bangladesh economy.

Two rival views exist on the issue of policy distortions. Some economists are of the opinion that the shadow exchange rate should correspond to optimal policies; that is, the shadow exchange rate should be estimated on the assumption that all policy distortions are removed and optimum policies are realised (Bruno 1965, Bacha and Taylor 1971, Balassa 1974a). The shadow exchange rate estimated on this assumption is sometimes called the `first-best' shadow exchange rate. In contrast, Harberger (1965), Schydlowsky (1968), Dasgupta *et al.* (1972), Jenkins (1977), and Jenkins and Kuo (1984), among others, have taken the view that in valuing foreign exchange, the continuation of existing policies should be assumed. The shadow exchange rate may then be termed a `second-best' shadow exchange rate. Given the fact that Bangladesh has a long tradition of taxes, tariffs, subsidies and quantitative restrictions, it is not likely that distorting policies will be removed or even reformed significantly in the immediate future. The second assumption seems to be more realistic in estimating the shadow exchange rate for Bangladesh. Existing distortions have been assumed to remain unchanged during the period in which the shadow exchange rate is relevant. Therefore the `second-best' shadow exchange rate, rather than the `first-best' shadow exchange rate, has been estimated for the Bangladesh economy.

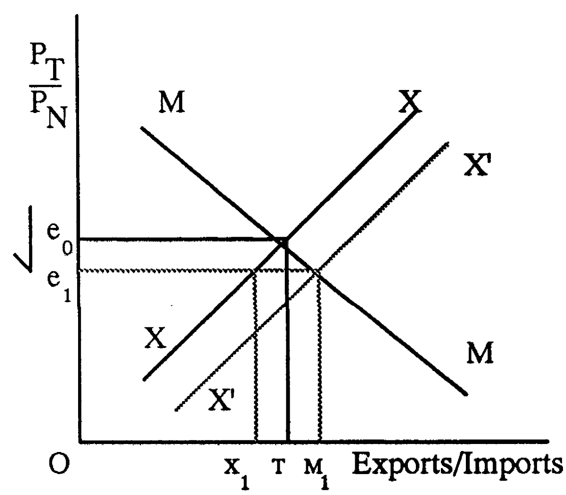
Given the economy's dependence on foreign aid (Table 2.13), it is assumed that an additional unit of foreign exchange is made available by an increased inflow of exogenous foreign aid. The experiment with the foreign aid inflow serves twin purposes: it allows the calculation of the shadow price of foreign exchange, and it examines the impact of foreign aid on the economy and, in particular, on the tradable sector, in a general equilibrium framework.

Effects of foreign aid on the tradable sector: an analytical framework

An inflow of foreign aid relaxes the limits set by the low domestic savings and scarce foreign exchange to investment in Bangladesh. But it is also depresses the national savings and the growth of the Bangladesh economy (Sobhan and Islam 1988, Fry 1984). Additional foreign aid, *ceteris paribus*, leads to an appreciation of the secondary exchange rate. This, in turn, erodes the competitiveness of the tradable sectors and may cause a contraction of the importable and exportable sectors. Resource movement effects and spending effects of additional foreign aid may indirectly lead to an increase in production of the non-tradables. This study thus explores the possibility whether foreign aid creates the same effects on the economy as are explained by Dutch disease, due to an appreciation of the real exchange rate, defined as the ratio of the price of traded goods to the price of non-traded goods (Cordon and Neary 1982, Cordon 1984).

Figure 6.1 illustrates the effects of foreign aid on the exchange rate, exports, imports.. While it illustrates the general equilibrium effects in a partial-equilibrium framework, the essence of the analysis remains largely unaffected for a general equilibrium framework. To maintain the analytical simplicity, it is assumed that imports and domestic goods are perfect substitutes as are domestic sales and exports. The international terms of trade is assumed to be fixed. Given tariffs, export subsidies, and other taxes, the relative prices of imports, import-competing goods, exports and exportables consumed domestically are all constant. The vertical axis measures the price of traded (P_T) relative to the price of non-traded goods (P_N), the real exchange rate. The horizontal axis measures the volumes of exports (X) and imports (M) in units so chosen as to equate a unit of imports to a unit of exports.

Figure 6.1 **Effects of foreign aid on the real exchange rate, exports and imports**



The curve MM represents the demand for imports and the curve XX indicates the supply of exports at various price ratios. The intersection of the curves MM and XX determines the real exchange rate for the economy. Export equals import at T corresponding to the point of intersection, which with zero net capital movements defines an overall external balance. Additional foreign aid shifts the XX curve to X'X'. The real exchange rate appreciates from e_0 to e_1; that is, the relative price of traded to non-traded goods falls. Import increases from T to M_1; but supply of domestic exports contracts from T to X_1.

Experiment: increase in the balance of trade deficit

The multi-sectoral general equilibrium model, CGE-B89, has been simulated, under the economic closures chosen in Chapter 5, to evaluate the absolute shadow price of foreign exchange, and to examine the impacts of foreign aid. The absolute shadow price of foreign exchange has been estimated in the presence of the fiscal and trade distortions modelled. In Bangladesh, the government receives foreign aid to buy imports for different projects. An additional unit of foreign aid is assumed to be received by the government and released into the economy by reducing lump-sum taxes with no accompanying reduction in distorting tax rates. The reduction in lump-sum taxes is endogenously determined to equal the exogenous increase in foreign aid plus the endogenous increase in government revenue from all distorting taxes, net of the extra cost of all distorting subsidies. The inflow of foreign aid permits an exactly equal increase in the balance of trade deficit. The increase in the balance of trade deficits (see Equation 28 in Appendix A4.2) by one unit, which for the 1989 data-set constructed for the CGE-B89, means an increase by one million US dollars. Increases in foreign exchange allow increased spending and induce changes within the economy. Through the general equilibrium adjustments, this results in an increase in household's consumption and, hence, in its utility. Under the unitary-marginal-utility-of-income assumption, a change in the utility of the consumer thus measures the shadow price of foreign exchange for Bangladesh.

Effects of the increase in foreign aid inflow

Tables 6.1a through 6.3b present the effects of foreign aid inflow on important macroeconomic variables. Because the model was specified in percentage changes, the model solutions gave the effects of foreign aid in percentage changes. Value changes at constant prices are calculated and presented in the tables. In a general equilibrium framework, both quantities and prices are endogenously determined unless otherwise specified under the closures. The constant price value change is the one-hundredth of the product of percentage change in quantity and the base-year value of the relevant variable. The percentage change in world export price index is, however, multiplied by the base-year export values to estimate the terms of trade effects.

Table 6.1a **Changes in the key macroeconomic variables[a] due to exogenous inflow of US$1 (or taka 32.14) million worth of foreign exchange under the Keynesian closure**

	value (mil. taka)	(%)
	Constant price changes of variables[b]	
Increased employment	5.27	0.002
Indirect taxes[c]	3.88	0.010
GDP at market price	9.15	0.001
Terms of trade effects[d]	1.04	0.003
Increased foreign aid	32.14	
Consumption[e]	42.33	0.006

Note: [a] For data comparability see Appendix A6.1 on Technical Notes.
[b]Percentages correspond to quantity changes, except for the terms of trade effect in which case it is percentage change in the world export price index. The value changes refer to changes in variables due to changes in quantities only (i.e., at the base-year prices).
[c]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus subsidies under the Export Performance Benefit Scheme. For disaggregated effects on various indirect tax revenues see Table 6.8.
[d]Defined as the product of the base-year total export value (*fob*) and the after-shock change in the border price index of exports (see the Efficiency Equation 4.56).
[e]Value change in consumption equals change in the utility.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and model simulation

The directions of macroeconomic responses to the exogenous inflow of foreign exchange were similar under both the Keynesian (sticky-wage) and Neoclassical (fixed aggregate employment) closures. An exogenous inflow of foreign aid was expansionary in both the cases. GDP at market prices, household consumption and hence, the economy's absorption - all increased in the base-year purchasers' prices

(Tables 6.1a,b). The foreign aid inflow led to an appreciation of the secondary exchange rate (Tables 6.2), to a rise in *cif* import bill, and to a decline in *fob* export earnings evaluated at the base-year border prices (Tables 6.3a,b).

Table 6.1b **Changes in the key macroeconomic variables[a] due to exogenous inflow of US$1 (or taka 32.14) million worth of foreign exchange under the Neoclassical closure**

	value (mil. taka)	(%)
	Constant price changes of variables[b]	
Employment	*	*
Indirect taxes[c]	3.54	0.009
GDP at market price	3.54	0.001
Terms of trade effects[d]	1.16	0.004
Foreign aid	32.14	
Consumption[e]	36.84	0.005

Notes: * fixed exogenously. See notes for Table 6.1a.

Source: CGE-B89 model database and model simulation

The immediate effect of exogenous inflow of additional foreign exchange is an increase in domestic spending. Households' real consumption increased by 0.006 per cent to taka 42.33 million in the Keynesian case and 0.005 per cent to taka 36.84 million in the Neoclassical case. With all other components of domestic absorption fixed at base-year levels, domestic absorption also rose. As consumption increased, demands for both domestically produced and imported goods rose. Given the fixed world prices of domestic imports, the *cif* import bill rose (Tables 6.3a,b). With a clearing secondary market for foreign exchange, greater supply of foreign exchange led to an appreciation of the secondary exchange rate (Table 6.2). As the official exchange rate was fixed exogenously, this appreciation of the secondary exchange rate gave the exporters a lower domestic currency revenue per unit of exports.

Appreciation of the secondary exchange rate together with the changes in spending moved the relative prices in favour of domestic sales (Table 6.4). Production for overseas markets was reduced in favour of domestic markets. A decline in export quantities (Tables 6.3a,b) led to a rise in the world prices of domestic exports. But the rise was insignificant due to high elasticities of export demands. Nevertheless, the terms of trade, defined as the ratio of the world price index of exports to that of imports, improved. The *fob* export value in current prices, given by the *fob* export values evaluated at the base-year prices plus the terms of trade effects, also fell (Tables 6.3a,b).

Table 6.2 **Effects of an exogenous inflow of foreign exchange worth US$1 million on key nominal macroeconomic variables** (%)

	Keynesian	Neoclassical
Official exchange rate	*	*
Secondary exchange rate	-0.018	-0.018
Money supply	*	*
CPI	-0.001	-*
Nominal wage	*	0.002

Note: * Implies the relevant variables have been fixed exogenously at the base-year levels. Figures have been rounded to the nearest number.

Source: CGE-B89 model database and simulation

Table 6.1a shows that under the Keynesian closure, the additional consumption of taka 42.33 million was financed by the increased income generated from the increased employment (taka 5.27 million), non-distortionary redistribution of additional net indirect taxes (taka 3.88 million), the improvement in terms of trade (taka 1.04 million) and additional foreign aid (taka 32.14 million). Under the Neoclassical closure, the additional consumption to the tune of taka 36.84 million was financed from additional income from the non-distortionary redistribution of additional

Table 6.3a **Changes in the balance of trade due to an exogenous foreign exchange inflow of US$1 (or taka 32.14) million worth under the Keynesian closure**

	value (mil. taka)	(%)
Reduced exports (fob)[a]	-14.13	-0.045
Increased imports (cif)[a]	19.05	0.014
	33.18[b]	
Increased foreign aid	32.14	
Terms of trade effects[c]	1.04	0.003
	33.18	

Note: [a]Percentage change is quantity change. Value change refers to change in variables due to change in quantity only (i.e., evaluated at the base-year prices).
[b]The change in the balance of trade deficit measured in the base-year border prices is not Taka 32.14 million. When adjusted for the terms of trade effect, it measures the balance of trade in the current border prices, which is Taka 32.14 million.
[c]Defined as the product of the base-year total export value (*fob*) and the after-shock change in the border price index of exports (see the Efficiency Equation 4.56).
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

Table 6.3b **Changes in the balance of trade due to an exogenous foreign exchange inflow of US$1 (or taka 32.14) million worth under the Neoclassical closure**

	value (mil. taka)	(%)
Reduced exports (fob)[a]	-15.09	-0.049
Increased imports (cif)[a]	18.21	0.013
	33.30[b]	
Increased foreign aid	32.14	
Terms of trade effects	1.16	0.004
	33.30	

Notes: Same as for Table 6.3a.

Source: CGE-B89 model database and simulation

net indirect taxes (taka 3.54 million), the improvement in terms of trade (taka 1.16 million) and additional foreign aid (taka 32.14 million). No additional income was generated from increased employment under the Neoclassical closure because total employment was fixed.

Table 6.4 **Short-run effects of a foreign exchange inflow of US$1 (or taka 32.14) million worth on basic prices (%)**

	Keynesian			Neoclassical		
	Exporters'	Importers'	Domestic	Exporters'	Importers'	Domestic
Exportables						
Jute	-0.001	n.a.	0.001	0.001	n.a.	0.002
Tea	-0.006	n.a.	0.009	-0.006	n.a.	0.008
Fish	-0.013	n.a.	•	-0.013	n.a.	0.002
Ready-made garments	-0.014	-0.018	-0.001	-0.013	-0.018	•
Jute textiles	-0.003		0.003	-0.002		0.005
Leather	-0.014	-0.018	-0.005	-0.013	-0.018	-0.004
Forestry	-0.002		0.004	-0.002		0.004
Importables						
Rice	n.a.	0.000	0.001	n.a.	0.000	0.003
Wheat	n.a.	0.000	•	n.a.	0.000	0.001
Edible oil	n.a.	-0.015	-0.002	n.a.	-0.014	-0.002
Other agriculture	-0.006	-0.017	0.001	-0.005	-0.017	0.002
Sugar	n.a.	-0.015	•	n.a.	-0.014	0.001
Cotton textiles	n.a.	-0.016	-0.003	n.a.	-0.016	-0.003
Paper	-0.005	-0.014	-0.002	-0.005	-0.014	-0.001
Chemicals	-0.005	-0.013	-0.005	-0.005	-0.013	-0.006
Other manufactures	-0.006	-0.016	-0.004	-0.006	-0.016	-0.003
Non-tradables						
Physical overheads	n.a.	n.a.	0.003	n.a.	n.a.	0.003
Social overheads	n.a.	n.a.	-•	n.a.	n.a.	0.001
Public administration	n.a.	n.a.	0.001	n.a.	n.a	0.002

Note: Figures are in percentage changes of the base-year values. Importers and exporters' prices were defined in Equations 4.20a-4.20c and 4.21. The basic prices of domestic sales followed from the market clearing and zero pure profit conditions.

Source: The CGE-B89 model simulations.

Under the Keynesian closure, a fall in the consumer price index (CPI) against the fixed nominal wages implies a rise in the real wage rates. Interestingly, total employment of the economy recorded an increase. The resource allocation effects of the balance-of-trade shock explains this apparent paradox.

With no change in the official exchange rate and the fixed Export Performance Benefit entitlement rates, an appreciation of the secondary exchange rate means a fall in the domestic currency exporters' prices defined by Equation 4.21 (Chapter 4). Table 6.4 also confirms the fall in exporters' prices. Fall in exporters' prices relative to the basic prices of the domestic sales may lead to a contraction in production for overseas markets in favour of the domestic market. An appreciation of the secondary exchange rate with unchanged tariff rates and a fixed official exchange rate, also leads to a fall in the domestic currency importers' prices defined by Equation 4.20c in Chapter 4 (Table 6.4). Costs for imported inputs fall. This gives additional impetus to production for the domestic market and may mitigate against price disincentives for export production.

On the consumption side, as relative prices move in favour of imports consequent upon the appreciation of the secondary exchange rate, households substitute imported goods for domestically produced goods. With more income consequent upon an additional inflow of foreign exchange, households, however, tend to increase consumption of all goods, domestically produced or imported (no good is assumed inferior). If the substitution effect is strong enough to more than offset the income effect, the demand curve for the domestic good will shift inward. If the income effect is stronger, however, the demand curve for the domestic good shifts outwards.

In a general equilibrium framework, shifts in all supplies and demands together determine the new market clearing prices and outputs. The direction of changes in prices and quantities of domestically produced goods depends on the position of, and relative shifts in, the relevant demand and supply functions.

Table 6.5a Effects of exogenous inflow of taka 100 million[a] worth of foreign exchange on sectoral output, cost and sales under the Keynesian closure (million taka)

	Value-added to labour[b]	Intermediate Inputs[c]	Gross outputs	Sales/demands			
				Exports	Domestic		
					Total	Consumption	Int. uses
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Changes at the constant basic prices[d]				
Exportables							
Jute	0.31	0.19	0.50	-0.29	0.79	0.78	0.01
Tea	0.18	0.07	0.24	-0.21	0.45	0.45	•
Fish	-2.45	-0.79	-3.25	-8.07	4.83	4.83	•
Forestry	0.60	0.16	0.76	•	0.76	1.28	-0.52
Ready-made garments	-6.43	-14.21	-20.64	-20.34	-0.30	0.11	-0.41
Jute textiles	-3.65	-4.61	-8.26	-8.35	0.09	0.18	-0.09
Leather	-2.39	-3.66	-6.06	-6.03	-0.03	0.09	-0.11
Importables							
Rice	8.28	2.80	11.08	n.a.	11.08	10.06	1.02
Wheat	0.36	0.11	0.47	n.a.	0.47	0.38	0.09
Edible oil	-0.32	-0.73	-1.05	n.a.	-1.05	-0.96	-0.09
Other agriculture	3.23	1.64	4.87	-0.67	5.54	8.57	-3.03
Sugar	-0.28	-0.57	-0.85	n.a.	-0.85	-0.78	-0.08
Cotton text	-0.76	-1.51	-2.26	n.a.	-2.26	2.96	-5.23
Paper	-0.22	-1.24	-1.46	-0.23	-1.23	0.75	-1.98
Chemicals	-0.38	-1.07	-1.45	n.a.	-1.45	1.30	-2.75
Other manufactures	-3.01	-6.77	-9.78	-0.62	-9.16	2.02	-11.18
Non-tradables							
Physical. overheads	14.94	7.20	22.14	n.a.	22.14	28.25	-6.11
Social overheads	3.21	0.39	3.60	n.a.	3.60	3.59	0.01
Public administration	5.22	1.07	6.28	n.a.	6.28	8.74	-2.45
Aggregate	16.42	-21.54	-5.12	-44.81	39.69	72.59	-32.90

Note: [a]The simulation results of exogenous inflow of Tk 32.14 million were scaled up for analytical convenience. The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in cost for primary inputs imply a change in labour costs only. [c]Cost of intermediate inputs includes sales and excise tax inclusive costs of inputs from both domestic and foreign sources. [d]Changes due to changes in quantities only. For exports the figures are at the base-year exporters' prices (Equation 4.21); and for domestic sales at the base-year basic prices (Equation 4.18). Identities for columns: (3) = (1) + (2); (3) = (4) + (5); (5) = (6) + (7); Figures have been rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 6.5b Effects of exogenous inflow of taka 100 million[a] worth of foreign exchange on sectoral output, cost and sales under the Neoclassical closure (million taka)

	Value-added to labour[b]	Intermediate Inputs[c]	Gross outputs	Sales/demands: Exports	Domestic: Total	Domestic: Consumption	Domestic: Int. uses
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Changes at the constant basic prices[d]				
Exportables							
Jute	0.14	0.08	0.22	-0.41	0.62	0.62	•
Tea	0.14	0.05	0.19	-0.20	0.39	0.38	•
Fish	-3.55	-1.15	-4.70	-8.60	3.90	3.93	-0.02
Forestry	0.24	0.06	0.31	•	0.31	1.18	-0.87
Ready made garments	-6.71	-14.81	-21.52	-21.17	-0.35	0.08	-0.43
Jute textiles	-4.24	-5.35	-9.59	-9.60	•	0.13	-0.12
Leather	-2.47	-3.78	-6.25	-6.21	-0.04	0.08	-0.11
Importables							
Rice	6.25	2.11	8.36	n.a.	8.36	7.93	0.43
Wheat	0.16	0.05	0.21	n.a.	0.21	0.20	•
Edible oil	-0.41	-0.92	-1.33	n.a.	-1.33	-1.06	-0.26
Other agriculture	0.53	0.27	0.80	-0.73	1.53	5.63	-4.10
Sugar	-0.41	-0.83	-1.25	n.a.	-1.25	-1.09	-0.16
Cotton text	-1.06	-2.11	-3.17	n.a.	-3.17	2.35	-5.52*
Paper	-0.28	-1.56	-1.83	-0.25	-1.58	0.62	-2.20
Chemicals	-0.50	-1.41	-1.91	n.a.	-1.91	1.27	-3.18
Other manufactures	-4.03	-9.04	-13.07	-0.67	-12.40	1.54	-13.94
Non-tradables							
Physical. overheads	10.28	4.96	15.24	n.a.	15.24	24.09	-8.85
Social overheads	2.53	0.31	2.83	n.a.	2.83	2.83	0.00
Public administration	3.39	0.69	4.08	n.a.	4.08	7.00	-2.92
Aggregate	0.00	-32.38	-32.38	-47.84	15.45	57.69	-42.24

Notes: Same as for Table 6.5a

Source: CGE-B89 simulations

The supply responses and changes in the composition of demands are presented in Tables 6.5a, 6.5b and 6.6. Under both the closures, gross outputs of all the three non-tradable sectors expanded. Outputs of some tradable sectors such as jute, tea, forestry, rice, wheat and other agriculture also expanded. The remaining tradable sectors experienced a contraction.

Table 6.4 showed that the exporters' and importers' prices fell in both cases. These prices, in turn, affected the basic prices of domestic sales (de Melo and Robinson 1985). Basic prices of the domestic sales of most of the importables fell (Table 6.4). Basic prices of domestic sales of the exportables except leather and ready-made garments rose. A weighted index of price changes of tradables, both import substitutes and exportables, sold in the domestic market was constructed; the weights being the base-year shares in total domestic sales of tradables (Appendix A5.2). For the Keynesian case, the index was estimated to be -0.0001 per cent, and for the Neoclassical case, it was 0.0006 per cent. Table 6.4 shows that, prices of non-tradables, on the other hand, increased. A weighted index of the price changes of non-tradables was constructed using the base-year sales' shares in total non-tradables. The index was estimated to be 0.0028 per cent for the Keynesian case, and 0.0027 for the Neoclassical case. Also, real wages, the prices of non-tradable services, rose in both the cases. Table 6.2 reported a fall in the CPI against fixed nominal wages in the Keynesian case, and a fall in the CPI together with a rise in the nominal wages in the Neoclassical case. All these indicate an appreciation of the real exchange rate, that is, a fall in the relative prices of tradables to non-tradables. The tradable and non-tradable sectors adjusted accordingly.

Table 6.5a shows that 6 out of 16 tradable sectors registered a rise in output. These sectors could produce an additional output which offset only a third of the fall in output of the contracting sectors. Table 6.5b shows that the additional outputs of 6 tradable sectors could offset only 16 per cent of the fall in output in other tradable sectors. Outputs of the non-tradable sectors, however, expanded under both the assumptions about labour markets. The marked expansion in the nontradable sectors could not offset the fall of the aggregate output of the tradable sectors. Aggregate gross output hence fell in both the Neoclassical and Keynesian closure. Appreciation of the real exchange rate, contraction of most of the tradable sectors and expansion of the non-tradables - all these seem to suggest the incidence of a Dutch disease caused by the inflow of foreign aid. The contraction of all but six tradable sectors may be viewed as the resource movement effects of foreign aid.

Column 4 in Tables 6.5a and 6.5b shows that all exports registered a decline in volume. Nevertheless, production for the domestic market of all exportables except ready made garments and leather increased (column 5 in Tables 6.5a and 6.5b). Columns on domestic sales in these tables also show that production for the domestic market of some importables namely, rice, wheat and other agriculture, also increased. Snape (1977) demonstrates that even though the Dutch disease could be expected to cause a decline in the production of goods other than the non-tradables, production of some tradables, however, could rise due to non-neutral technological change in the non-traded sectors. The simulation results based on CGE-B89, a rather more complex general equilibrium model than the one used by Snape (1977), show that some tradable sectors expanded. These tradable sectors seem, however, to expand for different reasons. Increases in production in these sectors were due to rise in domestic sales. As such, the rise in domestic sales might be attributed to the spending effects of exogenous inflow of foreign aid.

Increases in the outputs of non-tradables together with jute, tea, forestry, rice and other agriculture under the Keynesian closure increased the aggregate employment of the economy even in the face of a real wage increase. This was because these

Table 6.6 Effects of exogenous inflow of taka 100 million[a] worth of foreign exchange on imports (million taka)

	Keynesian			Neoclassical		
	Total (1)	Consumption (2)	Int. uses (3)	Total (4)	Consumption (5)	Int. uses (6)
	Changes at the constant basic prices [b]					
Rice	0.20	0.04	0.16	0.28	0.06	0.22
Wheat	0.93	0.91	0.02	0.94	0.92	0.02
Edible oil	4.41	4.15	0.26	4.26	4.01	0.25
Other agriculture	16.24	13.50	2.74	16.09	13.37	2.72
Sugar	4.31	4.15	0.16	4.26	4.10	0.16
Cotton textiles	3.77	3.99	-0.22	3.65	3.89	-0.25
Paper	1.72	1.27	0.45	1.61	1.22	0.39
Chemicals	2.36	1.92	0.44	1.93	1.78	0.14
Other manufactures	34.00	26.16	7.83	31.82	24.79	7.04
Ready-made garments	0.17	0.17	0.00	0.17	0.17	0.00
Aggregate	**68.11**	**56.28**	**11.83**	**65.00**	**54.33**	**10.67**

Note: [a]Simulation results of exogenous inflow of taka 32.14 (US$1) million worth of foreign exchange were scaled up for easy comparability. The base-year-values are in Appendix A5.2. For data comparability see Appendix A6.1 on Technical Notes.
[b]Changes due to changes in quantities.

Source: CGE-B89 simulations

Table 6.7 **Effects of an exogenous inflow of US$1 million dollars worth of foreign exchange on the composition of trade**[a] (US$ million)

	Keynesian		Neoclassical	
	Imports (1)	Exports (2)	Imports (3)	Exports (4)
	Changes at the base-year world prices[b]			
Exportables				
Jute	n.a	-.	n.a.	-.
Tea	n.a	-.	n.a.	-.
Fish	n.a	-0.08	n.a.	-0.08
Forestry	n.a	-.	n.a.	-.
Ready made garments	.	-0.20	.	-0.21
Jute textiles	n.a.	-0.08	n.a.	-0.10
Leather	-.	-0.06	-.	-0.06
Importables				
Rice	.	n.a.	.	n.a.
Wheat	0.01	n.a.	0.01	n.a.
Edible oil	0.04	n.a.	0.03	n.a.
Other agriculture	0.15	-0.01	0.15	-0.01
Sugar	0.03	n.a.	0.03	n.a.
Cotton textiles	0.03	n.a.	0.03	n.a.
Paper	0.01	-.	0.01	-.
Chemicals	0.02	-.	0.01	-.
Other manufactures	0.29	-0.01	0.28	-0.01
total[b]	**0.59**	**-0.44**	**0.57**	**-0.47**
Terms of trade effects	*	0.03	*	0.04
Column sum[c]	**0.59**	**-0.41**	**0.57**	**-0.43**

Note: [a]The base-year-values are in Appendix A5.2. Exports and imports in world prices are calculated by deflating the domestic currency *fob* export and *cif* import values respectively by the official exchange rate. For data comparability see Appendix A6.1.
[b]Changes are due to changes in export and import quantities.
[c]Values are in current world prices. For imports, *cif* values are same in both the current and base-year world prices. The *fob* export value in the current world prices equals the *fob* export value in the base-year world prices plus the change in the value due to change in the terms of trade.
*The world import prices are fixed exogenously.
Identity: Imports minus exports, evaluated in the current world prices, equal US$1 million.
Figures are rounded to the nearest number.

Source: CGE-B89 simulations

sectors paid about 82 per cent of the economy's wage bill in the base-year. The aggregate employment rose in spite of a decline in the aggregate gross output. The expanding sectors are more labour-intensive compared to the contracting sectors, but these expanding sectors are less material-intensive relative to the other sectors as a whole. As a result, these industries together used additional intermediate inputs less, in value, than the intermediate inputs given up by the contracting sectors (columns 2 and 7 in Tables 6.5a and 6.5b).

Under the Neoclassical closure, aggregate employment was fixed. The non-tradable sectors and other five tradable sectors thus expanded by drawing labour from other sectors. Reallocation of labour raised real wages (Table 6.2). Unlike as in the Keynesian case, the additional labour required for the expanding sectors could not be drawn from an unemployed reservoir in the Neoclassical case, the contracting sectors thus contracted much more under the Neoclassical than under the Keynesian case. For similar reason, the expanding sectors expanded less under the Neoclassical closure than under the Keynesian closure. Clearly, the conditions in the labour market did not seem to matter much for the direction of sectoral adjustments characterizing the Dutch disease. But these conditions seem to determine the magnitude of changes of inputs and outputs.

Exogenous inflow of foreign exchange also brought about changes in the composition of the international trade. This is evident from Tables 6.5a through 6.7. Column 4 in Tables 6.5a and 6.5b shows the changes in composition of export. The export values were evaluated at the base-year exporters' prices defined in Equation 4.21. Table 6.6 shows the changes in composition in imports, the values being evaluated in the base-year importers' prices defined in Equations 4.20a through 4.20c. The changes in the composition of the balance of trade in base-year world prices (in US dollars) are given in Table 6.7. Under both the closures, imports rose and exports fell, the difference being financed by the additional foreign exchange of US$1 million. That satisfied the balance of trade constraint. Imports of other manufacture rose the most, followed by other agriculture. On the other hand, exports of ready-made garments fell the most.

Welfare impact and the shadow exchange rate

Household consumption of all imported commodities has increased under both the closures (columns 2 and 5 in Table 6.6) due to both substitution and income effects. Increased purchasing power following the increase in foreign exchange inflows has also led to an increase in consumption of most of the domestically produced goods (column 6 in Tables 6.5a and 6.5b). In the aggregate, households' consumption has increased by taka 42.33 million in the Keynesian case (Table 6.1a), and by taka 36.84 million in the Neoclassical case (Table 6.1b). The welfare measured by utility of the household (under unitary marginal utility of income) has risen by 0.016 per cent in the Keynesian case and 0.014 per cent in the Neoclassical case (Table 6.8). The shadow exchange rates estimated as the change in utility are taka 42.33 and taka 36.84 per US dollar, respectively. These imply that the shadow exchange rates under the closures were respectively about 32 and 15 per cent more than the official exchange rate of taka 32.14 per US dollar.

Farashuddin (1980), based on the structure of imports prevalent in 1977-78, estimates the shadow exchange rate for Bangladesh as 107 per cent higher than the prevailing official exchange rate (taka 15 per US dollar)[1]. However, he argues that

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[1]Farashuddin (1980) estimates the shadow exchange rate for Bangladesh using Schydlowsky's methodology (Schydlowsky 1973) for computing the second best general disequilibrium shadow prices. Of the prevailing distortions, he incorporates the Wage Earners' Scheme, tariffs and sales taxes. The overall shadow exchange rate is defined as the weighted average of shadow exchange rates calculated for different end-uses of imports, namely intermediate, investment and final use. Given excess demand for foreign exchange, he equates the demand price of foreign exchange with the cost of production (the supply price) plus the taxes and the premium of the quantitative restrictions to

most of the difference between the shadow exchange rate and the official exchange rate was due to the under-utilization of installed industrial capacity consequent upon the scarcity of imported intermediate inputs. If more intermediate imports would become available due to an increased inflow of foreign exchange, additional installed capacity would be utilized and output would thereby be increased. His estimation was thus very sensitive to the assumption of excess capacity or what he called the activation effect ($\Delta GNP/\Delta M$). If the productive capacity of industries remained idle due to factors other than the shortage of intermediate imports, such as managerial inefficiency or a shortage of skilled labour, then the activation effect disappeared and the shadow exchange rate would become much lower. With the assumption of no excess capacity, or if excess capacity was not caused by a shortage of foreign exchange, his estimate of the shadow exchange rate was about 33 per cent more than the official rate. CGE-B89 does not model excess capacity of the industrial sector. Owing to the differences in assumptions implicit in the two different methodologies, no strict comparison can be made between the present estimates and those by Farashuddin (1980). However, the estimates seem to suggest that the industrial policy environment, as reflected in the shadow exchange rate, has not changed significantly since 1977-78. When the shadow exchange rate reflects the amount society is willing to pay for each unit of foreign exchange, the discrepancy between the shadow exchange rate estimated and the weighted exchange rate used for exports appears to be quite significant. The discrepancy is an indication of the overall discrimination against exporters.

Welfare change is measured by a change in utility, the marginal utility of income being normalized at unity. The change in utility is equal to the change in

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estimate the marginal social value or the consumers' willingness to pay for a marginal unit of foreign exchange (Farashuddin 1980:127-8).

aggregate consumption at constant prices. Table 6.8 thus presents the contributions to the rise in aggregate real consumption spending. It decomposes the increase in real consumption, and hence welfare, into the direct and indirect components on the basis of the Efficiency Equation (Equation 4.56 in Chapter 4).

The first term on the right hand side of the equation, E_1dF, measures the direct benefit of the exogenous inflow of foreign exchange. E_1, the official exchange rate, is taka 32.14 per Us dollar. dF is the change in the balance of trade deficit, 1 million US dollars in the experiment. The direct effects in the present experiment were thus taka 32.14 million.

The other terms on the right hand side measure the indirect welfare gains or losses consequent upon the inflow of foreign exchange. The indirect gains or losses arise due to various distortions modelled in the CGE-B89. Three broad sources of indirect gains (or losses) can be distinguished

- improvement (or deterioration) in the international terms of trade
- reduction (or increase) in the involuntary unemployment at fixed nominal wages (only in the Keynesian situation)
- lump-sum non-distortionary transfer (or tax) equal to the additional net government revenue from indirect taxes and subsidies

Product differentiation assumption conferred market power in export markets. World export prices are endogenously determined. Model closures hold *cif* world import prices constant. As a result, the economy's terms of trade changes following a policy change. Changes in the terms of trade affect the purchasing power of the economy. The last term in Equation 4.56 (also the last term in Equation 4.55, Chapter 4) measures the effects of the terms of trade on household welfare.

The second term on the right hand side of the Efficiency Equation, WdL, captures the indirect effects on welfare due to a change in the involuntary unemployment at fixed nominal wages. In the Neoclassical closure, aggregate employment is fixed by the exogenous supply of labour. This indirect effect thus does not occur under the Neoclassical closure.

In the experiments, government consumption and investment, private investment and inventories all were assumed to be fixed at the base-year levels. So the relevant terms in the Efficiency Equation reduced to zero. The remaining terms on the right hand side of the Efficiency Equation measure (at the base-year tax, subsidy rates and base-year prices) the changes in government revenues and expenditures, the implicit trade taxes associated with the dual exchange rate. Each term is explained in Equations 4.55 and 4.56 (Chapter 4). These effects are presented under the `other indirect effects' in Table 6.8. If the additional foreign aid inflow reduces the government budget deficit at constant prices, household receives a lump-sum transfer of an amount equal to the additional net aggregate indirect revenue. Household's consumption and welfare accordingly rise.

In addition to the direct effect of raising the purchasing power of households by taka 32.14 million (row 1 in Table 6.8), the exogenous inflow of US$1 million worth of foreign aid generated a second round of effects depending on the closure used. The aggregate indirect effects were taka 10.19 million in the Keynesian case and taka 4.70 million in the Neoclassical case (sum of rows 2, 3, 4 in Table 6.8). The indirect benefits accrued from various sources discussed above.

Households gained from the improvement in the terms of trade under both the Keynesian and Neoclassical closures. The rise in the world price index of domestic exports against the fixed world import prices, led to a terms of trade improvement.

Table 6.8 **Decomposition of welfare effects[a] of an exogenous inflow of US$1 (taka 32.14) million worth of foreign exchange**

	Contributions to rise in consumer spending[b]	
	Keynesian[c]	Neoclassical[c]
	value (mil. taka)	value (mil. taka)
(1) Direct effect[d]	**32.14**	**32.14**
(2) Terms of trade effects	**1.04**	**1.16**
(3) Employment	**5.27**	*
(4) Other indirect effects	**3.88**	**3.54**
Revenue from taxes on intermediate inputs	-0.14	-0.26
Revenue from taxes on consumption	0.91	0.84
Tariff revenue	2.39	2.25
Revenue from implicit taxes on imports[e]	0.45	0.42
Revenue from export taxes[f]	0.27	0.29
(5) **Aggregate change in welfare[g]**	**42.33**	**36.84**

Note: [a]A change in welfare is measured by the change in utility divided by the marginal utility of income (which is normalized at unity in the experiments). A rise in utility is equal to the increase in aggregate real consumption spending at constant prices, The decomposition of the welfare effects into its components, that is, the estimation of the contributions to rise in real consumer spending is based on the Efficiency Equation (Equation 4.56 in Chapter 4).

[b]Contributions are evaluated at base year prices, fixed tax and subsidy rates, and base-year exchange rates. For example, the increase in tariff revenue is the sum over each item of base-year tax multiplied by the rise in import of the item. Also see Equation 4.57. The only exception is the terms of trade effect which is the product of base-year exports and the change in border price index of exports.

[c]In the Keynesian case, nominal wages are fixed. A reduction in involuntary unemployment increases welfare. In the Neoclassical case, aggregate employment is fixed by the exogenous supply of labour.

[d]The exogenous inflow of foreign aid valued at the official exchange rate, taka 32.14 per US dollar.

[e]An implicit tax equal to the exchange rate premium is imposed on imports through the secondary exchange market.

[f]Export subsidies under the XPB Scheme are negative taxes. Aid inflow led to a fall in subsidies which is equivalent to a rise in taxes.

[g]The direct gains of the foreign exchange inflow plus the indirect gains (or losses) from alleviating (or exacerbating) other distortions equal the aggregate change in welfare, which measures the shadow exchange rate.

*Implies that the variable is fixed exogenously at the base-year level.

Identities: for the rows, (5) = (1) + (2) + (3) + (4); see the Efficiency Equation (Equation 4.56).

Since the figures are rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model database and simulation

Under the improved international terms of trade, base-year quantity of exports could now buy taka 1.04 million worth of additional imports in the Keynesian case, and taka 1.16 million worth of additional imports in the Neoclassical case (row 2 in Table 6.8).

The higher aggregate indirect effects under the Keynesian closure were mainly due to the welfare gains of taka 5.27 million associated with a reduction in involuntary unemployment at the fixed nominal wage rates. No such gains occurred in the Neoclassical case for reasons explained earlier.

Revenue from the sales and excise taxes on intermediate inputs fell because aggregate gross output contracted under both the closures. But revenue from commodity taxes on consumption rose as consumption increased. Tariff revenue at the base-year tariff rates rose because of additional imports. An implicit tax equal to the exchange rate premium was imposed on all imports through the secondary exchange market. Imports of rice and wheat were done through the official exchange market. The scarcity premiums did not arise for these imports. For all other imports, increases in import quantities raised the total implicit import taxes evaluated at the base-year exchange rates. The export subsidies given under the Export Performance Benefit Scheme depends on the value of exports, the Benefit entitlement rates and the two exchange rates. As exports declined, expenditure of the government under the Benefit Scheme, evaluated in the base-year entitlement rates and unchanged exchange rate premium, fell. The export subsidies may be viewed as negative taxes. A fall in subsidies would thus be equivalent to a rise in export taxes. All these increases in revenues raised the purchasing power of the households to the tune of taka 3.88 million in the Keynesian case, and taka 3.54 million in case of Neoclassical closure by way of non-distortionary transfer (row 4 in Table 5.8).

In aggregate, due to taka 32.14 million worth of exogenous inflow of foreign aid, households could increase consumption worth taka 42.33 million in the Keynesian case and taka 36.84 million in the Neoclassical case (row 5 which is the sum of rows 1, 2, 3, 4).

The welfare analysis thus revealed the expansionary and welfare augmenting implications of foreign aid. The decomposition of welfare effects in Table 6.8 according to the version of the Harberger's (1971) fundamental equation of the applied welfare economics developed in Chapter 4, gives valuable insights into the policy distortions. Under both the closures, indirect gain from tariff revenues was significant. The gain from the terms of trade improvement was substantial compared to indirect gains associated with the exchange rate regime. Foreign demand elasticities for domestic exports were high. But the product differentiation assumption regarding the domestic exports and products of the rest of the world led to variable terms of trade. In this regard, some optimal export taxes seemed to be required.

Under the Keynesian closure, a significant proportion of indirect effects accrued from the reduction in involuntary unemployment at the fixed wages. Turning to the Neoclassical closure, the removal of the nominal wage rigidity distortion, leaving many other distortions unchanged, was found to worsen welfare. This seems to be consistent with the theory of `second best' that the removal of one distortion with other distortions remaining in place would not necessarily improve welfare.

Analysis of the sectoral adjustments already showed that aid inflow could cause a Dutch disease. It might lead to a fall in the real exchange rate, the ratio of the price of tradable goods to the price of nontradable goods, inducing a decline in the production of most of the importables and exportables. In both the Keynesian and Neoclassical cases, aggregate gross output of the tradable sectors fell so much that even the substantial expansion in the nontradable sectors was not enough to offset the fall. The results suggest that a gift from the rest of the world would generate `booming sector' effects. This seems to lend support to the apprehension that foreign aid is not an unmixed blessing for Bangladesh. The case for promoting trade rather than lobbying for additional aid is strengthened.

The shadow exchange rate is, however, only a summary indicator of existing policy distortions, and is a measure of the overall extent of protection given to domestic industries from external competition. All industries in the economy do not enjoy the same level of protection as seen in Tables 6.5a and 6.5b. Protection provided to a particular industry is significantly determined by the macroeconomic and sector-specific policies. Chapters 7 and 8 simulate changes in such policies.

Appendix A6.1 Technical notes for the tables on simulation results

A number of tables on the effects of policy changes have been reported in the text. The variables used in these tables follow the standard definitions in economics literature. Nevertheless the following notes have been designed for a quick understanding of the relationship among various variables and, therefore, the relationship among different tables used for policy analysis. Most of the tables report changes in variables at the base-year prices termed `constant price changes'. In such a case, changes in variables are due to changes in relevant quantities only, which is equivalent to changes that are evaluated at the base-year prices. In a general equilibrium simulation, any exogenous policy change produces changes in both prices and quantities. The changes in endogenous variables at the current prices entail changes in both prices and quantities. To calculate `constant price changes', however, only the relevant quantity changes have been used. Changes due to price changes have not been taken into account. For example, constant price change in Gross Domestic Product (GDP) at market prices implies change in GDP at the base-year purchasers' (market) prices. When effect on the GDP deflator is also included it gives the change in GDP at the current purchasers' prices. It may be noted that a number of prices have been used in CGE-B89, namely basic domestic, exporters', importers', purchasers', *cif* and *fob*. These prices are defined in the text and not repeated here. It suffices to note that the constant price change always refers to change at the base-year price in which the variable is originally defined.

Glossary of terms

A	Domestic absorption at the purchaser (market) prices
BOT	Balance of trade deficits at border (or world) prices = Foreign capital inflow.
C	Household consumption at the purchaser prices

D	Total domestic sale at the basic prices
D_C	Aggregate household consumption of domestic good at the basic prices
GDP_{mp}	Gross Domestic Product at the market (or purchaser) prices
GDP_{fc}	Gross Domestic Product at factor cost
M	Aggregate imports at the importers' prices
M_C	Aggregate imports for household consumption at the importers' prices
M_{cif}	Aggregate *cost, insurance and freight* value of imports
TOT	International terms of trade
U	Utility of the household
VA_L	Value-added to labour/ level of employment when wages are normalized at unity.
V_c	Aggregate cost for intermediate inputs at purchaser prices
V_D	Aggregate domestic outputs at basic prices used as inputs
V_M	Aggregate imports for intermediate inputs at importer prices
X	Aggregate exports valued at the exporter prices
X_{fob}	Aggregate *free on board* value of exports
Z	Aggregate gross output at basic prices

Relations among variables

All variables in the following identities are evaluated at the base-year price, except for ΔTOT and ΔBOT^* . While ΔTOT measures the terms of trade effects as the base-year exports multiplied by the change in world export price index. ΔBOT^* measures the change in balance of trade in current border prices.

Tables on macroeconomic effects of policy changes

(i) $\Delta VA_L = \Delta GDP_{fc}$; when capital stocks are held constant.

(ii) ΔAggregate net indirect taxes $=\Delta$(All sales taxes and excise duties on intermediate inputs, and final demands) + ΔTariffs + Δ(Implicit taxes on imports due exchange rate premium) $-\Delta$(Implicit export subsidies under the Export Performance Benefit Scheme).

(iii) $\Delta GDP_{mp} = \Delta GDP_{fc} + \Delta$(Aggregate net indirect taxes)

(iv) $\Delta GDP_{mp} + \Delta TOT + \Delta BOT^* = \Delta C$

(v) $\Delta C = \Delta U = \Delta A$; because other domestic final demands are held fixed.

(vi) $\Delta BOT^* = \Delta M_{cif} - \Delta X_{fob} - \Delta TOT$.

(vii) $\Delta GDP_{mp} = \Delta A + \Delta X_{fob} - \Delta M_{cif}$.

Tables on output, cost, and sales

(i) $\Delta Z = \Delta VA_L + \Delta V_C$;

$\Rightarrow$ $\Delta Z - \Delta V_C = \Delta VA_L = \Delta GDP_{fc}$.

(ii) $\Delta Z = \Delta D + \Delta X$.

(iii) $\Delta D = \Delta D_C + \Delta V_D$.

(iv) $\Delta X = \Delta X_{fob} + \Delta$(Implicit export subsidies under the Export Performance Benefit Scheme) $- \Delta$(Export taxes, if any)

Tables on imports

(i) $\Delta M = \Delta M_C + \Delta V_M$.

(ii) $\Delta M = \Delta M_{cif} + \Delta$Tariffs + Δ(Implicit taxes on imports due to exchange rate premium);

7

ECONOMY-WIDE POLICY SIMULATIONS WITH CGE-B89

In this chapter, a number of simulations designed to evaluate the impacts of economy-wide policies on the industrial sector and hence, on the economy of Bangladesh, are described and analyzed.

Increases in the official exchange rate, money supply and nominal wages

The exchange rate regime in Bangladesh results in exports (if the Export Performance Benefit entitlement rate is significantly less than 100 per cent) and imports below the level that would occur under an equilibrium exchange rate regime (illustrated in Figure 4.1, Chapter 4). The overvalued exchange rate reduces export earnings, and purchases of raw materials and equipment are more costly than would be the case in an undistorted situation, except where producers are allocated privileged official exchange rate supplies.

A devaluation of the official exchange rate with no changes in other exogenous variables would reduce the aggregate implicit taxes on exports and imports arising from exchange controls. The simulation of an official exchange rate devaluation was followed by simulation of changes in the money supply. It might be suggested that a computable general equilibrium model should not be used to simulate changes in money supply. In a dual exchange rate system, however, even in the Neoclassical closure with a flexible money wage, the secondary exchange rate premium and hence the implicit taxes on exports and imports, can be reduced by contracting the domestic money supply. In the Keynesian closure, not only does this effect operate, but changes in the money supply also have real effects for the conventional Keynesian reasons relating to nominal wage rigidity. The money supply simulation involving a once-and-for-all increase in the money stock with no changes in the official exchange rate, wages and taxes, was designed as an alternative to devaluation to reduce or eliminate an exchange rate premium.'.

An expansionary, rather than contractionary, monetary policy was simulated. This, together with experiments with the official exchange rate devaluation and nominal wage increase in the Keynesian closure, checks the internal consistency of the numerical CGE-B89. A list of exogenous variables for the Keynesian closure was defined in Chapter 5. This list included four sets of nominal variables of which world import prices, P^{m}_{i3}, are not determined domestically. The remaining three sets represent the percentage changes in policy instruments: domestic money supply, the official exchange rate and nominal wage rates. CGE-B89 does not model money illusion. Only the changes in relative prices matter. Constant percentage changes in all these variables therefore raise all nominal variables by the same proportion. There will not be any changes in relative prices. Real endogenous variables therefore remain unchanged. The new general equilibrium is exactly the same as the initial one. If the CGE-B89 model is correctly specified and closures are properly defined, the combined effects of increasing the three nominal exogenous variables by 1 per cent under the Keynesian closure will result in a 1 per cent increase in all the nominal variables, leaving the real variables unchanged.

Simulation results can be used to identify appropriate policy packages for specified targets, or alternatively, they can be manipulated to examine the impacts of different policy packages on economic variables. Although the linearization errors that accompany such simulations are somewhat of a problem, they may, nevertheless, be ignored in the case of small changes in exogenous variables. A particular policy-mix of these instruments can thus be identified to attain a few macroeconomic targets such as consumption, aggregate employment and CPI and *vice versa*.

Simulations of devaluation of the official exchange rate and expansionary monetary policy are also carried out under a fixed-employment-flexible-nominal-wage assumption (Neoclassical closure). Simulation of changes in the nominal wages is not tenable under the fixed-employment-flexible-nominal-wage assumption. In the fixed employment case, equiproportional increases in the official exchange rate and money supply would produce offsetting changes in real variables. Combining the equiproportional changes in the official exchange rate and domestic money supply brings about changes in the nominal endogenous variables by the same proportion. This follows from the fact that in the Neoclassical case (nominal wages were endogenously determined), the official exchange rate and the money supply were the only nominal domestic policy variables in the exogenous variable list.

Effects on the secondary exchange rate: a graphical analysis

The CGE-B89 model developed in Chapter 4 did not reflect all the policies which constituted the industrial policy environment in 1989. Only a few important policies were modelled, namely the controls of foreign exchange through foreign exchange rationing and compulsory surrender of foreign currency export earnings under the dual exchange rate system, export subsidies under the Export Performance Benefit Scheme and various taxes including trade taxes.

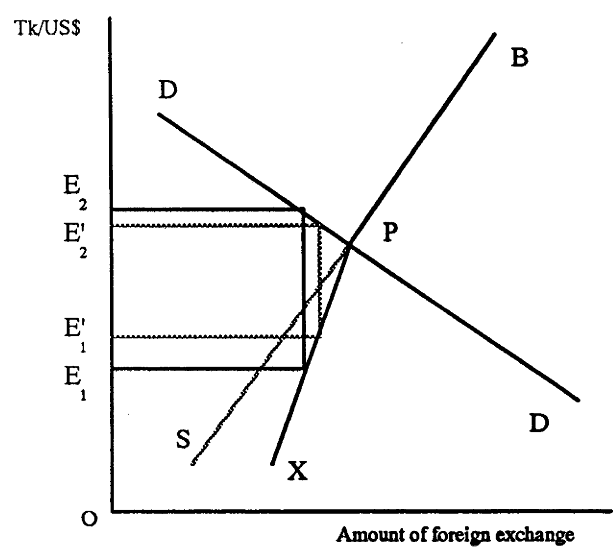
Both the economic environments, labeled as Keynesian and Neoclassical closures, under which policy simulations were carried out (discussed in Chapter 5), characterized a fixed balance of trade at the prevailing border (hence also the world) prices. As a result, the total *cif* value of imports is constrained to equal the *fob* value of exports in current prices plus the exogenously fixed inflow of foreign currencies in the form of foreign grants and remittances (measured in US$ or in taka when converted at the official exchange rate). In the short run, an exogenously fixed balance of trade was considered because all the simulations were designed for the one-period analysis of the permanent effects of permanent (rather than transitory) policy changes (Chapter 5).

Under the single exchange rate system, a devaluation uniformly brings about an increase in all domestic currency exporters' and importers' prices relative to the prices of domestic substitutes, thereby facilitating a switch in production and demand. Under a dual exchange rate system (wherein the secondary exchange rate is market determined) combined with sector-specific Benefit rates and tariff rates, a devaluation of the official exchange rate does not always change exporters' and importers' prices in the same direction as it would under a single fixed exchange rate system. Under a multiple exchange rate regime, devaluation of the official exchange rate changes the secondary exchange rate. Effects on the secondary exchange rate are crucial as changes in exporters' and importers' prices depend on a weighted average of changes in both the exchange rates (Equations 4.20 and 4.21). This is true also for other policy changes.

The short-side disequilibrium model in Figure 4.1 of Chapter 4 illustrates the workings of a dual exchange market. The same model can be used here to analyze the effects of policy changes on the secondary exchange rate. Figures 7.1, 7.2 and 7.3, all based on Figure 4.1, show the effects on the secondary exchange rate of an increase in the official exchange rate, domestic money supply and nominal wages respectively, under the Keynesian closure. The combined effect of an equiproportional increase in the official exchange rate, domestic money supply and nominal wages on the secondary exchange rate is depicted in Figure 7.4.

The immediate effect of a devaluation of the official exchange rate, *ceteris paribus*, is a rise in export revenue in the domestic currency, supply of exports increases as a result. As long as the world demand for export has a demand elasticity greater than 1 in absolute terms, the increase in exports will increase the supply of foreign exchange. In Figure 7.1, the increased supply of foreign exchange following devaluation of the official exchange rate (movement from E_1 to E'_1) brings down the secondary exchange rate to E'_2.

Figure 7.1 **Effect of devaluation on the secondary exchange rate**



Devaluation of the official exchange rate and the consequent appreciation of the secondary exchange rate influence direction of changes in the exporters' and importers' prices differently, depending on the Benefit entitlement rates and tariff rates (Equations 4.20 and 4.21). These prices, in turn, affect the basic prices of domestic sales depending on the various elasticities and base-year coefficients (de Melo and Robinson 1985). Changes in the relative prices bring about changes in outputs, employments, exports and imports in a general equilibrium framework.

When the domestic money supply is exogenously increased, *ceteris paribus*, demand for imports and hence for foreign exchange rises immediately. Graphically, the

DD curve shifts outward to D'D' (Figure 7.2). As a result, the secondary exchange rate depreciates.

Figure 7.2 **Effect of money expansion on the secondary exchange rate**

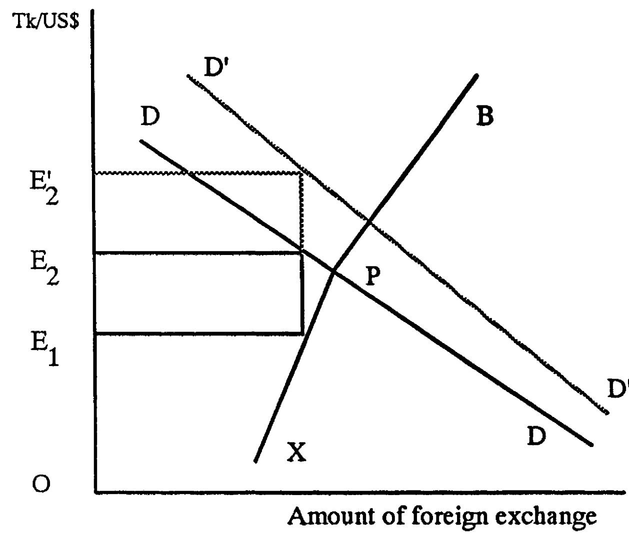
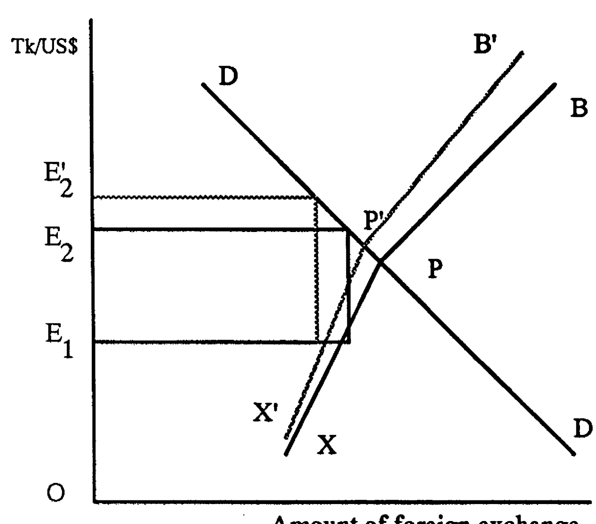
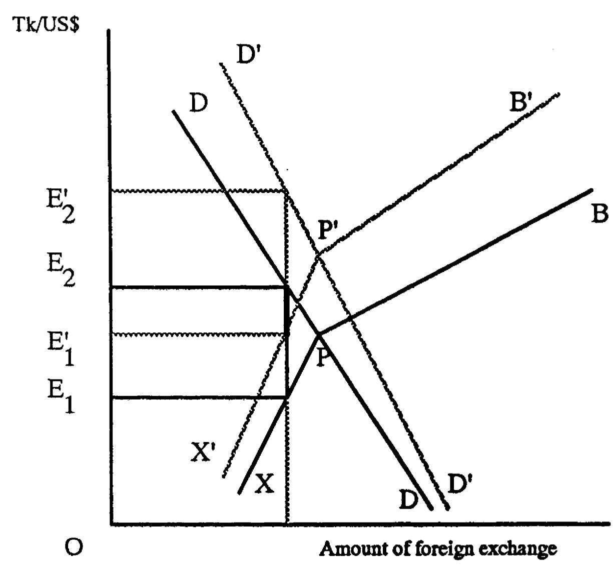


Figure 7.3 **Effect of nominal wage increase on the secondary exchange rate**



The effects of an exogenous increase in nominal wages are illustrated in Figure 7.3. As the cost of labour unit rises (capital being sector specific), aggregate production shrinks, and export supply also falls. In Figure 7.3, this causes an inward shift of the foreign exchange supply curve from XPB to X'P'B', as a result of reduced exports. Competition for the reduced supply of foreign exchange in the secondary market bids up the secondary exchange rate.

Figure 7.4 **Neutrality of the combined effects of devaluation, increases in money supply and nominal wages by the same proportion**



As discussed, the combined effects of an equiproportional increase in all these three policy instruments, namely, the official exchange rate, domestic money supply and the nominal wage, leads to a depreciation of the secondary exchange rate by the same proportion. Figure 7.4 illustrates the combined effects on the secondary exchange rate. It is the superimposition of the Figures 7.2, 7.3 for an x per cent increase in the domestic money supply, and nominal wages to Figure 7.1 for an x per cent devaluation of the official exchange rate.

Using the above reasoning, the economy-wide and sectoral effects of a 1 per cent devaluation in the official exchange rate, a 1 per cent increase in domestic money supply, and a 1 per cent increase in nominal wage under the Keynesian closure are separately analyzed below. In each case, the short-run (fixed capital) effects of the policy change under the Keynesian closure are compared with the effects of the corresponding policy change under the Neoclassical closure.

Devaluation of the official exchange rate

Macroeconomic effects

The impact effect of a devaluation of the official exchange rate and no changes in money supply and wages, is a general rise in exporters' prices and hence increased profitability of exports. The consequent increase in the supply of foreign exchange leads to an appreciation of the secondary exchange rate (Figure 7.1). Table 7.1 records the effects on the key macroeconomic nominal variables of a per cent devaluation of the official exchange rate under both the

Table 7.1 **Changes in the important nominal macroeconomic variables due to a 1 per cent devaluation** (short-run) (%)

	Keynesian	Neoclassical
Official e-rate	1.00	1.00
Secondary exchange rate	-0.16	-0.12
Money supply	*	*
Consumer price index	0.08	0.14
Nominal wage	*	0.17

Notes: *Implies that the relevant variables were fixed exogenously at the base-year levels. Figures have been rounded to the nearest number.

Source: CGE-B89 model simulations

Keynesian and Neoclassical closures, and confirms that a devaluation of the official exchange rate induces an appreciation of the secondary exchange rate. Export revenue depends on the weighted average of the two exchange rates, the weights being determined by the Export Performance Benefit rates (Equation 4.21). In both cases, appreciation is not very significant. Nevertheless, it adversely affects profitability of exports enjoying high Benefit rates. For other sectors with low Benefit rates, devaluation of the official exchange rate against the slight appreciation of the secondary exchange rate raises export revenue per unit in domestic currency. This rise in export revenue in domestic currency is likely to improve the international competitiveness of domestic exports and to encourage exports to increase unless the changes in the relative prices make production for the domestic markets even more profitable. Tables 7.2a and 7.2b, however, show that the *fob* values of aggregate exports in the base-year border prices rise. As the volume of exports rises (by 0.55 per cent), the world export price falls constrained by the relevant foreign demand elasticity. On the whole, the world export price index declines. This means a deterioration in the economy's international terms of trade (Tables 7.2a and 7.2b) because the world import prices are fixed exogenously. The changes in the aggregate

Table 7.2a **Short-run effects of a 1 per cent devaluation on the composition of balance of trade deficits under the Keynesian closure**

	(%)	value (mil. taka)
Increased exports (*fob*)[a]	0.55	169.61
Increased imports (*cif*)[a]	0.09	123.43
Terms of trade effects[b]	-0.15	-46.18
Balance of trade deficits	*	*

Notes: [a]Percentage changes refer to changes in quantities. Value changes refer to changes in variables due to changes in quantities only.
[b]Defined as the product of the base-year total export value and the after-shock change in the world export price index (see Equations 4.56 and 4.57).
*Balance of trade deficit in current border prices was fixed exogenously at the base-year level. Hence there was no change in the balance of trade in the current border prices.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulations *fob* export values in current world prices (increased export value in base-year border prices plus losses associated with the deterioration of the terms of trade) are still positive under both the closures. As the balance of trade, measured in current border prices, is held at the base-year level, aggregate *cif* values of imports rise in both cases. While the balance of trade deficit in base-year prices is reduced, it is constrained to equal in magnitude the loss from deteriorating terms of trade.

Table 7.2b **Short-run effects of a 1 per cent devaluation on the composition of balance of trade deficits under the Neoclassical closure**

	(%)	value (mil. taka)
Increased exports (*fob*)[a]	0.28	87.36
Increased imports (*cif*)[a]	0.04	51.57
Terms of trade effects[b]	-0.12	-35.79
Balance of trade deficits	*	*

Notes: Same as for Table 7.2a

Source: CGE-B89 model database and simulation

Devaluation, with no offsetting change in money supply, also brings about a rise in the consumer price index (CPI) in both cases (Table 7.1). Under the Keynesian closure, a rise in CPI against the fixed nominal wages rates means a fall in real wages. Consequently, aggregate employment increases lead to an increase in the value-added to labour by 0.15 per cent or taka 452.75 million (Table 7.3a). This also measures the increase in real GDP at factor cost when capital is fixed. The rise in GDP at factor cost plus the increase in total net indirect taxes measures the increase in GDP at the base-year market prices. The increase in GDP at market price, net of the loss due to worsening terms of trade, finances the increased consumption worth taka 451.84 million which is about 0.07 per cent of the base-year consumption. This identity holds because all other domestic final demands were held at the base-year levels. Higher consumption leads to higher level of utility. Under the assumption of unitary marginal utility of expenditure, taka 451.84 million increase in utility measures the change in welfare. A rise in CPI by 0.08 per cent against the fixed nominal wages means a fall in real wages by 0.08 per cent. However, an increase in aggregate employment by 0.15 per cent ensures overall welfare improvement for labour.

Table 7.3a **Short-run effects of a 1 per cent devaluation on important macroeconomic variables[a] under the Keynesian closure**

	(%)	value (mil. taka)
Increased employment	0.15	452.75
Indirect taxes[b]	0.11	45.27
GDP at market price	0.07	498.02
Terms of trade effects	-0.15	-46.18
Consumption[c]	0.07	451.84

Notes: [a]For data comparability see Appendix A6.1. Percentage changes refer to change in quantities and the value changes are evaluated at the base-year prices and rates. The exceptions are the terms of trade effect, in which case they are change in the border price index of exports, and the product of base-year exports and the change in border price index of exports.
[b]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus the subsidies under the Export Performance Benefit Scheme. The components are disaggregated in Table 7.8a.
[c]Value change in consumption equals change in utility (Equation 4.45, Chapter 4).
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

Under the Neoclassical (fixed employment) closure, aggregate value-added to labour does not change. But reallocation of resources among sectors and redistribution of expenditure result in an increase in aggregate indirect taxes. Hence, change in indirect taxes alone measures the change in GDP at market price. Table 7.3b shows that GDP at the base-year purchaser price increases by 0.002 per cent which amounts to taka 16.73 million. The economy loses taka 35.79 million due to the deterioration in the international terms of trade. Consequently, consumption, under the already mentioned constraints, declines by 0.003 per cent. As imports get cheaper, households increase their consumption of imports and they consume less domestic goods in the aggregate (discussed later in Tables 7.5b and 7.6b). The total consumption, both domestic and imported, at the base-year prices, however, falls by taka 19.06 million (Table 7.3b). Utility falls by taka 19.06 million too.

Table 7.3b **Short-run effects of a 1 per cent devaluation on important macroeconomic variables[a] under the Neoclassical closure**

	(%)	value (mil. taka)
Employment	*	*
Indirect taxes[b]	0.04	16.73
GDP at market price	0.002	16.73
Terms of trade effects	-0.12	-35.79
Consumption[c]	-0.003	-19.06

Notes: Same as for Table 7.3a.
[c]Disaggregated in Table 7.8b.

Source: CGE-B89 model database and simulations

In the fixed-employment case, aggregate exports in the base-year exporters' prices expand more than the fall in domestic sales in the base-year prices (explained later in Table 7.5b). Aggregate composite output expands as a result. Adjustments in the sectors put pressure on fixed employment. Real wages rise as nominal wages rise more than the increase in CPI. An increase in real wage with fixed employment means an overall welfare rise of labour.

Various macroeconomic effects of devaluation through market mechanism can be traced back by analyzing its sectoral effects.

Sectoral effects of devaluation

Effects on prices. Market mechanism works through changes in relative prices. Thus the sectoral effects of devaluation are traced starting with its effects on prices. Three different basic prices are distinguished in the CGE-B89 model for each commodity classification: the basic export (or exporters') price, the domestic basic price, and the basic import (or importers') price. Equations 4.20-4.20c in Chapter 4 define the importers' prices. Given the world prices of importables and the unchanged tariff rates, a 1 per cent devaluation of the official exchange rate raise importers' price for rice and wheat by 1 per cent also (4.20a). For others, the two exchange rates influence the importers' prices (4.20c). The devaluation of the official exchange rate and the consequent appreciation of the secondary exchange rate put opposing pressures on these importers' prices; they are also not likely to bring about uniform changes in all importers' prices. Columns 2 and 5 in Table 7.4 show that ready-made garments, leather, other agriculture and cotton textiles with no or a low tariff rate, experience a fall in their importers' prices under both the closures. Importers' price of other manufactures in the Keynesian case also fell. The remaining importers' prices register a rise, the percentages of which follow the order of magnitude of tariff rates in the base-year.

Domestic goods in the same statistical category are Armington substitutes for imports. *Ceteris paribus*, a rise of importers' prices switches demand towards domestic substitutes and a fall in importers' prices diverts demand away from domestic substitutes. Changes in importers' prices put pressure on the basic prices of domestic substitutes. The ultimate effect of a devaluation-induced rise in the importers' price on the basic price of domestic substitutes, however, depends on the magnitude of the Armington elasticity of substitution, demand elasticity of the Armington composite good, the supply elasticity of domestic substitutes, elasticity of transformation between domestic sale and export, and trade shares (**Appendix A4.1**; for further details see de Melo and Robinson 1985).

Table 7.4 **Short-run effects of a 1 per cent devaluation on basic prices (%)**

	Keynesian			Neoclassical		
	Exporters' (1)	Importers' (2)	Domestic (3)	Exporters' (4)	Importers' (5)	Domestic (6)
Exportables						
Jute	0.12	n.a.	...	0.23	n.a.	0.12
Tea	0.33	n.a.	0.21	0.33	n.a.	0.15
Fish	-0.03	n.a.	0.04	0.02	n.a.	0.14
Ready-made garments	-0.07	-0.16	0.06	-0.02	-0.12	0.14
Jute textiles	0.20	n.a.	-0.23	0.27	n.a.	-0.10
Leather	-0.02	-0.16	0.05	0.02	-0.12	0.10
Forestry	0.65	n.a.	0.19	0.64	n.a.	0.14
Importables						
Rice	n.a.	1.00	0.05	n.a.	1.00	0.17
Wheat	n.a.	1.00	0.33	n.a.	1.00	0.40
Edible oil	n.a.	0.05	0.08	n.a.	0.08	0.12
Other agriculture	0.44	-0.11	0.08	0.47	-0.08	0.14
Sugar	n.a.	0.06	0.07	n.a.	0.08	0.14
Cotton textiles	n.a.	-0.03	0.07	n.a.	-.	0.13
Paper	0.49	0.08	0.10	0.51	0.11	0.13
Chemicals	0.55	0.15	0.19	0.55	0.18	0.13
Other manufactures	0.44	-0.03	0.09	0.46	0.01	0.12
Non-tradables						
Physical overheads	n.a.	n.a.	0.12	n.a.	n.a.	0.15
Social overheads	n.a.	n.a.	0.02	n.a.	n.a.	0.16
Public administration	n.a.	n.a.	0.06	n.a.	n.a.	0.16

Notes: Importers' and exporters' prices were defined in Equations 4.20a-4.20c and 4.21. The basic prices for domestic sales followed from the market clearing and zero pure profit conditions. All the basic prices were defined in the domestic currency, taka. Figures in the Table are percentage changes of these base-year basic prices.

Source: The CGE-B89 model simulations.

Columns 1 and 4 in Table 7.4 show the short-run effects on exporters' prices defined in Equation 4.21 of Chapter 4. Export Performance Benefit entitlement rates distribute the weights between the two exchange rates and define the export exchange rates for individual goods. Given these rates, devaluation of the official exchange rates by 1 per cent and the consequent slight appreciation of the secondary exchange rate lead to an increase in the exporters' prices of most of the exportables. Exporters' prices of fish, ready-made garments and leather, under the Keynesian closure, declined however. For exports with very high Export Performance Benefit entitlement rates (that is, a very high weight assigned to the secondary exchange rate), exporters' prices either rise a little or fall, the latter being the case for fish, garments and leather. In the Keynesian situation in which the secondary exchange rate depreciated less, exporters' price for garments fell only. As constant elasticity of transformation has been assumed between exports and domestic sales, a devaluation-induced increase in exporters' prices causes changes in the basic prices of domestic sales depending on the transformation elasticities, supply elasticities of composite goods, trade shares, the price elasticities of demand and Armington trade elasticities (Appendix A4.1, for details see de Melo and Robinson 1985).

In the model, importables and exportables have not been strictly defined. Two-way trade has been assumed. The model data show that outputs of some sectors classified as importables are also exported, and some sectors classified as exportables are also imported to meet domestic demands. For these sectors, changes in basic prices of domestic goods are thus influenced by changes in both importers' and exporters' prices. Columns 3 and 6 in Table 7.4 show the effects of devaluation on domestic basic prices through its effects on importers' and/or exporters' prices. All the basic prices of domestic sales except that of jute textiles register an increase under both the closures. It is evident that devaluation caused changes in both sets of relative prices: domestic-export and domestic-import. Changes in relative prices induce adjustments in sectoral outputs and employments.

Effects on sectoral outputs, employments (or wages) and demands. The supply responses of individual sectors are, however, different under different closures (Table 7.5a and 7.5b). Under the same closure, the supply responses of individual sectors are not the same.

Under the Keynesian closure, gross (composite) outputs of all but three sectors increased (Columns 5 and 6 in Table 7.5a). Gross outputs of ready-made garments, leather and cotton textiles registered a fall. Columns 7 to 10 in Table 7.5a shows that both exports and domestic sales expanded for jute, tea, forestry, jute textiles, other agriculture, paper, chemicals and other manufactures sectors. For other expanding sectors, gross outputs increase because their domestic sales expanded. When the relative prices moved in favour of the overseas markets for jute, tea, forestry, jute textiles, other agriculture, paper, chemicals and other manufactures sectors (columns 1 and 3 in Table 7.4), their production for exports increased (column 7 in Table 7.5a). On the consumption side, when relative prices moved against the imports, they created incentives for increased demand for domestic substitutes. Increases in domestic sales of rice and wheat are examples. For edible oil, other agriculture, sugar, cotton textiles, paper, chemicals, and other manufacturing sectors, relative prices changed against the domestic sales. The positive effects on consumption of additional income and inter-sectoral linkages (expansion of some sectors requiring more raw material supplied by other sectors), however, led to increased domestic sales of these importables.

Fall in gross outputs in the ready-made garments and leather sectors was mainly driven by the drop in their exports (Columns 5-10 in Table 7.5a). Appreciation of the secondary exchange rate depressed the initial rise in export revenue per unit due to devaluation of the official exchange rate. For fish, ready-made garments and leather for which the Export Performance Benefit entitlement rates were 90, 95 and 89 per cent respectively (Table 5.1), appreciation of the secondary exchange rate more than

Table 7.5a Short-run effects of a 1 per cent devaluation on sectoral gross outputs, value-added and sales under the Keynesian closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands: Export		Domestic: Total		Consumption		Int.uses	
	(%) (1)	(mil. TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
	Changes at the base-year basic prices[d]													
Exportables														
Jute	0.28	15.47	0.27	9.59	0.27	25.06	0.65	20.46	0.07	4.60	0.07	4.45	0.15	0.15
Tea	0.29	1.14	0.02	0.42	0.02	1.56	0.59	0.53	0.01	1.03	0.01	1.01	0.06	0.02
Fish	0.05	8.81	0.03	2.85	0.03	11.65	-0.28	-11.65	0.08	23.31	0.08	22.98	0.05	0.33
Forestry	0.24	8.42	0.03	2.26	0.03	10.69	2.33	0.05	0.03	10.64	0.01	2.52	0.06	8.12
Rd. md. garments	-0.93	-20.48	-0.61	-45.22	-0.61	-65.69	-0.70	-64.82	-0.06	-0.87	0.04	0.44	-0.61	-1.31
Jute textiles	2.16	90.02	1.99	113.54	1.99	203.56	2.35	199.53	0.24	4.03	0.26	2.52	0.18	1.51
Leather	-0.50	-5.74	-0.29	-8.80	-0.29	-14.54	-0.35	-14.50	-0.01	-0.04	0.05	0.28	-0.31	-0.32
Importables														
Rice	0.09	63.18	0.05	21.36	0.05	84.54	n.a.	n.a.	0.05	84.54	0.04	53.24	0.14	31.30
Wheat	0.87	24.28	0.48	7.24	0.48	31.52	n.a.	n.a.	0.48	31.52	0.66	27.01	0.16	4.51
Edible oil	0.13	1.31	0.04	2.95	0.04	4.26	n.a.	n.a.	0.04	4.26	0.03	1.56	0.04	2.71
Other agric.	0.11	46.59	0.05	23.59	0.05	70.17	1.84	12.49	0.04	57.69	0.04	40.79	0.04	16.89
Sugar	0.09	2.21	0.05	4.46	0.05	6.67	n.a.	n.a.	0.05	6.67	0.06	5.33	0.05	1.34
Cotton textiles	-0.02	-1.36	-0.02	-2.72	-0.02	-4.08	n.a.	n.a.	-0.02	-4.08	0.07	11.24	-0.31	-15.32
Paper	0.21	1.84	0.11	10.38	0.11	12.21	2.00	6.81	0.05	5.40	0.08	3.30	0.03	2.10
Chemicals	0.45	3.14	0.05	8.88	0.05	12.02	1.88	0.22	0.05	11.81	0.03	1.24	0.06	10.56
Other manuf.	0.17	23.94	0.07	53.76	0.07	77.71	1.79	20.87	0.05	56.84	0.03	5.04	0.06	51.80
Nontradables														
Phy. overheads	0.21	124.23	0.07	59.87	0.07	184.10	n.a.	n.a.	0.07	184.10	0.07	97.32	0.10	86.78
Social overheads	0.07	16.29	0.07	1.97	0.07	18.27	n.a.	n.a.	0.07	18.27	0.12	18.21	0.07	0.05
Public admin.	0.12	49.44	0.08	10.11	0.08	59.56	n.a.	n.a.	0.08	59.56	0.10	41.04	0.15	18.52
Aggregate	0.15	452.75	0.07	276.51	0.07	729.26	0.54	169.99	0.06	559.27	0.06	339.52	0.07	219.75

Notes: [a]The base year-values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in value-added equal changes in value-added to labour only. [c]Intermediate inputs include material inputs from both domestic and foreign sources at the market prices. [d]Hence changes are due to changes in quantities only. Three basic prices of goods are, wherever applicable, the exporters' prices, importers' prices, and the basic prices for domestic sale. Identities: (2)+(4)=(6)=(8)+(10); (10)=(12)+(14). Figures have been rounded so that rounding errors may be present.

Source: CGE-B89 simulations

offset the initial rise in exporters' prices due to devaluation of the official exchange rate (Table 7.4). Changes in relative prices in favour of domestic sales caused a decline in these exports. As exports constituted more than 80 per cent for garments and leather in the base-year 1989 (Table A5.2 in Appendix A5.1), their gross outputs registered a fall. Fish exports fell, but exported fish was only 12 per cent of gross output in the base-year. As a result, the fall in fish export was more than compensated for by an increase in domestic sale. Decrease in garments production reduced its demand for its main raw materials, cotton textiles. Even though final demand for cotton textiles rose slightly, its gross output fell.

The reallocation of and increase in employment following devaluation are linked to the relative adjustments in sectoral outputs. In the short run, capital is sector-specific and labour employment only adjusts following output adjustments. The direction of changes in sectoral employments followed the corresponding changes in sectoral outputs (Columns 1 and 5 in Table 7.5a). The magnitude of changes in employments depended on the labour-intensity and supply response of the relevant industry. Employments in ready-made garments, leather and cotton textiles experienced a decline matching the declines in their composite outputs. Because these sectors only constituted a small fraction of the total employment in the base-year, the declines of employments in these sectors were insignificant compared to increases in employments experienced by all other expanding sectors. As a result, aggregate employment, rose. Increases in value-added to labour in physical overheads, jute textiles, rice, other agriculture and public administration sectors were considerable (column 2 in Table 7.5a).

Under the fixed employment (Neoclassical) closure, only jute, tea, jute textiles, rice, wheat and paper recorded an expansion. Some sectors which expanded in the fixed nominal wage (Keynesian) case namely, fish, forestry, edible oil, other

Table 7.5b Short-run effects of a 1 per cent devaluation on sectoral gross-outputs, value-added and sales under the Neoclassical closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands: Export		Domestic: Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
	Changes at the constant basic prices[d]													
Exportables														
Jute	0.20	10.69	0.19	6.63	0.19	17.31	0.54	17.17	0.00	0.14	0.00	0.07	0.07	0.07
Tea	0.01	0.05	0.00	0.02	0.00	0.06	0.88	0.79	-0.01	-0.73	-0.01	-0.73	0.00	0.00
Fish	-0.12	-21.39	-0.08	-6.91	-0.08	-28.30	-0.63	-26.12	-0.01	-2.17	-0.01	-1.92	-0.04	-0.26
Forestry	-0.04	-1.38	-0.01	-0.37	-0.01	-1.75	2.54	0.05	-0.01	-1.80	0.00	-0.37	-0.01	-1.43
Rd. md. garments	-1.28	-28.08	-0.84	-62.00	-0.84	-90.08	-0.95	-87.78	-0.16	-2.30	-0.04	-0.50	-0.84	-1.80
Jute textiles	1.77	73.80	1.64	93.08	1.64	166.87	1.94	165.08	0.11	1.80	0.12	1.19	0.07	0.61
Leather	-0.69	-7.85	-0.40	-12.02	-0.40	-19.87	-0.46	-19.46	-0.05	-0.41	0.00	0.01	-0.41	-0.42
Importables														
Rice	0.01	7.28	0.01	2.46	0.01	9.75	n.a.	n.a.	0.01	9.75	0.00	-5.42	0.07	15.16
Wheat	0.67	18.80	0.37	5.60	0.37	24.41	n.a.	n.a.	0.37	24.41	0.55	22.25	0.08	2.15
Edible oil	-0.11	-1.06	-0.03	-2.38	-0.03	-3.43	n.a.	n.a.	-0.03	-3.43	-0.03	-1.44	-0.03	-1.99
Other agric.	-0.07	-27.94	-0.03	-14.15	-0.03	-42.09	1.60	10.85	-0.04	-52.94	-0.04	-40.38	-0.03	-12.55
Sugar	-0.06	-1.40	-0.03	-2.83	-0.03	-4.23	n.a.	n.a.	-0.03	-4.23	-0.04	-3.24	-0.03	-0.99
Cotton textiles	-0.16	-9.72	-0.14	-19.41	-0.14	-29.13	n.a.	n.a.	-0.14	-29.13	-0.04	-5.62	-0.47	-23.52
Paper	0.03	0.29	0.02	1.64	0.02	1.93	1.85	6.27	-0.04	-4.34	-0.01	-0.32	-0.06	-4.02
Chemicals	-0.02	-0.17	0.00	-0.49	0.00	-0.66	2.10	0.24	0.00	-0.90	0.01	0.49	-0.01	-1.39
Other manuf.	-0.03	-3.99	-0.01	-8.97	-0.01	-12.96	1.66	19.36	-0.03	-32.32	-0.05	-8.15	-0.03	-24.17
Nontradables														
Phy. overheads	-0.01	-4.26	0.00	-2.05	0.00	-6.31	n.a.	n.a.	0.00	-6.31	-0.01	-17.30	0.01	10.99
Social overheads	-0.01	-2.61	-0.01	-0.32	-0.01	-2.92	n.a.	n.a.	-0.01	-2.92	-0.02	-2.92	0.00	0.00
Public admin.	0.00	-1.06	0.00	-0.22	0.00	-1.27	n.a.	n.a.	0.00	-1.27	-0.02	-7.01	0.05	5.74
Aggregate	*	0.00	-0.01	-22.67	-...	-22.68	0.27	86.44	-0.01	-109.12	-0.01	-71.29	-0.01	-37.83

Notes: *Aggregate employment was fixed. Hence there was no change in the aggregate value-added to labour.
Also, see notes in Table 7.6a

Source: CGE-B89 simulations

agriculture, sugar, chemicals, other manufactures, physical overheads, social overheads and public administration contracted under the fixed employment (Neoclassical) closure. Ready-made garments, leather and cotton textiles experienced a contraction as before.

Devaluation of the official exchange rate led to an increase in exports of the sectors with low Export Performance Benefit entitlement rates namely, jute, tea, forestry, and jute textiles also in the Neoclassical case (Table 7.5b). Sectors with very high Benefit rates such as fish, ready-made garments and leather experienced unfavourable movements in relative prices and hence declines in exports as in the Keynesian case. Jute textiles experienced a substantial export expansion while ready-made garments suffered the most export contraction. Ready-made garments and leather, characterized by very high export orientation, suffered declines in gross outputs. On the other hand imports, except rice, wheat and chemicals, became relatively cheaper due to the appreciation of the secondary exchange rate, and consumers and producers (for raw materials) switched from their domestic substitutes towards imports (Tables 7.5b and 7.6b). On the supply side, expansion in some sectors, including two highly labour intensive jute and jute textiles sectors (Table A5.2 in Appendix A5.1), put pressure on the fixed level of employment leading to a rise in real wages. Depressed domestic demands for domestic goods together with the increases in real wages explain the declines in gross outputs in 13 out of 19 sectors. Though ready-made garments and leather sectors experienced a contraction under both the closures, the falls in their gross outputs were greater in the fixed employment case than the fixed nominal wage case.

Effects on the composition of the balance of trade. Devaluation seemed to encourage exports in sectors with low Export Performance Benefit entitlements under both the closures (Tables 7.5a, 7.5b, 7.7a and 7.7b). Exports of jute textiles expanded

Table 7.6a **Short-run effects of a 1 per cent devaluation on imports[a] under the Keynesian closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
	Changes at the constant importers' prices[b]					
Rice	-1.47	-24.70	-1.67	-5.14	-1.42	-19.57
Wheat	-0.57	-44.00	-0.54	-41.90	-0.73	-2.10
Edible oil	0.08	6.82	0.08	6.47	0.09	0.35
Other agriculture	0.39	59.67	0.39	47.32	0.40	12.36
Sugar	0.08	5.03	0.09	4.86	0.08	0.17
Cotton textiles	0.20	10.25	0.25	11.09	-0.12	-0.85
Paper	0.08	3.07	0.10	1.81	0.07	1.26
Chemicals	0.08	6.92	0.07	2.30	0.09	4.62
Other manufacture	0.12	126.45	0.17	76.97	0.19	49.48
Ready-made garments	0.31	0.71	0.32	0.71	0.00	0.00
Leather	0.62	0.11	0.39	0.04	0.06	0.07
Aggregate	**0.09**	**150.31**	**0.12**	**104.52**	**0.11**	**45.79**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 7.6b **Short-run effects of a 1 per cent devaluation on imports[a] under the Neoclassical closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
			Changes at the base-year importers' prices[b]			
Rice	-1.35	-22.68	-1.51	-4.64	-1.31	-18.04
Wheat	-0.57	-43.50	-0.53	-41.43	-0.72	-2.07
Edible oil	0.03	2.78	0.03	2.67	0.03	0.11
Other agriculture	0.36	55.30	0.36	43.73	0.38	11.58
Sugar	0.06	3.70	0.06	3.56	0.06	0.14
Cotton textiles	0.13	6.88	0.20	8.53	-0.24	-1.65
Paper	0.00	-0.02	0.02	0.31	-0.02	-0.33
Chemicals	-0.06	-5.15	-0.05	-1.56	-0.07	-3.59
Other manufacture	0.07	66.52	0.09	39.02	0.10	27.50
Ready-made garments	0.29	0.65	0.30	0.65	0.00	0.00
Leather	0.12	0.02	0.36	0.03	-0.01	-0.01
Aggregate	**0.04**	**64.51**	**0.06**	**50.88**	**0.03**	**13.64**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities.
Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

the most. World export prices, inversely related to the volume of exports, fell for these exports. However, for fish, ready-made garments and leather, world export prices rose. As the world prices of imports were fixed exogenously and the world export price index fell the international terms of trade deteriorated. The aggregate *fob* export value at the current world prices, however, rose (Tables 7.7a and 7.7b) as all export demand elasticities were greater than one. Both the model closures under consideration contained the current balance of trade deficit to its base-year level with net foreign transfer being held constant. As a result, the increase in aggregate export earnings in the current world prices (*fob* export value at the base-year world prices plus changes due to changes in world prices) was matched by an increase in total value of imports at the fixed world import prices (Tables 7.7a and 7.7b). Imports in most of the individual sectors ballooned.

Under the Keynesian closure, as nominal wages were fixed and labour supply was demand determined, exporters were able to respond to favourable price changes. Those sectors which expanded sales in the overseas markets expanded more in the Keynesian case than the Neoclassical case, whereas sectors experiencing contraction in exports contracted exports less under the Keynesian closure. Consequently, aggregate exports rose more under the Keynesian closure. Imports also rose more in the Keynesian case due to balance of trade constraints.

Welfare effects

Welfare implications of devaluation are sensitive to the closure under consideration. Tables 7.8a and 7.8b break down the welfare effects of devaluation based on the Efficiency Equation 4.56 (Chapter 4). The sources of welfare gains and losses can be discussed under three broad groups: variable terms of trade (flexible world price of

Table 7.7a **Short-run effects of a 1 per cent devaluation on the composition of trade[a] under the Keynesian closure**

	Imports		Exports	
	(%)	(mil. US$)	(%)	(mil. US$)
	Changes in base-year world prices[b]			
Exportables				
Jute	n.a.	n.a.	0.65	0.63
Tea	n.a.	n.a.	0.59	0.02
Fish	n.a.	n.a.	-0.28	-0.35
Forestry	n.a.	n.a.	2.33	.
Ready made garments	0.31	0.02	-0.70	-1.97
Jute textiles	n.a.	n.a.	2.35	6.15
Leather	0.62	.	-0.35	-0.44
Importables				
Rice	-1.47	-0.77	n.a.	n.a.
Wheat	-0.57	-1.37	n.a.	n.a.
Edible oil	0.08	0.17	n.a.	n.a.
Other agriculture	0.39	1.75	1.84	0.38
Sugar	0.08	0.12	n.a.	n.a.
Cotton textiles	0.20	0.28	n.a.	n.a.
Paper	0.08	0.07	2.00	0.21
Chemicals	0.08	0.15	1.88	0.01
Other manufactures	0.12	3.41	1.79	0.64
Total[b]	**0.09**	**3.84**	**0.55**	**5.28**
Effects of world price changes	*	*	-0.15	-1.44
Aggregate[c]	**0.09**	**3.84**	**0.40**	**3.84**

Notes: [a]The base-year values are in Appendix A5.2. Exports and imports in world prices are calculated by deflating the *fob* export and *cif* import values respectively by the official exchange rate. For data comparability see Appendix A6.1.

[b]Changes are due to quantity changes.

[c]Values are in the current world prices. For imports, *cif* values in current and in the base-year world prices are the same. The *fob* export value in the current world prices equals the *fob* export value in the base-year world prices plus the change in export value due to changes in the world prices .

Identity: Since the balance of trade deficit in current border prices was fixed at the base-year level, value of *cif* imports equals that of *fob* exports in the current world prices.

*The world import prices are fixed exogenously.

Figures are rounded to the nearest number so that rounding error may be present.

Source: CGE-B89 simulations

exports), labour market distortions (wage rigidity) and government (indirect taxes and subsidies).

Table 7.7b **Short-run effects of a 1 per cent devaluation on the composition of trade[a] under the Neoclassical closure**

	Imports		Exports	
	(%)	(mil US$)	(%)	(mil. US$)
		Changes in base-year world prices[b]		
Exportables				
Jute	n.a.	n.a.	0.54	0.53
Tea	n.a.	n.a.	0.88	0.02
Fish	n.a.	n.a.	-0.62	-0.80
Forestry	n.a.	n.a.	2.54	.
Ready made garments	0.29	0.02	-0.95	-2.67
Jute textiles	n.a.	n.a.	1.94	5.09
Leather	0.12	.	-0.46	-0.59
Importables				
Rice	-1.35	-0.71	n.a.	n.a.
Wheat	-0.57	-1.35	n.a.	n.a.
Edible oil	0.03	0.07	n.a.	n.a.
Other agriculture	0.36	1.62	1.60	0.33
Sugar	0.06	0.09	n.a.	n.a.
Cotton textiles	0.13	0.19	n.a.	n.a.
Paper	-.	-.	1.85	0.19
Chemicals	-0.06	-0.11	2.10	0.01
Other manufactures	0.07	1.79	1.66	0.60
Total[b]	**0.04**	**1.60**	**0.28**	**2.72**
Effects of world price changes	*	*	-0.12	1.12
Aggregate[c]	**0.04**	**1.60**	**0.16**	**1.60**

Notes: Same as for Table 7.7b.

Source: CGE-B89 simulations

Table 7.8a **Disaggregation of welfare effects[a] of a 1 per cent devaluation under the Keynesian closure (short-run)**

	(%)	value (mil. taka)
		Constant price changes[b]
(1) Terms of trade effects	**-0.15**	**-46.18**
(2) Employment	**0.15**	**452.75**
(3) Other effects	**0.11**	**45.27**
Revenue from intermediate input taxes	0.10	10.97
Revenue from consumption taxes	0.10	7.80
Tariff revenue	0.12	22.30
Implicit taxes on imports	0.15	4.58
Revenue from export taxes[c]	-0.08	-0.38
(4) Aggregate change in welfare[d]	**0.17**	**451.84**

Notes: [a]Change in welfare equals the change in utility at unitary marginal utility of income. The disaggregation was based on the Efficiency Equation 4.56, Chapter 4.
[b]Changes in value measure the gains (or losses) from diminution (or intensification) of the distortions modelled in CGE-B89. Except for the terms of trade (TOT) effects, the value changes were evaluated at the base-year prices (ie. due to changes in quantities only). The TOT effects is the product of the base-year exports and the change in border price index of exports.
[c]Export subsidies under the Export Performance Benefit Scheme are negative taxes. Devaluation led to an increase in subsidies which is equivalent to a fall in export taxes and hence welfare.
[d]Aggregate change in welfare equals all the gains (or losses) from alleviation (or exacerbation) of the distortions.
Identity: (4)=(1)+(2)+(3). Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

Under both the closures, the economy was modelled to have market power in the world markets. Given the elasticities of foreign demands for domestic exports and world market power, some optimal export taxes could be contemplated. In absence of such optimal taxes, terms of trade deteriorated following devaluation. The deterioration of terms of trade implies a decline in the purchasing power of exports. The substantial loss in import capacity means a significant decline in welfare.

Table 7.8b **Decomposition of welfare effects[a] of a 1 per cent devaluation under the Neoclassical closure[1] (short-run)**

	(%)	value (mil. taka)
		Constant price changes[b]
(1) Terms of trade effects	**-0.12**	**-35.79**
(2) Total indirect taxes	**0.04**	**16.73**
Revenue from consumption taxes	0.02	1.36
Revenue from intermediate input taxes	0.01	1.51
Tariff revenue	0.06	10.13
Implicit taxes on imports	0.09	2.81
Export taxes[c]	0.18	0.92
(3) **Aggregate change in welfare[d]**	**-0.01**	**-19.06**

Notes: Same as for Table 7.8a.
[1]Under the Neoclassical closure, aggregate employment is fixed by the exogenous supply of labour. So, no gains from employment.
Identity: (3)=(1)+(2). Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

Under the Keynesian clôsure, welfare rose by reducing involuntary unemployment at fixed nominal wages. Devaluation raised employment by 0.15 per cent. Under the Neoclassical closure, employment was fixed by the exogenous supply of labour.

Total revenue from net indirect taxes rose under both the closures. A rise in demand for aggregate or highly tax-ridden consumption led to an increase in consumption tax. Demands for aggregate or highly tax-ridden intermediate inputs rose and with these revenue from taxes on the intermediate inputs. Imports also increased under both the closures. Hence, increasing revenues from tariffs and implicit import taxes (associated with exchange premium rate). Under both the closures, exports with high Export Performance Benefit (XPB) entitlement rates fell and those with low rates rose. Reduction of subsidies on account of high XPB-rated exports was offset by the increase in subsidies on account of low XPB-rated exports in the Keynesian case. Aggregate export subsidies thus rose which is equivalent to a fall in export tax revenue. The opposite is the case for the Neoclassical closure. Devaluation led to an increase in welfare on account of export subsidies.

In the aggregate, welfare rose under the Keynesian closure whereas it fell under the Neoclassical closure. Under the Neoclassical closure, the loss of welfare due to deterioration of the terms of trade more than offsets the gains associated with the redistribution of increased revenues from various taxes and of reduced expenditure on export subsidies. As a result, aggregate welfare dropped. With fixed labour and capital (hence, no change in value-added), the economy as a whole expanded exports which would otherwise be transformed for domestic uses. Exports failed to import sufficiently owing to deteriorated terms of trade so that the fall in household consumption of domestic goods could not be compensated. Aggregate welfare fell with reduced aggregate consumption (domestic and imported).

In the fixed nominal wage (Keynesian) case, the deleterious effects associated with the deteriorated terms of trade surpassed the gains from the net indirect taxes. But gains from additional employment compensated the loss and raised aggregate welfare by 0.17 per cent. In the aggregate, the economy increased exports of goods that would have been transformed for domestic uses, and failed to import enough under the deteriorated terms of trade to make up for the loss of consumption due to international trade. But as nominal wages were fixed and real wages fell, the economy could produce more for both domestic and overseas markets by reducing involuntary unemployment. Unlike the previous case, aggregate consumption did not drop and welfare increased.

Summary and policy implications. The directions of changes in the important variables due to devaluation under both the closures are summarized in Table 7.8c.

Table 7.8c: **The directions of the short-run effects of a 1 per cent devaluation on important variables under the both the closures**

	Keynesian	Neoclassical
Value-added to labour	+	n.a.
Total indirect taxes	+	+
GDP at market price	+	+
Terms of trade effects	-	-
Welfare/consumption	+	-
Exports (*fob*)	+	+
Imports (*cif*)	+	+

Source: Tables 7.2a,b; 7.3a,b; 7.8a,b.

Devaluation resulted in additional revenue from taxes in both the closure. In the Keynesian case, value-added to labour rose due to reduction in involuntary unemployment. In the Neoclassical case, employment was fixed. GDP at market prices (value-added plus net indirect taxes), however, rose in both the cases. As exports rose, terms of trade deteriorated irrespective of wage rigidity assumption. The loss of purchasing power due to deteriorating terms of trade offset the indirect gains of additional revenue in the Neoclassical case. Consumption and hence welfare fell. In the Keynesian case, increase in value-added was enough to compensate for the loss due to terms of trade deterioration. Consumption and welfare thus rose consequently.

The analysis of the sectoral effects revealed that under both the closures, ready-made garments and leather, characterized with high export orientation and high Benefit entitlements contracted. The extent of contraction was more for the Neoclassical case. Jute and jute textiles which enjoy low Benefit rates expanded remarkably under both the closures, expanded more so under the Keynesian closure. Some sectors which contracted under the Neoclassical closure, expanded under the Keynesian closure.

Overvaluation of the official exchange rate may be deemed to be an export tax. Devaluation is thus supposed to be beneficial. Given the chosen export demand elasticities and market power in export markets (following from the assumption of product differentiation), the absence of optimal taxes led to a deterioration in the terms of trade when the official exchange rate was devalued. Under the Keynesian closure, devaluation also led to a deterioration in the terms of trade, but imposition of another distortion in the labour market (fixing nominal wages) raised welfare and offset the welfare-reducing effects associated with deteriorated terms of trade in absence of optimal export taxes.

Simulation results suggest that a 2 per cent devaluation of the official exchange rate would unify the exchange rates and that the loss (or gain) from unification would not be significant. Given the sticky wages in presence of involuntary unemployment, a devaluation of the exchange rate would always produce a Keynesian stimulus.

Increase in domestic money supply

Economy-wide effects

As portrayed in Figure 7.2, a once-and-for-all exogenous increase in money supply leads to an increase in demand for foreign exchange causing a depreciation of the secondary exchange rate. Under the Keynesian closure, as the domestic money supply was increased by 1 per cent, the import bill in domestic currency rose by 0.22 per cent and by taka 308.15 million (Table 7.9a), and the secondary exchange rate depreciated by 0.94 per cent (Table 7.10). Depreciation of the secondary exchange rate makes

Table 7.9a **Effects of a 1 per cent increase in money supply on the composition of balance of trade deficits under the Keynesian closure** (short-run)

	(%)	value (mil. taka)
Increased exports (*fob*)[a]	1.04	324.40
Increased imports (*cif*)[a]	0.22	308.15
Terms of trade effects[b]	-0.05	-16.25
Balance of trade deficits	*	*

Notes: [a]Percentage changes refer to changes in quantities. Value changes refer to changes in variables due to changes in quantities only.
[b]Defined as the product of the base-year total export value and the after-shock change in the world export price index (see Equations 4.56 and 4.57).
*Balance of trade deficit in current border prices was fixed exogenously at the base-year level. Hence there was no change in the balance of trade in the current border prices.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model data base and simulation

Table 7.9b **Effects of a 1 per cent increase in money supply on the composition of balance of trade deficits under the Neoclassical closure**

	(%)	value (mil. taka)
Reduced exports (*fob*)[a]	-0.28	-87.36
Reduced imports (*cif*)[a]	-0.04	-51.57
Terms of trade effects	0.12	35.79
Balance of trade deficits	*	*

Note: Same as for Table 7.10a

Source: CGE-B89 model data base and simulation

Bangladeshi exports more competitive internationally. Changes in domestic markets (analyzed later) allowed aggregate exports in the base-year border prices to expand by 1.04 per cent. As exporters faced downward-sloping world demand curves, world prices fell with the expansion of exports. As a result, terms of trade deteriorated. Contraction in the balance of trade in base-year border prices for the Keynesian closure was exactly offset by a deterioration in the terms of trade due to the balance of trade constraint (Table 7.9a).

Table 7.10 **Effects of a 1 per cent increase in money supply on key nominal macroeconomic variables (%)**

	Keynesian	Neoclassical
Money supply	1.00	1.00
Official exchange rate	*	*
Secondary exchange rate	0.94	1.12
Consumer price index	0.56	0.86
Nominal wage	*	0.83

Notes: *Implies that the relevant variables have been fixed exogenously at the base-year levels. Figures have been rounded to the nearest number.

Source: CGE-B89 model data base and simulation

An increase in money supply also led to an increase in the consumer price index by 0.56 per cent in the Keynesian case (Table 7.10). As nominal wages were fixed at the base-year rates, this reduced the real wages by 0.56 per cent. Aggregate labour demand rose by 0.76 per cent (Table 7.11a). GDP at factor cost, which is equal to the aggregate value-added to labour in the short run characterized by sector-specific capital, expanded by taka 2266.47 million. Convergence to the new general equilibrium produced a rise in the aggregate net indirect tax revenue. GDP at the base-year market price hence increased by 0.32 per cent. The rise in GDP at the base-year market prices, taka 2392.63 million, minus the loss due to deteriorated terms of trade, taka 16.25 million, financed the increased consumption. Consumption in the base-year market prices increased approximately by 0.36 per cent. Additional consumption raised the utility of the households by taka 2376.38 million. Also, the loss of overall welfare to labour due to a fall in real wages was more than offset by the increase in employment by 0.76 per cent.

Table 7.11a **Effects of a 1 per cent increase in money supply on important macroeconomic variables[a] under the Keynesian closure**

	(%)	value (mil. taka)
Increased employment	0.76	2266.47
Indirect taxes[b]	0.32	126.16
GDP at mkt. price	0.35	2392.63
Terms of trade effects	-0.05	-16.25
Consumption[c]	0.36	2376.38

Notes: [a]For data comparability see Appendix A6.1. Percentage changes refer to change in quantities and the value changes are evaluated at the base-year prices and rates. The exceptions are the terms of trade effect, in which case they are change in the border price index of exports, and the product of base-year exports and the change in border price index of exports.
[b]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus the subsidies under the Export Performance Benefit Scheme. The components are disaggregated in Table 7.15a.
[c]Value change in consumption equals change in utility (Equation 4.45, Chapter 4).
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model data base and simulation

Under the Neoclassical closure, expansionary money supply generated different economy-wide effects (Tables 7.9b, 7.10 and 7.11b). More money in circulation was followed by an increase in spending. Consumption of domestic goods, which would have been transformed for export, rose. As aggregate employment was fixed and capital was sector specific, individual sectors which expanded exports could only do so at the cost of others. However, aggregate *fob* exports at the base-year border prices fell by 0.28 per cent (Table 7.9b). Improvement in the international terms of trade was insignificant compared to this fall in *fob* exports. As a result, the *fob* export value in current border prices also fell. The economy had to cut imports as the *cif* imports were constrained to equal the *fob* exports in the current border prices. Internationally, the economy experienced a bigger balance of trade deficit measured in the base-year border prices. But domestically, households consumed more with an increase in money supply and moved onto a higher utility level. Table 7.11b shows that household consumption rose by 0.003 per cent or taka 19.06 million. Domestic absorption in the base-year purchaser prices increased by taka 19.06 million, which equaled the value change in consumption as other domestic final demands were held at the base-year levels. But the balance of trade deficits increased even more, by taka 35.79 million. GDP at base-year market prices thus fell by taka 16.73 million which is about 0.002 per cent of the base-year value.

Table 7.11b **Effects of a 1 per cent increase in money supply on important macroeconomic variables[a] under the Neoclassical closure**

	(%)	value (mil. taka)
Employment	*	*
Indirect taxes[b]	-0.04	-16.73
GDP at mkt. price	-0.002	-16.73
Terms of trade effects	0.12	35.79
Consumption[c]	0.003	19.06

Note: Same as for Table 7.12a

Source: CGE-B89 model data base and simulation

Sectoral effects

As the economy-wide effects of expansionary money supply differ under two closures, sectoral effects are likely to be different also. Under both the closures, however, the secondary exchange rate depreciated (Table 7.10). This raised the importers' prices, at the fixed official exchange rate and unchanged tariff rates, except for rice and wheat (Table 7.12). It also raised the exporters' prices as the Export Performance Benefit entitlement rates were not changed. Increases in both these sets of prices put pressure on the basic prices of domestic sales which are imperfect substitutes for imports and exports within the same statistical categories. Table 7.12

records the changes in basic prices of domestic sales along with the changes in exporters' and importers' prices under both the closures.

Table 7.12 **Short-run effects of a 1 per cent increase in money supply on basic prices (%)**

	Keynesian			Neoclassical		
	Exporters'	Importers'	Domestic	Exporters'	Importers'	Domestic
Exportables						
Jute	0.21	n.a.	0.29	0.77	n.a.	0.88
Tea	0.64	n.a.	1.13	0.67	n.a.	0.85
Fish	0.73	n.a.	0.34	0.98	n.a.	0.86
Ready-md garments	0.79	0.94	0.48	1.02	1.12	0.86
Jute textiles	0.37	n.a.	0.46	0.73	n.a.	1.10
Leather	0.79	0.94	0.64	0.98	1.12	0.90
Forestry	0.37	n.a.	1.13	0.36	n.a.	0.86
Importables						
Rice	n.a.	0.00	0.27	n.a.	0.00	0.83
Wheat	n.a.	0.00	0.26	n.a.	0.00	0.60
Edible oil	n.a.	0.77	0.70	n.a.	0.92	0.88
Other agriculture	0.40	0.91	0.56	0.53	1.08	0.86
Sugar	n.a.	0.77	0.52	n.a.	0.92	0.86
Cotton textiles	n.a.	0.84	0.57	n.a.	1.00	0.87
Paper	0.38	0.74	0.70	0.49	0.89	0.87
Chemicals	0.45	0.69	1.15	0.45	0.82	0.87
Other manufactures	0.43	0.83	0.72	0.54	0.99	0.88
Non-tradables						
Physical overheads	n.a.	n.a.	0.73	n.a.	n.a.	0.85
Social overheads	n.a.	n.a.	0.12	n.a.	n.a.	0.84
Public administration	n.a.	n.a.	0.28	n.a.	n.a.	0.84

Source: The CGE-B89 model simulations.

Changes in relative prices induced sectoral adjustments. Tables 7.13a and 7.13b document the adjustments at the sectoral levels under the Keynesian and Neoclassical closures. In the Keynesian (fixed nominal wages) case, all sectors expanded (Columns 5 and 6 in Table 7.13a), but the sources of growth were not the same. Some industries, namely fish, ready-made garments, jute textiles and leather, grew because both exports and domestic sales increased (Columns 7 through 10 in Table 7.13a). For others, it was the increase in domestic sales that helped them grow. Sectors such as jute, tea, forestry, other agriculture, paper, chemical and other manufactures, experienced a fall in their exports even when the secondary exchange rate depreciated considerably. Exporters' prices for these sectors rose. Given the elasticities and trade shares, the basic prices of domestic sales rose even more due to increased demand following the injection of additional money into circulation.

Imports of all commodities except chemicals became more expensive relative to their domestic substitutes. The cost and price situations induced these sectors to expand domestic sales at the cost of exports. However, as increases in domestic sales exceeded the losses in exports, composite outputs of these sectors expanded. For fish, ready-made garments and leather, favourable changes in relative prices worked toward expanding their exports. The spending effects of additional money supply also led to an increase in domestic demands for domestic goods. As a result, the composite outputs in these sectors rose considerably. In the new general equilibrium, physical overheads expanded the most in value. Expansions in other agriculture, other manufactures, rice and public administration were, however, remarkable. The aggregate gross output rose by 0.38 per cent in the Keynesian case.

Under the Neoclassical closure, relative prices of fish, ready-made garments and leather moved in favour of overseas markets (Table 7.12) as under the fixed nominal wage case. As a result, their exports expanded (column 7 in Table 7.13a). For others, exporters' prices rose less than their domestic equivalents and exports did not increase for these sectors. Domestic demands for domestic goods were to rise due to substitution and income effects but aggregate employment was fixed and capitals were

Table 7.13a **Short-run effects of a 1 per cent increase in money supply on sectoral gross outputs, value-added and sales under the Keynesian closure[a]**

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands: Export		Domestic: Total		Consumption		Int.uses	
	(%) (1)	(mil Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables					Changes at the base-year basic prices[d]									
Jute	0.24	13.25	0.23	8.21	0.23	21.47	-0.02	-0.69	0.36	22.16	0.36	21.87	0.29	0.29
Tea	1.38	5.43	0.10	2.02	0.10	7.44	-2.32	-2.08	0.12	9.53	0.13	9.40	0.30	0.12
Fish	0.93	172.56	0.65	55.75	0.65	228.31	2.37	98.57	0.42	129.74	0.42	126.57	0.51	3.17
Forestry	1.42	50.44	0.20	13.55	0.20	63.99	-3.58	-0.07	0.20	64.07	0.08	14.82	0.35	49.24
Rd. md. garments	3.02	66.14	1.98	146.04	1.98	212.18	2.19	202.73	0.66	9.45	0.44	5.21	1.98	4.24
Jute textiles	0.18	7.42	0.16	9.36	0.16	16.78	0.09	7.40	0.55	9.38	0.57	5.48	0.45	3.91
Leather	1.61	18.40	0.93	28.17	0.93	46.56	1.06	44.29	0.29	2.28	0.26	1.32	0.93	0.95
Importables														
Rice	0.39	272.55	0.22	92.14	0.22	364.68	n.a.	n.a.	0.22	364.68	0.21	299.04	0.29	65.64
Wheat	0.31	8.65	0.17	2.58	0.17	11.22	n.a.	n.a.	0.17	11.22	0.04	1.56	0.35	9.67
Edible oil	1.28	12.90	0.37	29.07	0.37	41.97	n.a.	n.a.	0.37	41.97	0.33	16.47	0.41	25.50
Other agric.	0.96	401.06	0.40	203.03	0.40	604.10	-0.39	-2.63	0.40	606.72	0.42	446.74	0.36	159.99
Sugar	0.79	19.51	0.47	39.31	0.47	58.82	n.a.	n.a.	0.47	58.82	0.51	46.13	0.43	12.69
Cotton textiles	0.85	51.58	0.75	102.96	0.75	154.54	n.a.	n.a.	0.75	154.54	0.58	90.01	1.29	64.53
Paper	0.87	7.44	0.46	42.09	0.46	49.54	-1.05	-3.57	0.51	53.11	0.45	18.45	0.54	34.65
Chemicals	2.40	16.76	0.27	47.39	0.27	64.14	-3.21	-0.37	0.27	64.51	0.07	3.27	0.33	61.24
Other manuf.	1.02	143.85	0.42	323.00	0.42	466.85	-1.01	-11.78	0.44	478.63	0.48	74.17	0.43	404.46
Nontradables														
Phy. overheads	1.07	647.47	0.35	312.03	0.35	959.50	n.a.	n.a.	0.35	959.50	0.40	591.09	0.41	368.41
Social overheads	0.44	97.21	0.39	11.78	0.39	108.99	n.a.	n.a.	0.39	108.99	0.72	108.71	0.35	0.28
Public admin.	0.60	253.85	0.39	51.93	0.39	305.78	n.a.	n.a.	0.39	305.78	0.63	247.51	0.47	58.27
Aggregate	**0.76**	**2266.47**	**0.41**	**1520.40**	**0.38**	**3786.87**	**1.05**	**331.79**	**0.35**	**3455.08**	**0.37**	**2127.83**	**0.41**	**1327.25**

Notes: [a]The base year-values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in value-added equal changes in value-added to labour only. [c]Intermediate inputs include material inputs from both domestic and foreign sources at the market prices. [d]Hence changes are due to changes in quantities only. Three basic prices of goods are, wherever applicable, the exporters' prices, importers' prices, and the basic prices for domestic sale. Identities: (2)+(4)=(6)=(8)+(10); (10)=(12)+(14). Figures have been rounded so that rounding errors may be present.

Source: CGE-B89 simulations

Table 7.13b Short-run effects of a 1 per cent increase in money supply on sectoral gross-outputs, value-added and sales under the Neoclassical closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands							
							Export		Domestic					
									Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables					**Changes at the base-year basic prices[d]**									
Jute	-0.20	-10.69	-0.19	-6.63	-0.19	-17.31	-0.54	-17.17	0.00	-0.14	0.00	-0.07	-0.07	-0.07
Tea	-0.01	-0.05	0.00	-0.02	0.00	-0.06	-0.88	-0.79	0.01	0.73	0.01	0.73	0.00	0.00
Fish	0.12	21.39	0.08	6.91	0.08	28.30	0.63	26.12	0.01	2.17	0.01	1.92	0.04	0.26
Forestry	0.04	1.38	0.01	0.37	0.01	1.75	-2.54	-0.05	0.01	1.80	0.00	0.37	0.01	1.43
Rd. md. garments	1.28	28.08	0.84	62.00	0.84	90.08	0.95	87.78	0.16	2.30	0.04	0.50	0.84	1.80
Jute textiles	-1.77	-73.80	-1.64	-93.08	-1.64	-166.87	-1.94	-165.08	-0.11	-1.80	-0.12	-1.19	-0.07	-0.61
Leather	0.69	7.85	0.40	12.02	0.40	19.87	0.46	19.46	0.05	0.41	0.00	-0.01	0.41	0.42
Importables														
Rice	-0.01	-7.28	-0.01	-2.46	-0.01	-9.75	n.a.	n.a.	-0.01	-9.75	0.00	5.42	-0.07	-15.16
Wheat	-0.67	-18.80	-0.37	-5.60	-0.37	-24.41	n.a.	n.a.	-0.37	-24.41	-0.55	-22.25	-0.08	-2.15
Edible oil	0.11	1.06	0.03	2.38	0.03	3.43	n.a.	n.a.	0.03	3.43	0.03	1.44	0.03	1.99
Other agric.	0.07	27.94	0.03	14.15	0.03	42.09	-1.60	-10.85	0.04	52.94	0.04	40.38	0.03	12.55
Sugar	0.06	1.40	0.03	2.83	0.03	4.23	n.a.	n.a.	0.03	4.23	0.04	3.24	0.03	0.99
Cotton textiles	0.16	9.72	0.14	19.41	0.14	29.13	n.a.	n.a.	0.14	29.13	0.04	5.62	0.47	23.52
Paper	-0.03	-0.29	-0.02	-1.64	-0.02	-1.93	-1.85	-6.27	0.04	4.34	0.01	0.32	0.06	4.02
Chemicals	0.02	0.17	0.00	0.49	0.00	0.66	-2.10	-0.24	0.00	0.90	-0.01	-0.49	0.01	1.39
Other manuf.	0.03	3.99	0.01	8.97	0.01	12.96	-1.66	-19.36	0.03	32.32	0.05	8.15	0.03	24.17
Nontradables														
Phy. overheads	0.01	4.26	0.00	2.05	0.00	6.31	n.a.	n.a.	0.00	6.31	0.01	17.30	-0.01	-10.99
Social overheads	0.01	2.61	0.01	0.32	0.01	2.92	n.a.	n.a.	0.01	2.92	0.02	2.92	0.00	0.00
Public admin.	0.00	1.06	0.00	0.22	0.00	1.27	n.a.	n.a.	0.00	1.27	0.02	7.01	-0.05	-5.74
Aggregate	*	0.00	0.01	22.67	...	22.68	-0.27	-86.44	0.01	109.12	0.01	71.29	0.01	37.83

Notes: *Aggregate employment was fixed. Hence there was no change in the aggregate value-added to labour.
Also, see notes in Table 7.14a

Source: CGE-B89 simulations

sector specific. All sectors could not increase their domestic production (column 5 in Table 7.13b). As a result, unlike the Keynesian case, only some industries, fish, forestry, ready-made garments, leather, edible oil, other agriculture, sugar, cotton textiles, chemicals, other manufactures and non-tradables expanded, at the cost of the rest. The aggregate gross output of the economy rose by taka 22.68 million in the base-year prices.

Adjustments in sectoral productions called for a reallocation of and in the Keynesian case, a rise in sectoral employment of labour. Columns 1 and 2 of Tables 7.13a and 7.13b show the employment effects of a 1 per cent increase in domestic money supply in the Keynesian and Neoclassical cases respectively.

Effects on the volume of imports are mixed. As a result of increases in importers' prices relative to basic prices of domestic substitutes, lower amounts of goods would be imported. On the other hand, increases in demands for final consumption associated with increased income, and increases in demands for raw materials due to the expansion of some sectors, may require more imports. Tables 7.14a and 7.14b show the combined effects on imports for the Keynesian and Neoclassical case respectively. In the Keynesian case, every imports did not increase but aggregate imports rose because the additional imports could be financed by additional export earnings. In the Neoclassical case, even though some imports such as rice, wheat, paper and chemicals increased, aggregate imports declined constrained by the decline in aggregate export earning.

Table 7.14a **Short-run effects of a 1 per cent increase in money supply on imports[a] under the Keynesian closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
	Changes at the base-year importers' prices[b]					
Rice	0.74	12.54	0.69	2.14	0.75	10.40
Wheat	0.53	40.98	0.50	39.04	0.68	1.94
Edible oil	0.20	17.44	0.20	16.33	0.29	1.11
Other agriculture	-0.22	-33.42	-0.21	-25.74	-0.25	-7.68
Sugar	0.05	2.97	0.05	2.95	0.01	0.01
Cotton textiles	0.19	9.97	0.10	4.31	0.82	5.66
Paper	0.41	15.44	0.39	7.16	0.44	8.27
Chemicals	0.74	65.55	0.61	20.89	0.82	44.66
Other manufacture	0.23	233.49	0.34	150.97	0.31	82.52
Ready-made garments	-0.15	-0.35	-0.16	-0.35	0.00	0.00
Leather	2.36	0.40	-0.23	-0.02	0.38	0.42
Aggregate	**0.23**	**365.00**	**0.25**	**217.68**	**0.37**	**147.31**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 7.14b **Short-run effects of a 1 per cent increase in money supply on imports[a] under the Neoclassical closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
	Changes at the base-year importers' prices[b]					
Rice	1.35	22.68	1.51	4.64	1.31	18.04
Wheat	0.57	43.50	0.53	41.43	0.72	2.07
Edible oil	-0.03	-2.78	-0.03	-2.67	-0.03	-0.11
Other agriculture	-0.36	-55.30	-0.36	-43.73	-0.38	-11.58
Sugar	-0.06	-3.70	-0.06	-3.56	-0.06	-0.14
Cotton textiles	-0.13	-6.88	-0.20	-8.53	0.24	1.65
Paper	0.00	0.02	-0.02	-0.31	0.02	0.33
Chemicals	0.06	5.15	0.05	1.56	0.07	3.59
Other manufacture	-0.07	-66.52	-0.09	-39.02	-0.10	-27.50
Ready-made garments	-0.29	-0.65	-0.30	-0.65	0.00	0.00
Leather	-0.12	-0.02	-0.36	-0.03	0.01	0.01
Aggregate	**-0.04**	**-64.51**	**-0.06**	**-50.88**	**-0.03**	**-13.64**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Welfare effects

Expansionary monetary policy led to an increase in spending under both the closures. As a result, consumption increased raising utility in both the Keynesian and Neoclassical cases. Increase in utility measures the rise in welfare. Tables 7.15a and

Table 7.15a **Decomposition of welfare effects[a] of a 1 per cent increase in money supply under the Keynesian closure** (short-run)

	(%)	value (mil. taka)
		Constant price changes[b]
(1) Terms of trade effects	**-0.05**	**-16.25**
(2) Value added to labour	**0.76**	**2266.47**
(3) Total indirect taxes	**0.32**	**126.16**
Revenue from:		
Consumption taxes	0.38	30.87
Intermediate input taxes	0.43	45.84
Tariffs	0.27	50.76
Implicit taxes on imports	0.20	6.07
Implicit export taxes[c]	-1.48	-7.38
(4) **Aggregate welfare[d] change**	**0.90**	**2376.38**

Notes: [a]Change in welfare equals the change in utility at unitary marginal utility of income. The disaggregation was based on the Efficiency Equation 4.56, Chapter 4.
[b]Value changes measure the gains (or losses) from diminution (or intensification) of the distortions modelled in CGE-B89. Except for the terms of trade (TOT) effects, the value changes were evaluated at the base-year prices (ie. due to changes in quantities only). The TOT effects is the product of the base-year exports and the change in border price index of exports.
[c]Export subsidies under the Export Performance Benefit Scheme are negative taxes. Expansionary money supply led to an increase in subsidies which is equivalent to a fall in export taxes and hence, in welfare.
[d]Aggregate change in welfare equals all the gains (or losses) from alleviation (or exacerbation) of the distortions.
Identity: (4)=(1)+(2)+(3). Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

7.15b disaggregate the welfare effects of a 1 per cent increase in domestic money supply. Clearly, the sources of welfare improvement under the two closures were different.

Table 7.15b **Decomposition of welfare effects[a] of a 1 per cent increase in money supply under the Neoclassical closure** (short-run)

	(%)	value (mil. taka)
	Constant price changes[b]	
(1) Terms of trade effects	**0.12**	**35.79**
(2) Total indirect taxes	**-0.04**	**-16.73**
Revenue from:		
Consumption taxes	-0.02	-1.36
Intermediate input taxes	-0.01	-1.51
Tariffs	-0.06	-10.13
Implicit import taxes	-0.09	-2.81
Export taxes[c]	-0.18	-0.92
(3) Aggregate welfare change[d]	**0.01**	**19.06**

Notes: Same as for Table 7.15a.
Identity: (3)=(1)+(2). Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

In the Keynesian case, additional money supply increased employment (that is, reduced involuntary unemployment) and hence raised wage income. The new equilibrium generated extra revenue from indirect taxes to the tune of taka 126.16 million (Table 7.15a). Although the economy lost welfare due to the deterioration in terms of trade, the loss was insignificant compared to the aggregate welfare gains from increased employment, which was considerable, and increased indirect taxes.

In contrast, most of the welfare gains in the Neoclassical case were associated with the improvement in international terms of trade (Table 7.15b). In the new equilibrium, households were consuming more domestically produced goods and reducing consumption of imported goods. As terms of trade improved, households did not have to cut imports as much as they would have at the initial terms of trade, because exports could buy more imports. Nevertheless, aggregate imports fell, so that revenues from tariffs and gains associated with the implicit import taxes declined. Revenues from taxes on intermediate inputs and consumption also declined as uses of relatively highly taxed goods fell even though both expenditure on intermediate inputs and consumption rose. Total welfare loss from net indirect taxes (and subsidies), was small compared to the gains driven by the terms of trade improvement. Therefore, aggregate welfare rose.

Summary and policy considerations. Expansionary monetary policy is welfare augmenting under both the closures. But conditions in the labour market seemed to determine the level and sources of welfare, and the directions of changes in aggregate outputs, exports, imports and GDP. Results showed that expansionary monetary policy performs much better in a fixed-nominal-wage situation.

A contractionary monetary policy hence is likely to be welfare reducing under both the closures. As pointed out at the outset, either a contractionary monetary policy, as an alternative to devaluation of the official exchange rate, might be executed to reduce the exchange rate premium or in the extreme case, to eliminate it (that is, unify the exchange rates). Under the Neoclassical closure, the choice of the alternative policies did not seem to matter much. Both the contractionary monetary policy and devaluation of the official exchange rate seemed to generate similar results: a deterioration of the terms of trade and ultimate loss of welfare (Tables 7.8b and 7.15b). Nevertheless, the consequences of these two alternative policies seemed to differ under the Keynesian closure. Devaluation resulted in an increase in the employment (hence, value-added to labour) and the revenue from net indirect taxes. It brought about a deterioration in the terms of trade but raised aggregate welfare (Table 7.8a). A contraction of the domestic money supply is likely to reduce employment and value-added to labour and the revenue from the net indirect taxes, to improve the international terms of trade, and to reduce welfare in the aggregate (Table 7.15a). In case of sticky-wages in the presence of involuntary unemployment, a monetary contraction is expected to degenerate the Keynesian stimulus. Simulation results show that a contraction of money supply by 2.5 per cent in the Keynesian case and 2.1 per cent in the Neoclassical case would unify the exchange rates. Welfare loss from such a contraction would not be much.

Increases in nominal wages

Economy-wide effects

Increases in nominal wages without any exogenous compensating changes are contractionary. This is confirmed by effects on key macroeconomic variables as reported in columns 5 and 6 of Tables 7.16 and 7.18 and column 3 in Table 7.17. Figure 7.3 illustrated that increases in nominal wages, with sector-specific capital, reduced production and exports. Competition for lower amounts of foreign currencies in the secondary exchange market bid up the secondary exchange rate. The simulation results also show that as nominal wages were increased exogenously by 1 per cent, *fob* export earnings in the base-year border prices fell by 1.59 per cent (Table 7.16) and the secondary exchange rate depreciated by 0.21 per cent (Table 7.17). The terms of trade improved and allowed base-year exports to buy taka 62.43 million of additional imports (Table 7.16). The *cif* imports, nevertheless, fell by taka 431.58 million resulting in a widening balance of trade deficits measured in base-year border prices (Table 7.16).

Table 7.16 **Effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increases in nominal wages on composition of the balance of trade under the Keynesian closure** (short-run)

	Devaluation		Money supply		Nominal wage		Combined[a]
	(%) (1)	value (mil. TK) (2)	(%) (3)	value (mil. TK) (4)	(%) (5)	value (mil. TK) (6)	(%) or value (mil TK)
Increased exports (*fob*)[b]	0.55	169.61	1.04	324.40	-1.59	-494.01	0.0
Increased imports (*cif*)[b]	0.09	123.43	0.22	308.15	-0.31	-431.58	0.0
Terms of trade effects[c]	-0.15	-46.18	-0.05	-16.25	0.20	62.43	0.0
Balance of trade deficits	**	*	*	*	*	*	

Notes: [a] Combined effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increases in nominal wages.
[b]Percentage changes refer to changes in quantities. Value changes refer to changes in variables due to changes in quantities only.
[c]Defined as the product of the base-year total export value and the after-shock change in the world export price index (see Equations 4.56 and 4.57).
*Balance of trade deficit in current border prices was fixed exogenously at the base-year level. Hence there was no change in the balance of trade in the current border prices.
Identities: (1)+(3)+(5)=0=(2)+(4)+(6)
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model data base and simulation

Table 7.17 **Effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increase in nominal wages on important nominal macroeconomic variables under the Keynesian closure** (short-run)

	Devaluation	Money supply	Nominal wage
	(%) (1)	(%) (2)	(%) (3)
Official e-rate	1.00	*	*
Secondary exchange rate	-0.15	0.94	0.21
Money supply	*	1.00	*
Consumer price index	0.08	0.56	0.36
Nominal wage	*	*	1.00

Notes: *Implies that the relevant variables have been fixed exogenously at the base-year levels.
Identities: (1)+(2)+(3)=1
Figures have been rounded to the nearest number.

Source: CGE-B89 model data base and simulation

Increases in nominal wages raised the consumer price index by 0.36 per cent (Table 7.17). The consequent increases in the economy-wide real wages by 0.64 per cent led to a fall in aggregate employment by 0.91 per cent (columns 5 in Table 7.18). Thus real GDP at factor cost declined. GDP at the base-year purchaser price fell even more as revenues from the indirect taxes also fell. Even with a widening the balance of trade deficit (measured in the base-year prices), the economy's real absorption fell. The utility index of the households recorded a decline following the decline in consumption of taka 2828.22 million. An aggregate employment cut of 0.91 per cent against a 0.64 per cent rise in real wage implied an overall welfare loss for labour.

Table 7.18 **Effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increase in nominal wages on key macroeconomic variables[a] under the Keynesian closure** (short-run)

	Devaluation		Money supply		Nominal wage		Combined[b]
	(%) (1)	value (mil. TK) (2)	(%) (3)	value (mil. TK) (4)	(%) (5)	value (mil. TK) (6)	(%) or value (mil TK)
	Changes of variables at the base-year prices[c]						
Employment	0.15	452.75	0.76	2266.47	-0.91	-2719.22	0.0
Indirect taxes[d]	0.11	45.27	0.32	126.16	-0.43	-171.43	0.0
GDP at mkt. price	0.07	489.02	0.36	2392.63	-0.43	-2890.65	0.0
Terms of trade effects	-0.15	-46.18	-0.05	-16.25	0.20	62.43	0.0
Consumption[e]	0.07	451.84	0.36	2376.38	-0.42	-2828.22	0.0

Notes: [a]For data comparability see Appendix A6.1 on Technical Notes.
[b]Combined effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increase in nominal wages.
[c]Refer to changes in variables due to changes in quantities only.
[d]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus the subsidies under the Export Performance Benefit Scheme.
[e]Change in consumption equals change in the utility.
Identities: (1)+(3)+(5) = (2)+(4)+(6) = 0
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model data base and simulation

Sectoral effects

Exogenous increases in nominal wages in the economy raised the cost of domestic production. The situation was aggravated by increases in costs of intermediate imports due to depreciation of the secondary exchange rate. Supply price for domestic sales,

Table 7.19 **Short-run effects of a 1% increase in nominal wage on basic prices (%)**

	Keynesian		
	Exporters'	Importers'	Domestic
Exportables			
Jute	0.67	n.a.	0.70
Tea	0.03	n.a.	-0.34
Fish	0.30	n.a.	0.61
Ready-md garments	0.28	0.21	0.45
Jute textiles	0.43	n.a.	0.76
Leather	0.23	0.21	0.31
Forestry	-0.02	n.a.	-0.33
Importables			
Rice	n.a.	0.00	0.68
Wheat	n.a.	0.00	0.41
Edible oil	n.a.	0.17	0.22
Other agriculture	0.16	0.20	0.36
Sugar	n.a.	0.17	0.41
Cotton textiles	n.a.	0.19	0.36
Paper	0.12	0.17	0.20
Chemicals	-.	0.18	-0.33
Other manufactures	0.13	0.19	0.18
Non-tradables			
Physical overheads	n.a.	n.a.	0.14
Social overheads	n.a.	n.a.	0.86
Public administration	n.a.	n.a.	0.67

Source: The CGE-B89 model simulations.

Table 7.20 Short-run effects of a 1 per cent increase in nominal wage on sectoral gross outputs, value-added and sales under the Keynesian closure[a]

	Gross output						Sales/demands							
	Value-added to labour[b]		Intermediate inputs[c]				Export		Domestic					
									Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
	Changes at the constant basic prices[d]													
Exportables														
Jute	-0.53	-28.72	-0.50	-17.81	-0.50	-46.53	-0.62	-19.77	-0.43	-26.75	-0.44	-26.32	-0.44	-0.43
Tea	-1.67	-6.57	-0.12	-2.44	-0.12	-9.01	1.73	1.55	-0.14	-10.56	-0.14	-10.41	-0.36	-0.14
Fish	-0.98	-181.37	-0.69	-58.59	-0.69	-239.96	-2.09	-86.91	-0.50	-153.05	-0.50	-149.55	-0.57	-3.50
Forestry	-1.65	-58.86	-0.24	-15.82	-0.24	-74.68	1.25	0.03	-0.24	-74.70	-0.10	-17.35	-0.40	-57.36
Rd. md. garments	-2.08	-45.66	-1.37	-100.83	-1.37	-146.49	-1.49	-137.91	-0.60	-8.58	-0.48	-5.65	-1.37	-2.93
Jute textiles	-2.34	-97.44	-2.16	-122.90	-2.16	-220.34	-2.43	-206.92	-0.79	-13.42	-0.83	-8.00	-0.63	-5.42
Leather	-1.11	-12.65	-0.64	-19.37	-0.64	-32.02	-0.71	-29.79	-0.28	-2.23	-0.31	-1.60	-0.62	-0.64
Importables														
Rice	-0.48	-335.73	-0.27	-113.50	-0.27	-449.23	n.a.	n.a	-0.27	-449.23	-0.25	-352.29	-0.43	-96.94
Wheat	-1.18	-32.93	-0.65	-9.82	-0.65	-42.75	n.a.	n.a	-0.65	-42.75	-0.70	-28.57	-0.51	-14.18
Edible oil	-1.42	-14.22	-0.41	-32.02	-0.41	-46.24	n.a.	n.a	-0.41	-46.24	-0.36	-18.03	-0.45	-28.21
Other agric.	-1.07	-447.65	-0.45	-226.62	-0.45	-674.27	-1.45	-9.86	-0.44	-664.41	-0.46	-487.53	-0.40	-176.88
Sugar	-0.88	-21.73	-0.53	-43.77	-0.53	-65.50	n.a.	n.a.	-0.53	-65.50	-0.56	-51.46	-0.47	-14.03
Cotton textiles	-0.83	-50.22	-0.73	-100.24	-0.73	-150.46	n.a.	n.a	-0.73	-150.46	-0.66	-101.25	-0.99	-49.21
Paper	-1.08	-9.28	-0.57	-52.47	-0.57	-61.75	-0.95	-3.25	-0.56	-58.51	-0.53	-21.76	-0.58	-36.75
Chemicals	-2.85	-19.90	-0.32	-56.27	-0.32	-76.16	1.33	0.15	-0.32	-76.32	-0.09	-4.52	-0.38	-71.80
Other manuf.	-1.19	-167.80	-0.49	-376.76	-0.49	-544.56	-0.78	-9.09	-0.49	-535.46	-0.51	-79.20	-0.49	-456.26
Nontradables														
Phy. overheads	-1.27	-771.71	-0.41	-371.90	-0.41	-1143.60	n.a.	n.a.	-0.41	-1143.60	-0.46	-688.42	-0.51	-455.19
Social overheads	-0.51	-113.50	-0.46	-13.76	-0.46	-127.26	n.a.	n.a.	-0.46	-127.26	-0.84	-126.93	-0.41	-0.33
Public admin.	-0.72	-303.29	-0.47	-62.04	-0.47	-365.34	n.a.	n.a.	-0.47	-365.34	-0.74	-288.54	-0.62	-76.79
Aggregate	**-0.91**	**-2719.22**	**-0.48**	**-1796.92**	**-0.45**	**-4516.14**	**-1.59**	**-501.78**	**-0.41**	**-4014.35**	**-0.43**	**-2467.36**	**-0.48**	**-1547.00**

Notes: [a]The base year-values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in value-added equal changes in value-added to labour only. [c]Intermediate inputs include material inputs from both domestic and foreign sources at the market prices. [d]Hence changes are due to changes in quantities only. Three basic prices of goods are, wherever applicable, the exporters' prices, importers' prices, and the basic prices for domestic sale. Identities: (2)+(4)=(6)=(8)+(10); (10)=(12)+(14). Figures have been rounded so that rounding errors may be present.

Source: CGE-B89 simulations

Table 7.21 **Short-run effects of a 1 per cent increase in nominal wage on imports**[a]

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
			Changes at the base-year importers' prices[b]			
Rice	0.72	12.17	0.97	3.00	0.66	9.17
Wheat	0.04	3.02	0.04	2.86	0.06	0.16
Edible oil	-0.28	-24.26	-0.28	-22.80	-0.37	-1.46
Other agriculture	-0.17	-26.25	-0.18	-21.57	-0.15	-4.68
Sugar	-0.13	-8.00	-0.14	-7.82	-0.08	-0.19
Cotton textiles	-0.39	-20.21	-0.35	-15.40	-0.70	-4.81
Paper	-0.49	-18.50	-0.49	-8.97	-0.50	-9.53
Chemicals	-0.82	-72.47	-0.68	-23.19	-0.91	-49.28
Other manufacture	-0.35	-359.94	-0.52	-227.94	-0.50	-132.00
Ready-made garments	-0.16	-0.36	-0.16	-0.36	0.00	0.00
Leather	-2.98	-0.51	-0.16	-0.01	-0.45	-0.49
Aggregate	**-0.32**	**-515.31**	**-0.37**	**-322.20**	**-0.48**	**-193.10**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

except that of chemicals and other manufactures, rose more than the corresponding importers' prices (Table 7.19). Demands and hence sales in the domestic market fell (Table 7.20).

Depreciation of the secondary exchange rate made domestic exports more competitive internationally but increases in the costs of production allowed only tea, forestry and chemicals to expand exports slightly (columns 7 and 8 of Table 7.20). Aggregate exports declined forcing cuts in almost all imports (columns 1 and 2 of Table 7.21) even though the relative prices moved towards imports (except for chemicals and other manufactures). Imports of rice and wheat increased as their uses as intermediate inputs and final consumption expanded.

Welfare effects

Column 10 in Table 7.20 and column 4 in Table 7.21 showed that the domestic consumption of domestic and imported goods fell in the aggregate although not for all sectors. Table 7.18 also reported that aggregate consumption in the base-year purchasers' prices fell by taka 2828.22 million forcing households to a lower utility level. Table 7.22 identifies the sources of welfare loss due to a 1 per cent increase in nominal wages.

The results accumulated in Table 7.22 are not surprising. The gains accrued only from improvement in terms of trade and savings, on account of less subsidies to exporters under the Export Performance Benefit Scheme. Government expenditure on subsidies fell with the decline in exports, whereas the increases in world export prices on average (that is, improvement in the terms of trade), allowed additional imports of taka 62.43 million. Losses from decreased employment (and hence, value-added) plus the losses from decreased indirect tax revenues, however, surpassed the gain from the improved terms of trade by taka 2828.22 million. Hence, aggregate welfare fell.

Table 7.22 **Decomposition of welfare effects[a] of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increase in nominal wage under the Keynesian closure** (short-run)

	Constant price changes[b]						
	Devaluation		Money supply		Nominal wage		Combined[c]
	(%)	value (mil. TK)	(%)	value (mil. TK)	(%)	value (mil. TK)	(%) or value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Terms of trade effects	**-0.15**	**-46.18**	**-0.05**	**-16.25**	**0.20**	**62.43**	**0.0**
(2) Value-added to labour	**0.15**	**452.75**	**0.76**	**2266.47**	**-0.91**	**-2719.22**	**0.0**
(3) Total indirect taxes	**0.11**	**45.27**	**0.32**	**126.16**	**-0.43**	**-171.43**	**0.0**
Revenue from:							
Consumption taxes	0.10	7.80	0.38	30.87	-0.48	-38.67	0.0
Intermediate input taxes	0.10	10.97	0.43	45.84	-0.53	-56.81	0.0
Tariffs	0.12	22.30	0.27	50.76	-0.39	-73.06	0.0
Implicit import taxes	0.15	4.58	0.20	6.07	-0.35	-10.65	0.0
Export taxes[d]	-0.08	-0.38	-1.48	-7.38	1.56	7.76	0.0
Aggregate welfare changes[e]	**0.17**	**451.84**	**0.90**	**2376.38**	**-1.07**	**-2828.22**	**0.0**

Notes: [a]Change in welfare equals the change in utility at unitary marginal utility of income. The disaggregation was based on the Efficiency Equation 4.56, Chapter 4.

[b]Value changes measure the gains (or losses) from diminution (or intensification) of the distortions modelled in CGE-B89. Except for the terms of trade (TOT) effects, the value changes were evaluated at the base-year prices (ie. due to changes in quantities only). The TOT effects is the product of the base-year exports and the change in border price index of exports.

[c]Combined welfare effects of a 1 per cent devaluation, a 1 per cent increase in money supply and a 1 per cent increase in nominal wage.

[d]Export subsidies under the Export Performance Benefit Scheme are negative taxes. An increase in subsidies is equivalent to a fall in export taxes (and hence welfare).

[e]Aggregate change in welfare equals all the gains (or losses) from alleviation (or exacerbation) of the distortions.

Identities: For rows, (4)=(1)+(2)+(3); For columns, (1)+(3)+(5) = (2)+(4)+(6)= 7. Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

Combined effects

Analysis of the combined effects of different policy changes discussed so far has important policy implications. Under the Neoclassical closure, devaluation of the official exchange rate and the increase in domestic money supply by constant percentage points produce exactly opposite effects (Table 7.23). Given the stylized facts, GDP at base-year market prices is increased by devaluation but decreased by expansionary monetary policy. Devaluation leads to deteriorating terms of trade while expansionary money supply improves them. On the whole, devaluation is welfare worsening while increasing the money supply is welfare augmenting.

Table 7.23 **Decomposition of welfare effects[a] of a 1 per cent devaluation and a 1 per cent increase in money supply under the Neoclassical closure** (short-run)

	Constant price changes[b]				
	Devaluation		Money supply		Combined[c]
	(%) (1)	value (mil. TK) (2)	(%) (3)	value (mil. TK) (4)	(%) or value (5)
(1) Terms of trade effects	**-0.12**	**-35.79**	**0.12**	**35.79**	**0.0**
(2) Total indirect taxes	**0.04**	**16.73**	**-0.04**	**-16.73**	**0.0**
Revenue from:					
Consumption taxes	0.02	1.36	-0.02	-1.36	0.0
Intermediate input taxes	0.01	1.51	-0.01	-1.51	0.0
Tariffs	0.06	10.13	-0.06	-10.13	0.0
Implicit import taxes	0.09	2.81	-0.09	-2.81	0.0
Implicit export subsidies[d]	0.18	0.92	-0.18	-0.92	0.0
(3) Aggregate welfare change[e]	**-0.01**	**-19.06**	**0.01**	**19.06**	**0.0**

Notes: Same as for Table 7.22 except that the combined effects here are due to a 1 per cent devaluation and a 1 per cent increase in money supply.
Identity: (3)=(1)+(2). Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

Under the Keynesian closure, the combined effects of a 1 per cent devaluation, a 1 per cent increase in money supply and 1 per cent increase in nominal wage were a 1 per cent increase in all the nominal endogenous variables and no changes in the real variables (Tables 7.16 to 7.18 and 7.22). The effects of the individual policy simulations are different form those under the Neoclassical closure. In the Keynesian case, both an increase in money supply and devaluation of the official exchange rate appeared to be expansionary. Unlike the Neoclassical case, devaluation and expansionary money supply were complementary. The positive real gains associated with a 1 per cent devaluation of the official exchange rate and a 1 per cent increase in money supply were, however, offset by the contractionary effects of proportionate increases in nominal wages in the economy (Tables 7.16, 7.18 and 7.22). When a devaluation of the official exchange rate was accompanied with equiproportional increases in money supply and nominal wages, only the nominal variables registered a 1 per cent increase, with all the real variables remaining unchanged. This signifies the importance of appropriate policy choices. For example, if a devaluation or an increase in money supply takes place amid considerable wage-rises, the economy's performance may be worsened rather than improved.

The above results under the Keynesian closure could be useful in choosing a particular policy-mix to attain specific targets, or to analyze the economic impacts of various policy options. Suppose the authorities want to devise a policy package to achieve specified percentage increases in the real consumption (c), aggregate employment (l) and the CPI (ε^3). Simulation results in percentage changes give the elasticities with respect to the three policy instruments. Using the relevant elasticities, a policy-mix can be formulated to attain specified targets by solving the following system of simultaneous equations

$$c = 0.07\phi_1 + 0.35ms - 0.42w$$
$$l = 0.15\phi_1 + 0.76ms - 0.91w$$
$$\varepsilon^3 = 0.08\phi_1 + 0.55ms + 0.36w$$

where ϕ_1, ms and w are the percentage changes in the official exchange rate, domestic money supply and nominal wage respectively. If the authorities want to attain a 4 per cent increase in employment to ensure 2 per cent increase in consumption allowing the

CPI to rise by 7 per cent only, they need approximately a 38 per cent devaluation, a 4 per cent rise in money supply and a 5 per cent rise in nominal wages. But it must be noted that such projections are subject to linearization errors. For more accurate projections, simulations based on the multi-step GEMPACK solution technique (Codsi and Pearson 1991) have to be used.

8

SECTOR-SPECIFIC POLICY SIMULATIONS WITH CGE-B89

This chapter is concerned with the simulations and analyses of two sector-specific policy changes. First, the experiment with radial (across-the-board proportional) reductions in tariffs is analyzed followed by the analysis of simulation results of the radial reductions in the Export Performance Benefit entitlement rates.

The previous chapter simulates and analyzes the effects of a hypothetical devaluation of the official exchange rate and finds that the effects are sensitive to the conditions in the labour market. The experience of many developing countries shows the extreme difficulty in sustaining equilibrium in foreign exchange markets under a fixed exchange rate regime. Adjustment policies often resulted in unsuccessful devaluation (Kreuger 1978, Bruno 1979, Diaz-Alejandro *et al* 1979) followed by a return to various systems of foreign exchange rationing (Kreuger 1978) and other protectionist measures. Bangladesh is no exception. Bangladesh has a complex system of foreign exchange controls with a dual exchange rate regime[1] along with various other protectionist policies. Macroeconomic policies, such as devaluation and changes in money supply, have to interact with sector-specific industrial policies to induce structural adjustments. Quantitative impact of these sector-specific policies needs to be systematically explored for a better understanding of the working of macroeconomic policies.

Various regulatory practices, such as industrial licensing and exchange rationing systems, tariffs and protection-offsets and export incentives, such as the Export Performance Benefit Scheme, lie at the heart of industrial policy. Such

[1] In 1992, the two exchange rates were unified. However, exchange controls operate (Chapter 2).

rationing and licensing practices do not induce efficient uses of resources. If the rules of allocation are not well articulated and administered, rationing can induce rent-seeking activities leading to wastage of resources. Reducing the scope for controls and administrative discretion would contribute to rapid industrial growth, but the diverse range of motives with which controls have traditionally been run in Bangladesh pose a formidable obstacles to decontrols. The relaxation of investment, and import controls in Bangladesh have to be triggered by exceptional circumstances (Mallon and Stern 1991). In 1988, the government adopted program to reduce tariffs. In 1992, the unification of the exchange rates eliminated export subsidies under the Export Performance Benefit Scheme (Chapter 2). This chapter thus concentrates on tariffs and export subsidies.

Tariffs insulate the domestic market from external competition and confer market power on a few domestic producers encouraging inefficient import substitution industries. Tariffs also confer protection to some industries at the cost of other domestic industries which might otherwise be internationally competitive. Resources, in such cases, are channeled into the protected industries away from potential export-oriented industries. Attempts to create offsets to protection, and to provide export incentives in Bangladesh did not seem to be successful (Rab 1985, Sakhawatullah 1985). Khan and Hossain (1989) and Stern *et al.* (1988) are of the opinion that the industrial incentive structure favoured production for the domestic market and taxed industries which would have been internationally competitive without domestic protection. Efficiency in production and hence industrial growth are likely to be substantially improved by reforming these policies. Given the political constraints in Bangladesh, it is unlikely that all these distortions could be removed simultaneously. Reforms usually take place in a `second-best' world in which some distortions may be unalterable.

Two sector-specific policy simulations were thus run in a `second-best' situation. The computable general equilibrium model, CGE-B89, was simulated for radial reductions in tariffs and in Export Performance Benefit entitlement rates in economic environments characterized by two different model closures (Chapter 5). The policy simulations were conducted to estimate the direction of the inter-sectoral resource reallocation and output adjustments at the microeconomic level. Although the resource allocation effects of the policy simulations are particularly important, the simulation results were also used to track the direction of changes in important macroeconomic variables such as GDP, exports and imports. Effects on welfare are evaluated and decomposed according to the efficiency equation 4.55.

Radial reduction in tariffs

Experimental design. The simulation was based on a 10 per cent radial reduction of tariff rates. In practice, reductions of both tariff rates and the variability of tariff rates across industries are crucial for improving the efficiency in industrial production. Differential tariff rates reflect the relative strength of pressure groups. Reduction of high rates to reduce variability is likely to involve considerable information and administrative arbitrariness and to yield greater opposition from pressure groups. Moreover, if the goods whose tariff rates are reduced have substitutes subject to high tariff rates, and complements subject to low tariff rates, then such a reform may not necessarily increase welfare because the `cross-effect' losses due to decreased imports of substitutes with high tariffs may outweigh the by-product gains due to increased complementary imports with low tariffs (Vousden 1990:205). A simple proportional-tariff-cutting reform may appear to be equitable in its treatment of the various protected industries. Such a reform yields minimum `cross-effect' losses. Relative prices within a group of protected commodities are not affected. The domestic price of the protected commodities as a group, however, is reduced relative to unprotected commodities. Such a reform thus reduces the aggregate anti-export bias and enables the economy to reap the static gains from increased trade. A proportional reduction of tariff rates ensures a welfare gain under the usual conditions which guarantee gains from trade (Vousden 1990: 209).

In the 1989 input-output table (Appendix A5.2), tariff rates appear to be lower than those presented in Chapter 2. Due to sectoral aggregations, the input-output table misses the prohibitive tariffs rates. When adjusted for underestimation, the actual gains from trade liberalization are likely to be higher than those suggested by the model results.

The model has not specify tariff rates *per se* but has powers of tariffs which are defined as one plus the *ad valorem* tariff rate. A 10 per cent radial reduction in tariff rates, in fact, means less than a 3 per cent fall in all the powers of tariffs in case of the 1989 input-output table. Such a small policy change is dealt with by a one-step solution technique (Dixon et al. 1982).

Macroeconomic effects of the 10 per cent across-the-board tariff reduction

With the reduction of tariff rates, the tariff-ridden imports immediately become cheaper in domestic currency. This generates upward pressure on the demand for imports and hence for foreign exchange. At the initial level of foreign exchange supply, this leads to a depreciation of the secondary exchange rate. As the export revenue per unit depends on the weighted average of the two exchange rates (the weights being determined by the Export Performance Benefit entitlement rates), depreciation of the secondary exchange rate together with the fixed official exchange rate and the base-year Benefit rates, raises export revenue per unit. If the relative prices of outputs move in favour of foreign markets, exports expand. Table 8.1 shows that in the new equilibrium following the 10 per cent radial reduction of tariffs, secondary exchange

Table 8.1 **Effects of a 10 per cent radial reduction in tariffs on important nominal macroeconomic variables (%)**

	Keynesian[a]	Neoclassical[a]
Official e-rate	*	*
Secondary exchange rate	0.62	0.66
Money supply	*	*
Consumer price index	-0.08	-*
Nominal wage	*	0.22

Note: [a]Nominal wages have been fixed in presence of involuntary unemployment in the Keynesian case, and aggregate employment has been fixed by exogenous supply of labour in the Neoclassical case.
*Implies that the relevant variables have been fixed exogenously at the base-year levels.
Figures have been rounded to the nearest number.

Source: CGE-B89 model database and simulation

Table 8.2a **Effects of a 10 per cent radial reduction in tariffs on the composition of balance of trade deficit under the Keynesian closure** (short-run)

	(%)	value (mil. taka)
Increased exports (*fob*)[a]	2.07	643.60
Increased imports (*cif*)[a]	0.43	596.20
Terms of trade effects[b]	-0.15	-47.40
Balance of trade deficits	*	*

Note: [a]Percentage change refers to quantity change, and value change refers to changes in variables due to changes in quantities only (that is, at the base-year border prices).
[b]Defined as the product of the base-year total export value (*fob*) and the after-shock change in the border price index of exports (see the Efficiency Equation 4.56). The percentage change refers to the change in world export index.
*Balance of trade deficit in current border prices is fixed exogenously at the base-year level.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

rate depreciates by 0.62 per cent under the Keynesian closure and 0.66 per cent under the Neoclassical closure. Exports and imports evaluated at the base-year border prices increase by 2.07 and 0.43 per cent respectively under the Keynesian closure (Table

8.2a). Under the Neoclassical closure, these percentages are respectively 1.73 and 0.37 (Table 8.2b). The international terms of trade deteriorate as exports increase under both the closures. The terms of trade effect (defined by the last term in Equation 4.56) in Tables 8.2a and 8.2b equals the balance of trade deficits evaluated in the base-year border prices while the balance of trade deficit in the current border prices is fixed at the base-year level.

GDP and households' consumption evaluated in the base-year market prices rise under both the closures (Tables 8.3a and 8.3b). Under the Neoclassical closure, the rise in GDP at market price of 0.02 per cent is driven by the increase in net indirect taxes by 0.35 per cent. In the Keynesian case, increases in value-added to labour (due to increase in employment) and net indirect taxes in the base year prices and rates together raise GDP at market prices by 0.11 per cent. The additional employment at the fixed nominal wages is due to the expansion in domestic production of exportables, non-tradables, and of some importables with low or no tariffs (explained later). A deterioration in the terms of trade means a loss of purchasing power to the rest of the world. The net increase in income (that is, the rise in GDP at market price net of the loss due to the deterioration in the terms of trade), finances an additional 0.11 per cent of the base-year consumption of the households in the Keynesian case (Table 8.3a). In the Neoclassical case, households' consumption rose by 0.02 per cent of the base-year level (Table 8.3b).

Under the Keynesian closure, tariff-cuts lead to a fall in the consumer price index by 0.08 per cent (Table 8.1). At the fixed nominal wages, this means a rise in the real wages. Still, as shown in Table 8.3a, aggregate employment increases by 0.20 per cent (explained later). The combined effect of the additional employment and the rise in real wages is an overall improvement in welfare of labour.

Table 8.2b **Effects of a 10 per cent radial reduction in tariffs on the composition of balance of trade deficit under the Neoclassical closure** (short-run)

	(%)	value (mil. taka)
Increased exports (*fob*)[a]	1.73	536.39
Increased imports (*cif*)[a]	0.37	502.53
Terms of trade effects[b]	-0.11	-33.86
Balance of trade deficits	*	*

Note: Same as for Table 8.2a.
* fixed exogenously

Source: CGE-B89 model database and simulation

Table 8.3a **Effects of a 10 per cent radial reduction in tariffs on important macroeconomic variables[a] under the Keynesian closure** (short-run)

	(%)[b]	value (mil. taka)[b]
Increased employment	0.20	590.17
Indirect taxes[c]	0.45	177.30
GDP at market price	0.11	767.47
Terms of trade effects	-0.15	-47.40
Consumption[d]	0.11	720.07

Notes: [a]For data comparability see Appendix A6.1 on Technical Notes.
[b]Percentage change refers to quantity change except for the terms of trade effects in which case it refers to change in world export price index. Value changes refer to changes in variables due to changes in quantities only.
[c]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus the subsidies under the Export Performance Benefit Scheme.
[d]Change in consumption evaluated at base-year prices equals change in the utility, which measures the change in welfare at unitary marginal utility of income.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

Increased consumption means a higher level of utility which equals the rise in welfare of households under the assumption of unitary marginal utility of expenditure. The balance of trade and private investment are fixed under the relevant closures. This implies a unitary marginal propensity to consume. In other words, households spend the entire additional income on current consumption. Tables 8.4a and 8.4b show the sources of households' additional income under the Keynesian and the Neoclassical closures, respectively.

Table 8.3b **Effects of a 10 per cent radial reduction in tariffs on important macroeconomic variables[a] under the Neoclassical closure** (short-run)

	(%)[b]	value (mil. taka)[b]
Employment	*	*
Indirect taxes[c]	0.35	140.10
GDP at market price	0.02	140.10
Terms of trade effects	-0.11	-33.86
Consumption[d]	0.02	106.24

Note: Same as for Table 8.3a.
* Fixed exogenously at the base-year level.

Source: CGE-B89 model database and simulation

Under the Keynesian closure, households lose their purchasing power worth taka 47.40 million to the rest of the world due to deterioration in the terms of trade, since world export prices fall (Table 8.4a). Reduction in involuntary unemployment, however, contributes to households' income. Table 8.4a shows an increase in the value-added due to increased employment to the tune of taka 590.17 million. Changes in the consumption and production induced by the tariff-cuts also bring about increases in government revenue from taxes on consumption goods, intermediate inputs and from tariffs and implicit import taxes, at the base-year prices and rates. Tariff revenue in the current prices and rates, however, decreases by taka 1720 million, which is about 9.3 per cent of the base-year tariff revenue. Subsidies under the Export Performance Benefit Scheme (negative taxes) also rise as exports increase. Net government revenue evaluated at the base-year prices and rates, however, rises by taka 177.30 million. Non-distortionary lump-sum transfer of this additional net revenue to the households raises their income by the same amount. In the aggregate households' income rises by taka 720.07 million. As the whole amount is spent on current consumption, utility and hence, welfare of the households rise also by taka 720.07 million which is 0.27 per cent of the base-year level (Table 8.4a).

Table 8.4a **Decomposition of welfare effects[a] of a 10 per cent radial reduction in tariffs under the Keynesian closure** (short-run)

	Contributions to rise in consumer spending[b] (%)	value (million taka)
(1) Terms of trade effects	**-0.15**	**-47.40**
(2) Employment	**0.20**	**590.17**
(3) Net lump-sum transfer	**0.45**	**177.30**
Tax revenue from intermediate inputs	0.22	23.66
Tax revenue from consumption	0.30	24.02
Tariff revenue[c]	0.69	127.71
Implicit import taxes	0.46	14.10
Export taxes[d]	-2.44	-12.19
(4) Aggregate welfare[e]	**0.27**	**720.07**

Notes: [a]Equation (4.56) describes the sources of welfare gains.
[b]Imply changes in the relevant variables due to changes in quantities only.
[c]Change in tariff revenue evaluated at the base-year prices and rates. In current prices and rates, tariff revenue falls by taka 1720 million in the Keynesian case, and taka 1736 million in the Neoclassical case, which are 9.3 and 9.4 per cent of the base-year tariff revenue, respectively.
[d]Tariff cuts cause an increase in export subsidies (negative taxes) under XPB, which is equivalent to a fall in export taxes.
[e]Aggregate welfare equals the utility level under the unitary marginal utility of income. *Implies that the relevant variables have been fixed exogenously at the base-year level.
Identity: (4)= (1)+(2)+(3).
Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model database and simulation

Table 8.4b **Decomposition of welfare effects[a] of a 10 per cent radial reduction in tariffs under the Neoclassical closure** (short-run)

	Contributions to rise in consumer spending[b] (%)	value (mil. taka)
(1) Terms of trade effects	**-0.11**	**-33.86**
(2) Net lump-sum transfer	**0.35**	**140.10**
Tax revenue from intermediate inputs	0.11	11.33
Tax revenue from consumption	0.19	15.62
Tariff revenue[c]	0.61	111.85
Implicit import taxes	0.39	11.81
Export taxes[d]	-2.11	-10.51
(3) **Aggregate welfare[e]**	**0.04**	**106.24**

Note: Same as for Table 8.4a

Source: CGE-B89 model database and simulation

Under the Neoclassical closure, radial reduction of tariff is also welfare augmenting (Table 8.4b). However, the rise in welfare is much less than in the Keynesian case. Welfare gain associated with the reduction in involuntary unemployment in the Keynesian case does not incur because aggregate employment is fixed by the exogenous supply of labour under the Neoclassical closure. Welfare of the households rises only by 0.04 per cent.

Simulation results, however, suggest that the welfare gains from radial reduction in tariffs are quite small as a proportion of base-year GDP: only 0.11 per cent under the assumption of nominal wage rigidity and 0.02 per cent under the exogenously fixed aggregate employment assumption. Low estimates from tariff reduction emerge from studies of many countries, including Bangladesh (Cline *et al* 1977, Brown and Whalley 1980, Hossain 1989). The gains from the reduction in nominal protection might be higher than the model results suggest if some of the key assumptions, made when the model was built and the simulations were carried out, are relaxed.

For example, the model assumes perfect competition and constant returns to scale. Relaxing these assumptions and allowing instead a monopoly or oligopolistic market structure, and increasing returns to scale, similar tariff reductions might produce greater welfare gains (Harris 1984, Krugman 1986b, Rodrik 1988). The simulations with tariff cuts were carried out with labour being inter-sectorally mobile and capital being sector-specific. When in the longer run, capital is mobile between sectors, tariff cuts might result in higher production and consumption gains (Hartigan and Tower 1982). Because of the imperfect substitution assumption between the Bangladesh exports and goods produced by other countries, tariff reduction led to deteriorating terms of trade, thus depressing the welfare gain. The Armington assumption of imperfect substitutes between imports and domestically produced goods also limited the gains from tariff cuts.

If reduction in tariffs leads to lower rent-seeking wastage associated with the distribution of the tariff revenue, and allows additional product variety, welfare gains might also be higher.

The data-base used seems to understate the nominal protection accorded to the import-substituting industries, and hence to understate the gains from proportional tariff cuts. Because of the aggregation of the model industries the average tariff rates might not take into account the gains from the variance of tariff rates across the constituting sub-sectors. Aggregated data, as they appear in the source input-output table, might also obscure the gains from tariff reduction when tariff rates differ markedly across groups of close substitutes.

Sector Specific Results

Effects of the 10 per cent radial reduction on the various basic prices are reported in Table 8.5. The directions of changes in the basic prices do not seem to be sensitive to the different conditions in labour that define the two closures. Equations 4.20a through 4.20c define the importers' prices. Other things remaining the same, tariff-cuts reduce the tariff-ridden importers' prices and depreciation of the secondary exchange rate raises importers' prices (except rice and wheat) according to the equations. In this experiment, tariff-cuts bring about a depreciation of the secondary exchange rate. Hence, the immediate fall in the importers' prices following the tariff-cuts is subsequently offset partially or fully, or even more than offset, depending on the tariff rates, due to depreciation of the secondary exchange rate. In the new equilibrium, importers' prices of high tariff imports fall both in absolute terms as well as in relation to the basic prices of domestic substitutes (Table 8.5) Importers' prices of edible oil, sugar, cotton textiles, paper, chemicals and other manufactures register a fall under both the closures. The basic prices of domestic substitutes for these imports also experience a decline although less proportionately than the corresponding importers' price. In case of ready-made garments, leather with no tariff and other agriculture with a very low tariff, importers' prices rise. Importers' prices of ready-made garments and leather rise due to the depreciation of the secondary exchange rate. For other agriculture, the rise in importers' price associated with the depreciation of the secondary exchange rate dominates over the immediate falls in the importers' prices following tariff-cuts. Importers' prices of rice and wheat, with no tariff in the base-year, remain unchanged as the official exchange rate remains fixed exogenously. Basic prices of domestic sales of rice, wheat and other agriculture rise.

Table 8.5 **Short-run effects of a 10 per cent across-the-board reduction in tariffs on the different basic prices (%)**

	Keynesian			Neoclassical		
	Domestic	Exporters'	Importers'	Domestic	Exporters'	Importers'
Exportables						
Jute	0.01	0.02	n.a.	0.16	0.16	n.a.
Tea	0.14	0.30	n.a.	0.06	0.31	n.a.
Fish	0.02	0.44	n.a.	0.16	0.51	n.a.
Ready-made garments	-0.10	0.43	0.62	.	0.49	0.66
Jute textiles	-0.24	0.03	n.a.	-0.07	0.12	n.a.
Leather	0.01	0.43	0.62	0.08	0.48	0.66
Other Forestry	0.10	0.12	n.a.	0.04	0.12	n.a.
Importables						
Rice	0.01	n.a.	0.00	0.16	n.a.	0.00
Wheat	0.01	n.a.	0.00	0.10	n.a.	0.00
Edible oil	-0.30	n.a.	-1.32	-0.26	n.a.	-1.28
Other agriculture	0.01	0.20	0.22	0.09	0.23	0.27
Sugar	-0.11	n.a.	-1.34	-0.03	n.a.	-1.30
Cotton textiles	-0.21	n.a.	-0.53	-0.14	n.a.	-0.48
Paper	-0.24	0.13	-1.60	-0.20	0.16	-1.57
Chemicals	-0.60	0.04	-2.22	-0.67	0.04	-2.19
Other manufactures	-0.16	0.17	-0.59	-0.12	0.19	-0.55
Non-tradables						
Physical overheads	0.06	n.a.	n.a.	0.09	n.a.	n.a.
Social overheads	-0.02	n.a.	n.a.	0.16	n.a.	n.a.
Public administration	-.	n.a.	n.a.	0.14	n.a.	n.a.

Source: The CGE-B89 model simulations.

Table 8.5 also reports the increases in all the exporters' prices valued in domestic currency (defined in Equation 4.21) because of the depreciation of the secondary exchange rate. The rates of increase reflect the dispersions in the Export Performance Benefit entitlement rates for different exports. The increase in exporters' prices brings about changes in basic prices of domestically sold exportables depending on the transformation elasticities, supply elasticities of the composite goods, trade shares, the price elasticities of demand, and Armington trade elasticities (de Melo and

Table 8.6a Effects of a 10 per cent radial reduction in tariffs on sectoral output, cost and sales under the Keynesian closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands							
							Export		Domestic					
									Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables					**Changes at the constant basic prices[d]**									
Jute	0.07	3.87	0.07	2.40	0.07	6.27	0.11	3.36	0.05	2.91	0.05	2.84	0.07	0.07
Tea	0.28	1.11	0.02	0.41	0.02	1.52	0.84	0.75	0.01	0.77	0.01	0.74	0.07	0.03
Fish	0.44	81.43	0.31	26.31	0.31	107.74	2.18	90.85	0.05	16.89	0.05	15.71	0.19	1.19
Forestry	0.14	5.04	0.02	1.35	0.02	6.39	0.10	0.00	0.02	6.39	0.01	2.41	0.03	3.98
Rd. md. garments	4.35	95.50	2.86	210.88	2.86	306.39	3.21	297.89	0.59	8.50	0.20	2.38	2.86	6.12
Jute textiles	1.43	59.48	1.32	75.02	1.32	134.51	1.54	130.98	0.21	3.52	0.22	2.12	0.16	1.40
Leather	3.52	40.24	2.04	61.61	2.04	101.85	2.38	99.76	0.26	2.09	0.06	0.29	1.74	1.79
Importables														
Rice	0.05	33.97	0.03	11.48	0.03	45.45	n.a.	n.a.	0.03	45.45	0.03	37.42	0.04	8.03
Wheat	0.06	1.61	0.03	0.48	0.03	2.10	n.a.	n.a.	0.03	2.10	0.02	1.00	0.04	1.10
Edible oil	-1.38	-13.91	-0.40	-31.33	-0.40	-45.24	n.a.	n.a.	-0.40	-45.24	-0.80	-40.17	-0.08	-5.07
Other agric.	0.10	43.35	0.04	21.94	0.04	65.29	0.99	6.75	0.04	58.54	0.09	99.10	-0.09	-40.56
Sugar	-0.74	-18.25	-0.44	-36.78	-0.44	-55.03	n.a.	n.a.	-0.44	-55.03	-0.57	-51.92	-0.11	-3.11
Cotton textiles	0.50	30.57	0.45	61.01	0.45	91.57	n.a.	n.a.	0.45	91.57	0.12	18.64	1.46	72.94
Paper	-0.14	-1.19	-0.07	-6.74	-0.07	-7.94	1.73	5.87	-0.13	-13.81	-0.11	-4.37	-0.15	-9.43
Chemicals	-2.01	-14.03	-0.23	-39.69	-0.23	-53.72	2.95	0.34	-0.23	-54.06	-0.04	-2.08	-0.28	-51.98
Other manuf.	0.11	15.99	0.05	35.89	0.05	51.88	1.65	19.24	0.03	32.64	-0.02	-3.27	0.04	35.91
Nontradables														
Phy. overheads	0.25	148.94	0.08	71.78	0.08	220.72	n.a.	n.a.	0.08	220.72	0.05	81.04	0.16	139.68
Social overheads	0.06	13.24	0.05	1.60	0.05	14.84	n.a.	n.a.	0.05	14.84	0.10	14.77	0.08	0.06
Public admin.	0.15	63.23	0.10	12.93	0.10	76.16	n.a.	n.a.	0.10	76.16	0.09	33.95	0.34	42.21
Aggregate	0.20	590.17	0.13	480.58	0.11	1070.75	2.08	655.80	0.04	414.95	0.04	210.59	0.06	204.36

Notes: [a]The base year-values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in value-added imply changes in value-added to labour only. [c]Intermediate inputs include material inputs from both domestic and foreign sources at the market prices. [d]Changes due to changes in quantities only. Three basic prices are, wherever applicable, the exporters' prices, importers' prices, and the domestic basic prices.

Identities: (2)+(4)=(6)=(8)+(10); (10)=(12)+(14).

Figures have been rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 8.6b Effects of a 10 per cent radial reduction in tariffs on sectoral output, cost and sales under the Neoclassical closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands							
							Export		Domestic					
									Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables	Changes at the constant basic prices[d]													
Jute	-0.04	-2.36	-0.04	-1.46	-0.04	-3.82	-0.03	-0.93	-0.05	-2.89	-0.05	-2.87	-0.02	-0.02
Tea	-0.08	-0.32	-0.01	-0.12	-0.01	-0.43	1.21	1.09	-0.02	-1.52	-0.02	-1.52	-0.01	0.00
Fish	0.23	42.07	0.16	13.59	0.16	55.66	1.73	71.98	-0.05	-16.33	-0.06	-16.75	0.07	0.43
Forestry	-0.22	-7.74	-0.03	-2.08	-0.03	-9.82	0.37	0.01	-0.03	-9.82	-0.01	-1.36	-0.06	-8.47
Rd. md. garments	3.90	85.59	2.56	189.00	2.56	274.60	2.89	267.95	0.46	6.64	0.10	1.15	2.56	5.49
Jute textiles	0.92	38.33	0.85	48.35	0.85	86.68	1.01	86.07	0.04	0.61	0.04	0.38	0.03	0.23
Leather	3.28	37.49	1.90	57.41	1.90	94.90	2.22	93.30	0.20	1.60	-0.01	-0.05	1.61	1.65
Importables														
Rice	-0.06	-38.90	-0.03	-13.15	-0.03	-52.05	n.a.	n.a.	-0.03	-52.05	-0.03	-39.04	-0.06	-13.01
Wheat	-0.20	-5.53	-0.11	-1.65	-0.11	-7.18	n.a.	n.a.	-0.11	-7.18	-0.13	-5.20	-0.07	-1.98
Edible oil	-1.69	-16.99	-0.49	-38.28	-0.49	-55.28	n.a.	n.a.	-0.49	-55.28	-0.88	-44.09	-0.18	-11.19
Other agric.	-0.13	-53.81	-0.05	-27.24	-0.05	-81.05	0.68	4.61	-0.06	-85.67	-0.01	-6.71	-0.18	-78.95
Sugar	-0.93	-22.97	-0.56	-46.28	-0.56	-69.25	n.a.	n.a.	-0.56	-69.25	-0.69	-63.09	-0.21	-6.15
Cotton textiles	0.32	19.67	0.29	39.25	0.29	58.92	n.a.	n.a.	0.29	58.92	-0.02	-3.34	1.25	62.26
Paper	-0.37	-3.21	-0.20	-18.13	-0.20	-21.34	1.52	5.16	-0.25	-26.50	-0.22	-9.09	-0.27	-17.41
Chemicals	-2.63	-18.35	-0.30	-51.90	-0.30	-70.25	3.24	0.37	-0.30	-70.62	-0.06	-3.06	-0.36	-67.57
Other manuf.	-0.14	-20.43	-0.06	-45.88	-0.06	-66.31	1.48	17.27	-0.08	-83.58	-0.13	-20.46	-0.07	-63.12
Nontradables														
Phy. overheads	-0.03	-18.55	-0.01	-8.94	-0.01	-27.49	n.a.	n.a.	-0.01	-27.49	-0.05	-68.38	0.05	40.89
Social overheads	-0.05	-11.40	-0.05	-1.38	-0.05	-12.78	n.a.	n.a.	-0.05	-12.78	-0.08	-12.77	-0.01	-0.01
Public admin.	-0.01	-2.60	n.a.	-0.53	0.00	-3.13	n.a.	n.a.	0.00	-3.13	-0.07	-28.68	0.21	25.54
Aggregate	*	0.00	0.02	90.58	0.01	90.58	1.73	546.90	-0.05	-456.31	-0.06	-324.92	-0.04	-131.40

Notes: *Aggregate employment was fixed. Hence there was no change in the aggregate value-added to labour.
Also, see notes in Table 8.6a

Source: CGE-B89 simulations

Robinson 1985). In Table 8.5, the basic prices of domestically sold ready-made garments and jute textiles register a fall, while the rest of the exportables sold in the domestic market experiences a rise in the basic prices.

Changes in the relative prices following the tariff-cuts lead to substitution between domestic and imported goods on the consumption side, and to re-orientation of sales between domestic and foreign markets on the production side. Tables 8.6a and 8.6b present the output adjustments and reallocation of (and in the Keynesian case, increase in) aggregate employment in the short run.

The reduced cost of production following reduced cost for imported inputs and increased revenue per unit of export relative to the unit revenue from the domestic sale (mainly due to depreciation of the weighted exchange rate) give incentive to expand exports under both the closures (columns 7 and 8 in Tables 8.6a and 8.6b) The only exception is jute, under the Neoclassical closure, where exports fall.

Responses of domestic sales of exportables are sensitive to the assumption of nominal wage rigidity. In the Keynesian case, domestic sales of all exportables rise (columns 9 and 10 in Table 8.6a). Uses of these commodities for domestic final consumption and as intermediate inputs increase. Even though unit revenue from domestic sale of ready made garments, jute textiles and leather falls (Table 8.5), the reduced cost of production following tariff cuts allows domestic sales to expand at the lower prices. The composite outputs of all exportables thus record an increase in the Keynesian case. When aggregate employment is fixed by the exogenous supply of labour, domestic sales of ready-made garments, jute textiles and leather rise (columns 9 and 10 in Table 8.6b). For forestry, however, domestic sales decline.

Under the Keynesian closure with fixed nominal wages, the domestic-import relative price of other agriculture with low tariffs moves in favour of domestic

Table 8.7a **Short-run effects of a 10 per cent radial reduction in tariffs on imports[a] under the Keynesian closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
	Changes at the base-year importers' prices[b]					
Rice	0.06	0.96	0.05	0.15	0.06	0.81
Wheat	0.05	3.79	0.05	3.63	0.06	0.16
Edible oil	1.06	91.55	1.03	84.89	1.71	6.66
Other agriculture	-0.32	-48.57	-0.29	-36.04	-0.41	-12.54
Sugar	1.58	95.59	1.63	91.24	1.96	4.34
Cotton textiles	0.85	43.60	0.68	29.86	1.99	13.75
Paper	1.58	58.96	1.67	30.64	1.49	28.32
Chemicals	1.64	145.03	1.91	65.10	1.47	79.93
Other manufacture	0.34	348.31	0.49	217.69	0.49	130.62
Ready-made garments	-0.71	-1.60	-0.73	-1.60	0.00	0.00
Leather	2.45	0.42	-0.92	-0.08	0.46	0.50
Aggregate	**0.46**	**738.03**	**0.55**	**485.47**	**0.63**	**252.56**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 8.7b **Short-run effects of a 10 per cent radial reduction in tariffs on imports[a] under the Neoclassical closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
	Changes at the base-year importers' prices[b]					
Rice	0.21	3.60	0.26	0.80	0.20	2.80
Wheat	0.06	4.45	0.05	4.25	0.07	0.19
Edible oil	1.00	86.29	0.97	79.94	1.63	6.35
Other agriculture	-0.35	-54.27	-0.33	-40.72	-0.44	-13.55
Sugar	1.55	93.85	1.60	89.55	1.94	4.30
Cotton textiles	0.76	39.22	0.61	26.51	1.84	12.70
Paper	1.47	54.94	1.56	28.69	1.38	26.25
Chemicals	1.46	129.30	1.76	60.07	1.27	69.24
Other manufacture	0.27	270.19	0.38	168.22	0.39	101.97
Ready-made garments	-0.74	-1.68	-0.76	-1.68	0.00	0.00
Leather	1.81	0.31	-0.95	-0.09	0.36	0.39
Aggregate	**0.39**	**626.19**	**0.47**	**415.54**	**0.53**	**210.65**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

substitute (Table 8.5). Demand for the domestic substitute rises leading to an increase in output (column 5 and 6 in Table 8.6a). Highly tariff-ridden imports, namely edible oil, sugar, paper and chemicals become cheaper relative to their domestic outputs (Table 8.5). Their imports rise (Table 8.7a) and domestic productions shrink even at the fixed nominal wages (column 5 and 6 in Table 8.7a). Interestingly, production of cotton textiles and other manufactures expands although their relative prices change in favour of imports. This can be explained as follows: exportables, non-tradables and some importable sectors, while expanding, demanded additional intermediate inputs supplied by the other manufactures (columns 13 and 14 in Table 8.6a). Added to this is the fall in cost of production of other manufactures because of the substantial fall of prices of their main intermediate inputs such as chemicals, paper and other manufactures. In the new equilibrium, both imports and domestic production of other manufactures rise. This sector could meet increased demand for its output even at a lower prices. The reduced cost of production of cotton textiles, and increased demands for cotton textiles as intermediate inputs (mainly by ready-made garments) and for final consumption together allow the sector to expand even at a lower revenue per unit.

Under the Keynesian closure, domestic production of all sectors except edible oil, sugar, paper and chemicals, thus expands following the 10 per cent radial reduction in tariffs (columns 5 and 6 in Table 8.6a). The ready-made garment industry expands the most in value followed by physical overheads, jute textiles, and fish.

The employment implications of the tariff-cuts follow from the output adjustments. While there is a major reallocation of labour among sectors, the redundant labour of the contracting sectors can not fully meet the increased demand for labour of the expanding sectors. As a result, total employment in the economy registers an increase of approximately 0.20 per cent.

Under the Neoclassical closure, aggregate employment is fixed. The main exportable sectors, namely fish, ready-made garments, jute textiles, and leather, thus expand (mainly due to increases in exports) by drawing labour from other sectors. As a result, all non-tradables and importables, except cotton textiles, recorded a fall in activity levels. Expansion in ready-made garments exerts a demand pull on cotton textiles by demanding more intermediate inputs. Ready-made garments grow the most in value followed by leather and jute textiles (columns 5 and 6 in Table 8.6b). The assumption of wage rigidity thus seems to play an important role in determining the output responses of various sectors.

Radial reduction in the Export Performance Benefit entitlements

Design of the simulation. This experiment is designed to examine the effectiveness of the Export Promotion Benefit Scheme in promoting export-oriented industries. Export-oriented industries are discriminated against due to various protection measures (Figure 4.4). Some protection-offsets such as tariff exemptions, duty drawbacks have already been introduced to offset the discriminatory impact of protection accorded to import competing industries. Export incentives including subsidies under the Export Performance Benefit Scheme have also been provided to raise export profitability. Protection offsets are restricted to a handful of exports only, and because of administrative inefficiency they fail to provide the exporters access to inputs at international prices (Chapter 2). Increasing their coverage, relaxing the administrative discretion, and improving the administrative efficiency would contribute to export growth. The Export performance Benefit Scheme is claimed to be administratively transparent. The industry-specific Benefit entitlement rates together with the wedge between the official exchange rate and the secondary exchange rate determine the rate of subsidy accorded to exporters under the Benefit Scheme. To examine the efficacy of the Scheme the Benefit entitlement rates (R_i) are reduced by

10 per cent across all the industries covered by the Scheme. The effects of a 10 per cent radial reduction of the Benefit rates are compared with those of the 10 per cent tariff-cuts. The sets of exogenous variables with which the previous experiments were conducted, remain for the present experiment.

Macroeconomic effects

Subsidy to exporters under the Export Performance Benefit Scheme is reduced immediately after the reduction in industries' Benefit rates. The fall in their per unit export revenues leads to a reduction in exports and hence in the supply of foreign exchange. Increased competition for the reduced supply of foreign exchange leads to a depreciation of the secondary exchange rate. Tables 8.9a and 8.9b show that a 10 per cent radial reduction in Benefit rates causes a 0.36 and 0.31 per cent reductions in the

Table 8.8a **Effects of a 10 per cent radial reduction in Export Performance Benefit entitlement rates on the composition of balance of trade deficits under the Keynesian closure** (short-run)

	(%)	value (mil. taka)
Reduced exports (*fob*)[a]	-0.36	-112.52
Reduced imports (*cif*)[a]	-0.08	-104.11
Terms of trade effects[b]	0.03	8.41
Balance of trade deficits	*	*

Note: [a]Percentage change refers to change in quantity, and value change refers to change in the variable due to change in quantity only (that is, value change is evaluated at the base-year border prices).
[b]Defined as the base-year total export value (*fob*) times the after-shock change in the border price index of exports (the last term in efficiency equation 4.56).
*Balance of trade deficit in current border prices is fixed exogenously at the base-year level. Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

Table 8.8b **Effects of a 10 per cent radial reduction in Export Performance Benefit entitlement rates on the composition of balance of trade deficits under the Neoclassical closure** (short-run)

	(%)	value (million taka)
Exports (*fob*)[a]	-0.31	-97.34
Imports (*cif*)[a]	-0.07	-90.84
Terms of trade effects	0.02	6.50
Balance of trade deficits	*	*

Note: Same as for Table 8.2a.
* Fixed exogenously at the base-year level.

Source: CGE-B89 model database and simulation

Table 8.9 **Effects of a 10 per cent radial reduction in the Export Performance Benefit entitlement rates on important nominal macroeconomic variables** (%)

	Keynesian[a]	Neoclassical[a]
Official exchange rate	*	*
Secondary exchange rate	0.11	0.10
Money supply	*	*
Consumer price index	0.01	-*
Nominal wage	*	-0.03

Note: [a]Nominal wages are fixed in presence of involuntary unemployment in the Keynesian case, and aggregate employment is fixed by exogenous supply of labour in the Neoclassical case.
*Implies that the relevant variables have been fixed exogenously at the base-year levels.
Figures have been rounded to the nearest number so that rounding error may be present.

Source: CGE-B89 model database and simulation

Table 8.10a **Effects of a 10 per cent radial reduction in Export Performance Benefit entitlement rates on important macroeconomic variables[a] under the Keynesian closure (short-run)**

	(%)[b]	value (million taka)[b]
Employment	-0.03	-83.56
Indirect taxes[c]	-0.05	-19.81
GDP at market price	-0.02	-103.37
Terms of trade effects	0.03	8.41
Consumption[d]	-0.01	-94.96

Notes: [a]For data comparability see Appendix A6.1 on Technical Notes.
[b]Percentage change refers to quantity change except for the terms of trade effects in which case it refers to change in world export price index. Value changes refer to changes in variables due to changes in quantities only.
[c]All sales taxes and excise duties, plus tariffs and implicit taxes on imports, minus the subsidies under the Export Performance Benefit Scheme.
[d]Change in consumption evaluated at base-year prices equals change in the utility, which measures the change in welfare at unitary marginal utility of income.
Figures have been rounded to the nearest number so that rounding errors may persist.

Source: CGE-B89 model database and simulation

Table 8.10b **Effects of a 10 per cent radial reduction in Export Performance Benefit entitlement rates on important macroeconomic variables[a] under the Neoclassical closure (short-run)**

	(%)[b]	value (mil. taka)[b]
Employment	*	*
Indirect taxes[c]	-0.037	-14.55
GDP at market price	-0.002	-14.55
Terms of trade effects	0.021	6.50
Consumption[d]	-0.001	-8.05

Note: Same as for Table 811a
*Employment is fixed by the exogenous supply of labour.

Source: CGE-B89 model database and simulation

fob value of exports under the Keynesian and Neoclassical closures respectively. The international terms of trade improve as exports fall. Table 8.9 reports 0.11 and 0.10 per cent depreciation of the secondary exchange rate under the two closures. Depreciation of the secondary exchange rate leads to a rise in importers' prices and a fall in the aggregate *cif* value of imports (Tables 8.9a and 8.9b). The macroeconomic implications of the reduction of the Benefit rates is contractionary irrespective of the wage rigidity assumption (Tables 8.11a and 8.11b). GDP at the base-year market price falls, and real consumption falls with it. In the Keynesian case, involuntary unemployment rises.

As consumption declines, households' welfare deteriorates. The contractionary impact of the radial reduction of the Benefit rates leads to a decline in the government revenue from indirect taxes. Despite the fall in subsidies under the Benefit Scheme, the net revenue of the government and hence the households' transfer income falls by 0.05 and 0.04 per cent under the Keynesian and Neoclassical closure respectively (Tables 8.12a and 8.12b). Improvement in international terms of trade does not compensate for the reduction in the lump-sum transfer income in the fixed employment case. As a result, welfare of the households declines 0.003 per cent of the base-year level under the Neoclassical closure (Table 8.11b). The loss of welfare is even greater under the Keynesian closure. As value-added to labour falls due to a rise in involuntary unemployment, households become much worse-off with 0.04 per cent decline in the welfare (Table 8.11a).

Table 8.11a **Decomposition of welfare effects[a] of a 10 per cent radial reduction in Export Performance Benefit entitlement rates under the Keynesian closure (short-run)**

	(%)[b]	value (mil. taka)[b]
(1) Terms of trade effects	**0.027**	**8.41**
(2) Employment	**-0.028**	**-83.56**
(3) Total indirect taxes	**-0.050**	**-19.81**
Intermediate inputs	-0.028	-2.93
Consumption	-0.031	-2.54
Tariff revenue	-0.076	-14.01
Implicit import taxes	-0.081	-2.48
Export taxes[c]	0.429	2.15
(4) Aggregate welfare[d]	**-0.036**	**-94.96**

Notes: [a]Equation (4.56) describes the sources of welfare gains.
[b]Percentage change refers to quantity change except for the terms of trade effects in which case it refers to change in world export price index. Value changes refer to changes in variables due to changes in quantities only. Again, terms of trade is the exception (see Equation 4.56, Chapter 4)
[c]Radial reduction in entitlement rates cause a decrease in export subsidies (negative taxes) under XPB, which is equivalent to a rise in export taxes.
[d]Aggregate welfare equals the utility level under the unitary marginal utility of income. *Implies that the relevant variables have been fixed exogenously at the base-year level.
Identity: (4)= (1)+(2)+(3).
Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

A 10 per cent across-the-board reduction in the Benefit entitlement rates would reduce household consumption and hence their welfare by 0.001 per cent of the base-year GDP when aggregate employment is fixed, and by 0.01 per cent of the base-year GDP when nominal wages are fixed. Relaxing some of the assumptions might produce higher welfare losses.

Table 8.11b **Decomposition of welfare effects[a] of a 10 per cent radial reduction in Export Performance Benefit entitlement rates under the Neoclassical closure (short-run)**

	(%)[b]	value (mil. taka)[b]
(1) Terms of trade effects	**0.021**	**6.50**
(2) Total net indirect taxes	**-0.037**	**-14.55**
Consumption	-0.017	-1.35
Intermediate inputs	-0.011	-1.19
Tariff revenue	-0.064	-11.76
Implicit import taxes	-0.070	-2.16
Export taxes[c]	0.382	1.91
(3) **Aggregate welfare**[d]	**-0.003**	**-8.05**

Note: Same as for Table 8.11a
Identity: (3) = (1) + (2).
Since the figures have been rounded to the nearest numbers, rounding errors may persist.

Source: CGE-B89 model data base and simulation

Effects on prices and sectoral outputs of the radial reduction of the Benefit rates

The effects on various prices are reported in Table 8.12. All the exporters' prices and hence the per unit export revenue registers a fall under both the closures. The depreciation of the secondary exchange rate is not sufficient to compensate for the loss of the export subsidy immediately after the reduction in the Benefit rates. In the Keynesian case, the basic prices of domestic sale of exportables, namely jute, ready-made garments and jute textiles, rise while basic prices of domestic sales of tea, fish, leather, and forestry fall. Under the Neoclassical closure, basic prices of domestic sales of all the exportables except jute textiles fell. Depreciation of the secondary exchange rate induces a rise in all the importers' prices except rice and wheat for both the closures. The basic prices of the import substitutes, except those of edible oil, chemicals and other manufactures, however, do not rise.

Table 8.12 **Short-run effects of a 10 per cent radial reduction of the Export Performance Benefit entitlement rates on basic prices (%)**

	Keynesian			Neoclassical		
	Domestic	Exporters'	Importers'	Domestic	Exporters'	Importers'
Exportables						
Jute	.	-.	n.a.	-0.02	-0.02	n.a.
Tea	-0.02	-0.06	n.a.	-0.01	-0.06	n.a.
Fish	-0.01	-0.09	n.a.	-0.03	-0.10	n.a.
Ready-made garments	0.01	-0.09	0.11	-.	-0.10	0.10
Jute textiles	0.03	-0.01	n.a.	0.01	-0.03	n.a.
Leather	-0.02	-0.09	0.11	-0.03	-0.10	0.10
Forestry	-0.02	-0.02	n.a.	-0.01	-0.02	n.a.
Importables						
Rice	-.	n.a.	0.00	-0.02	n.a.	0.00
Wheat	.	n.a.	0.00	-0.01	n.a.	0.00
Edible oil	0.03	n.a.	0.09	0.02	n.a.	0.08
Other agriculture	0.01	-0.04	0.11	-.	-0.04	0.10
Sugar	0.01	n.a.	0.09	-.	n.a.	0.08
Cotton textiles	0.01	n.a.	0.10	-.	n.a.	0.09
Paper	.	-0.03	0.09	-.	-0.04	0.08
Chemicals	.	-0.03	0.08	0.01	-0.03	0.08
Other manufactures	0.01	-0.04	0.10	0.01	-0.04	0.09
Non-tradables						
Physical overheads	-0.01	n.a.	n.a.	-0.02	n.a.	n.a.
Social overheads	.	n.a.	n.a.	-0.02	n.a.	n.a.
Public administration	-.	n.a.	n.a.	-0.02	n.a.	n.a.

Source: The CGE-B89 model simulations.

In the Keynesian closure, domestic sales of exportables decline (columns 9 and 10 in Table 8.13a). As domestic-export relative prices change against sales in the overseas markets, all exports decline under both the closures (columns 7 and 8 in Tables 8.14a and 8.14b). As a result, composite outputs of all exportables register a decline in this case (columns 5 and 6 in Tables 8.14a and 8.14b). In contrast, composite outputs of some exportables, namely jute, tea, forestry, increase as their

Table 8.13a **Effects of a 10 per cent radial reduction in Export Performance Benefit entitlements on sectoral output, cost and sales under the Keynesian closure**[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands							
							Export		Domestic					
									Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables					**Changes at the constant basic prices**[d]									
Jute	-0.01	-0.77	-0.01	-0.47	-0.01	-1.24	-0.02	-0.77	-0.01	-0.47	-0.01	-0.46	-0.01	-0.01
Tea	-0.04	-0.17	0.00	-0.06	0.00	-0.23	-0.19	-0.17	0.00	-0.06	0.00	-0.05	-0.01	0.00
Fish	-0.08	-14.87	-0.06	-4.80	-0.06	-19.68	-0.42	-17.67	-0.01	-2.01	-0.01	-1.81	-0.03	-0.20
Forestry	-0.03	-1.10	0.00	-0.30	0.00	-1.39	-0.01	0.00	0.00	-1.39	0.00	0.01	-0.01	-1.40
Rd. md. garments	-0.78	-17.05	-0.51	-37.65	-0.51	-54.70	-0.58	-53.62	-0.07	-1.08	0.00	0.02	-0.51	-1.09
Jute textiles	-0.24	-10.16	-0.23	-12.81	-0.23	-22.97	-0.26	-22.41	-0.03	-0.56	-0.03	-0.30	-0.03	-0.26
Leather	-0.52	-5.92	-0.30	-9.06	-0.30	-14.97	-0.35	-14.87	-0.01	-0.11	0.00	0.01	-0.12	-0.12
Importables														
Rice	-0.01	-3.90	0.00	-1.32	0.00	-5.22	n.a.	n.a.	0.00	-5.22	0.00	-5.52	0.00	0.30
Wheat	-0.01	-0.24	0.00	-0.07	0.00	-0.31	n.a.	n.a.	0.00	-0.31	-0.01	-0.43	0.00	0.12
Edible oil	0.09	0.89	0.03	2.01	0.03	2.90	n.a.	n.a.	0.03	2.90	0.04	2.11	0.01	0.79
Other agric.	0.01	5.66	0.01	2.87	0.01	8.53	-0.23	-1.54	0.01	10.07	0.00	2.77	0.02	7.30
Sugar	0.05	1.12	0.03	2.26	0.03	3.38	n.a.	n.a.	0.03	3.38	0.03	2.94	0.01	0.44
Cotton textiles	-0.06	-3.88	-0.06	-7.75	-0.06	-11.63	n.a.	n.a.	-0.06	-11.63	0.01	0.86	-0.25	-12.49
Paper	-0.03	-0.28	-0.02	-1.60	-0.02	-1.88	-0.20	-0.69	-0.01	-1.19	0.00	0.20	-0.02	-1.40
Chemicals	-0.01	-0.10	0.00	-0.28	0.00	-0.38	-0.16	-0.02	0.00	-0.36	0.01	0.37	0.00	-0.72
Other manuf.	0.00	-0.28	0.00	-0.63	0.00	-0.91	-0.25	-2.91	0.00	2.00	0.02	2.98	0.00	-0.98
Nontradables														
Phy. overheads	-0.03	-21.00	-0.01	-10.12	-0.01	-31.12	n.a.	n.a.	-0.01	-31.12	-0.01	-8.74	-0.03	-22.38
Social overheads	-0.01	-1.81	-0.01	-0.22	-0.01	-2.03	n.a.	n.a.	-0.01	-2.03	-0.01	-2.02	-0.01	-0.01
Public admin.	-0.02	-9.71	-0.01	-1.99	-0.01	-11.70	n.a.	n.a.	-0.01	-11.70	-0.01	-3.85	-0.06	-7.85
Aggregate	-...	-83.56	-0.02	-81.99	-0.02	-165.55	-0.36	-114.67	-0.01	-50.89	-...	-10.90	-0.01	-39.98

Notes: [a]The base year-values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]With fixed capital, changes in value-added imply changes in value-added to labour only. [c]Intermediate inputs include material inputs from both domestic and foreign sources at the market prices. [d]Changes due to changes in quantities only. Three basic prices are, wherever applicable, the exporters' prices, importers' prices, and the domestic basic prices. Identities: Identities: (2)+(4)=(6)=(8)+(10); (10)=(12)+(14). Figures have been rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 8.13b Effects of a 10 per cent radial reduction in Export Performance Benefit entitlement rates on sectoral output, cost and sales under the Neoclassical closure[a]

	Value-added to labour[b]		Intermediate inputs[c]		Gross output		Sales/demands: Export		Domestic: Total		Consumption		Int.uses	
	(%) (1)	(mil.Tk) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)	(%) (7)	(mil.TK) (8)	(%) (9)	(mil.TK) (10)	(%) (11)	(mil.TK) (12)	(%) (13)	(mil.TK) (14)
Exportables					**Changes at the constant basic prices[d]**									
Jute	0.00	0.12	0.00	0.07	0.00	0.19	-0.01	-0.16	0.01	0.35	0.01	0.35	0.00	0.00
Tea	0.01	0.03	0.00	0.01	0.00	0.05	-0.24	-0.22	0.00	0.27	0.00	0.27	0.00	0.00
Fish	-0.05	-9.30	-0.04	-3.00	-0.04	-12.30	-0.36	-15.00	0.01	2.69	0.01	2.79	-0.02	-0.10
Forestry	0.02	0.71	0.00	0.19	0.00	0.90	-0.05	0.00	0.00	0.90	0.00	0.54	0.00	0.36
Rd. md. garments	-0.71	-15.65	-0.47	-34.55	-0.47	-50.20	-0.53	-49.38	-0.06	-0.81	0.02	0.19	-0.47	-1.00
Jute textiles	-0.17	-7.16	-0.16	-9.03	-0.16	-16.19	-0.19	-16.05	-0.01	-0.14	-0.01	-0.05	-0.01	-0.09
Leather	-0.48	-5.53	-0.28	-8.46	-0.28	-13.99	-0.33	-13.95	0.00	-0.04	0.01	0.06	-0.10	-0.10
Importables														
Rice	0.01	6.41	0.01	2.17	0.01	8.58	n.a.	n.a.	0.01	8.58	0.00	5.31	0.01	3.28
Wheat	0.03	0.77	0.02	0.23	0.02	1.00	n.a.	n.a.	0.02	1.00	0.01	0.45	0.02	0.55
Edible oil	0.13	1.33	0.04	2.99	0.04	4.32	n.a.	n.a.	0.04	4.32	0.05	2.67	0.03	1.65
Other agric.	0.05	19.42	0.02	9.83	0.02	29.25	-0.18	-1.24	0.02	30.49	0.02	17.75	0.03	12.73
Sugar	0.07	1.79	0.04	3.60	0.04	5.39	n.a.	n.a.	0.04	5.39	0.05	4.52	0.03	0.87
Cotton textiles	-0.04	-2.34	-0.03	-4.67	-0.03	-7.01	n.a.	n.a.	-0.03	-7.01	0.03	3.97	-0.22	-10.98
Paper	0.00	0.00	0.00	0.02	0.00	0.02	-0.17	-0.59	0.01	0.60	0.02	0.87	0.00	-0.27
Chemicals	0.07	0.51	0.01	1.45	0.01	1.97	-0.20	-0.02	0.01	1.99	0.01	0.51	0.01	1.48
Other manuf.	0.03	4.87	0.01	10.94	0.01	15.82	-0.23	-2.64	0.02	18.45	0.03	5.41	0.01	13.04
Nontradables														
Phy. overheads	0.00	2.72	0.00	1.31	0.00	4.02	n.a.	n.a.	0.00	4.02	0.01	12.41	-0.01	-8.39
Social overheads	0.01	1.68	0.01	0.20	0.01	1.89	n.a.	n.a.	0.01	1.89	0.01	1.88	0.00	0.00
Public admin.	0.00	-0.39	0.00	-0.08	0.00	-0.47	n.a.	n.a.	0.00	-0.47	0.01	5.02	-0.04	-5.49
Aggregate	*	0.00	-0.01	-26.78	-...	-26.77	-0.31	-99.25	0.01	72.47	0.01	64.92	...	7.55

Notes: *Aggregate employment was fixed. Hence there was no change in the aggregate value-added to labour.
Also, see notes in Table 8.15a

Source: CGE-B89 simulations

Table 8.14a: **Short-run effects of a 10 per cent radial reduction in Export Performance Benefit entitlements on imports[a] under the Keynesian closure**

	Total		Consumption		Intermediate uses	
	(%)	(mil.TK)	(%)	(mil.TK)	(%)	(mil.TK)
	(1)	(2)	(3)	(4)	(5)	(6)
		Changes at the base-year importers' prices[b]				
Rice	.	-0.02	.	-0.01	.	.
Wheat	.	-0.25	.	-0.27	0.01	0.02
Edible oil	-0.07	-6.18	-0.07	-5.80	-0.10	-0.38
Other agriculture	-0.17	-25.93	-0.17	-21.27	-0.15	-4.67
Sugar	-0.11	-6.56	-0.11	-6.29	-0.12	-0.27
Cotton textiles	-0.18	-9.37	-0.15	-6.62	-0.40	-2.75
Paper	-0.11	-4.05	-0.10	-1.89	-0.11	-2.16
Chemicals	-0.09	-7.74	-0.09	-2.91	-0.09	-4.83
Other manufacture	-0.06	-59.96	-0.08	-36.18	-0.09	-23.78
Ready-made garments	-0.12	-0.28	-0.13	-0.28	.	.
Leather	-1.54	-0.26	-0.21	-0.02	-0.22	-0.24
Aggregate	**-0.08**	**-120.60**	**-0.09**	**-81.52**	**-0.10**	**-39.08**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity:(2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

Table 8.14b **Short-run effects of a 10 per cent radial reduction in Export Performance Benefit entitlements on imports**[a] **under the Neoclassical closure**

	Total		Consumption		Intermediate uses	
	(%) (1)	(mil.TK) (2)	(%) (3)	(mil.TK) (4)	(%) (5)	(mil.TK) (6)
			Changes at the base-year importers' prices[b]			
Rice	-0.02	-0.39	-0.03	-0.11	-0.02	-0.29
Wheat	0.00	-0.34	0.00	-0.36	0.00	0.01
Edible oil	-0.06	-5.44	-0.06	-5.10	-0.09	-0.34
Other agriculture	-0.16	-25.13	-0.17	-20.60	-0.15	-4.52
Sugar	-0.10	-6.31	-0.11	-6.05	-0.12	-0.27
Cotton textiles	-0.17	-8.75	-0.14	-6.14	-0.38	-2.60
Paper	-0.09	-3.48	-0.09	-1.61	-0.10	-1.87
Chemicals	-0.06	-5.52	-0.06	-2.20	-0.06	-3.32
Other manufacture	-0.05	-48.90	-0.07	-29.17	-0.07	-19.72
Ready-made garments	-0.12	-0.27	-0.12	-0.27	0.00	0.00
Leather	-1.44	-0.25	-0.21	-0.02	-0.21	-0.23
Aggregate	**-0.07**	**-104.76**	**-0.08**	**-71.62**	**-0.08**	**-33.14**

Notes: [a]The base-year values are in Appendix A5.2. For data comparability see Appendix A6.1. [b]Changes due to changes in quantities. Importers prices include *cif* border prices, tariffs and implicit taxes on imports due to exchange rate premium.
Identity: (2)=(4)+(6); Figures are rounded to the nearest number so that rounding errors may be present.

Source: CGE-B89 simulations

domestic sales increase to more than offset the fall in their exports in the Neoclassical case.

In import competing sectors, the production of edible oil, other agriculture, and sugar expands while production of rice, wheat, cotton textiles, paper, chemicals, and other manufactures, registers a decline under the Keynesian closure (columns 5 and 6 in Table 8.13a). The three non-tradable sectors also contract. In the Neoclassical closure, production of all importables except cotton textiles rises (columns 5 and 6 in Table 8.13b).

The assumptions about the labour market seemed to determine the direction of supply responses of jute, tea, forestry, rice, wheat, chemical, paper, chemicals, other manufactures, physical overheads and social overheads sectors. For other sectors, production changes in the same direction irrespective of the two labour market assumptions.

Combined effects of the radial reduction in tariffs and Benefit rates

The above analysis suggests, as expected, that the radial reduction in tariffs is expansionary and in the Benefit rates is contractionary. Equiproportional cuts in tariffs and the Benefit rates together, however, are expansionary. The contractionary effects of a 10 per cent reduction in the Benefit rates are more than offset by the expansionary effects of tariff-cuts. Tables 8.6a and 8.14a added together indicate that both exports and domestic sales of exportables industries expand. Viewed in reverse, export subsidy in the presence of tariffs is desirable (Loo and Tower 1990), but the Export Performance Benefit Scheme alone does not seem to overcome the deleterious effects of tariff protection on exports. Any reduction in the Benefit entitlement rates accompanied by equiproportional tariff-cuts is, however, expansionary and welfare augmenting while maintaining, by and large, the *status quo* in treating the export-oriented and import-substituting industries.

9

CONCLUSIONS

The objective of this study has been to examine, in a general equilibrium framework, the economic consequences, including the welfare implications, of some of the key policies which influence the structure and growth of industries in Bangladesh. The computable general equilibrium model developed and used for the study has some distinctive features: (i) it can disaggregate the change in welfare, due to a small change in an exogenous variable, into the direct welfare impact of the change and indirect gains (or losses) from alleviating (or exacerbating) distortions in all other markets; (ii) the effects of any policy (or exogenous) change under the Neoclassical closure of the model can be estimated from effects of policy changes in the Keynesian version of the model.

More rapid industrial growth is a necessary component of accelerated overall economic growth in Bangladesh. Analysts agree that economic policies have been inappropriate and are responsible for the poor performance of the industrial sector. High protection (with offsets for protection), control over production and privileged access to low cost finance for selected firms have been the principal policies intended to stimulate industry. These policies were not, however, effective and the distortions they created, contributed to the over-valuation of the taka, monetary instability and inflation. Resource misallocation and inefficient resource utilization were the overall results.

In the 1980s, reforms began to be instituted to reduce regulation. Industrial and import licensing systems were simplified and liberalised. Tariffs and industrial incentives were somewhat rationalized to expose the economy to international competition.

Exchange rate management had important effects on industrial growth. The growth of the secondary exchange eroded controls over imports, production, and investment (Mallon and Stern 1991). Incentives that had relied on the duality of exchange rates were gradually eroded. The exchange rates were finally unified in 1992.

To evaluate the welfare and sectoral implications of the exchange rate unification, tariff and export subsidy policies a neo-classical, micro-theoretic computable general equilibrium model, CGE-B89, was developed for Bangladesh. The model belongs to the Johansen class. It is similar to the ORANI model of Australia in structure. To suit this study, however, the model has stylised the institutional aspects and principal trade and industrial policies used in the Bangladesh economy. These include external imbalances, divergence between international and domestic prices, trade taxes, the foreign exchange allocation system under the dual exchange rate regime, the subsidy under the Export Performance Benefit Scheme, and domestic excise and sales taxes. A skeleton monetary sector was included to clear the secondary exchange market. The CGE-B89 is an `almost small' open economy model with exogenously given border prices of imports (the index of which was considered as the numeraire of the model) and finite-elastic demands for exports which have been differentiated from competing products abroad. The Armington assumption of imperfect substitution among domestic and imported products was applied to all commodities. The consumption behaviour of the households who owned all the primary factors was covered by a single representative agent. Government budget deficit or surplus is assumed to be financed by lump-sum non-distortionary taxes, or subsidies.

Simulations using data for the year 1989 were conducted to examine whether particular policy changes would improve resource allocation and generate substantial growth of output, employment and export. An utility index was constructed to measure the welfare impacts of policy changes. A version of the Harberger's (1971) fundamental equation of the applied welfare economics was derived and evaluated to disaggregate the sources of the change in households' welfare, defined as the change in utility divided by the marginal utility of income. In view of the approximate nature of the data employed and the simplified behavioural assumptions made, the simulation results were regarded as indicative of the quantitative effects of the policy reforms under consideration.

First, a simulation with an exogenous inflow of foreign aid was analysed. In this case, the change in the utility index, under the assumption of a unitary marginal utility of income, measures the shadow exchange rate defined as the increase in welfare resulting from the costless increase in foreign exchange availability by one unit. Then, some economy-wide and sector-specific policies were simulated and analysed. The economy-wide policy simulations included (i) a 1 per cent devaluation, (ii) a 1 per cent increase in the domestic money supply, and (iii) a 1 per cent increase in nominal wages. The sector-specific policy simulations involved a 10 per cent radial reduction in (i) tariffs and (ii) Export Performance Benefit Scheme entitlement rates. These changes in policies were assumed to be permanent and credible.

The policy experiments were carried out in identical economic environments to facilitate comparisons. Capital, one of the two primary factors, was treated as industry-specific and hence fixed in the aggregate. Labour was perfectly mobile between sectors. In other words, a zero adjustment cost for labour movements among sectors was assumed. Real consumption and investment expenditures by the government, differentiated by sources, remained unchanged. Real private investment expenditures and changes in inventories of both domestic and imported components, were kept at the base-year levels. Only real household consumption expenditure would change as the hypothetical policy reforms were carried out. Since each policy experiment was conducted essentially for a one-period analysis, a unitary marginal propensity to consume was assumed by keeping the balance of trade deficit at its base-year level. In other words, policy reforms would change the real aggregate expenditure of households, and also switch expenditure towards (or away from) domestic substitutes as various elasticities in consumption and production mandated. Two alternative assumptions were made regarding the labour market: nominal wage rigidity in the presence of involuntary unemployment, and unchanged aggregate employment due to the exogenous supply of labour. In the former case, aggregate employment changed while, in the later case, nominal wages changed. Each policy experiment accordingly had a fixed-nominal wage (Keynesian) and a fixed employment (Neoclassical) version.

Simulation results of the exogenous inflow of additional foreign aid were used to construct the shadow exchange rate as an approximate index of policy distortions. In the case of rigid nominal wages, the shadow exchange rate was estimated to be taka 42.33. In other words, the model implies that each additional US dollar worth of foreign exchange inflow would raise households' welfare by taka 42.33, which is 32 per cent more than the market value of the foreign exchange at the official rate of taka 32.14 per US dollar. Of the total welfare gain of taka 42.33, taka 32.14 measure the direct benefit of the additional foreign exchange while taka 10.19 measure the indirect benefits. Approximately a quarter of this indirect gain could be attributed to the existing tariff structure. The exchange rate regime could explain only 7 per cent of the indirect benefit while the international terms of trade could explain 10 per cent. The reduction in involuntary unemployment at the fixed nominal wages following the increase in foreign exchange inflow could account for more than 50 per cent of the indirect gains. The aggregate indirect benefit declined to 15 per cent of the direct benefit of taka 32.14, and the shadow exchange rate fell to taka 36.84, when the nominal wages were flexible but the aggregate employment was fixed at the base-year level. The results thus lend support to the theory of second best that the removal of one distortion with other distortions remaining in place may reduce welfare. Even in case of fixed aggregate employment, gain from additional tariffs dominated, followed by gain from improved terms of trade.

The inflow of foreign aid would raise households' welfare under both the assumptions of fixed nominal wages and fixed aggregate employment, but at the expense of reduced production in the tradable sectors. It would cause a fall in the real exchange rate, the ratio of the price of tradable goods to the price of nontradable goods, inducing a decline in the production of most of the importables and exportables. In both the cases, aggregate gross output of the tradable sectors fell so much that even the substantial expansion in the nontradable sectors could not offset the fall. The results thus show that a gift from the rest of the world may bring about what may be diagnosed as something akin to the Dutch disease. This seems to lend support to the apprehension that foreign aid is not an unmixed blessing for Bangladesh. The case for promoting trade rather than lobbying for additional aid is strengthened.

Efficient management of exchange rate policy is a prerequisite for promoting trade and industrial growth. The study explored the consequences of two instruments for exchange rate unification: devaluation of the official exchange rate and a contraction of the domestic money supply. Given the insignificant wedge between the official exchange rate and the secondary exchange rate in the financial year 1988-89, it might be thought *a priori* that the economy had little to gain (or loose) from unification of the exchange rates.

The welfare implications of devaluation appeared to be sensitive to the assumptions of nominal wage rigidity. Model results suggest that a devaluation would improve households' welfare under wage rigidity, but would worsen households' welfare when nominal wages were flexible but the aggregate employment is fixed. Overvaluation of the official exchange rate may be deemed to be an export tax and devaluation is thus supposed to be beneficial. But the model results do not always support this view. Given the chosen export demand elasticities and the assumed market power in export markets (which followed from the assumption of finite elasticity demands for exports which have been differentiated from competing products abroad), the absence of optimal export taxes seems to allow a deterioration in the terms of trade when the official exchange rate is devalued. A deterioration in the terms of trade implies a loss of welfare. Aggregate welfare was reduced under the Neoclassical closure as the gain from additional revenue was insignificant compared to the loss due to deteriorating terms of trade. Under the Keynesian closure, devaluation also led to a deterioration in the terms of trade. But gains from the reduction of involuntary unemployment at the fixed nominal wages would raise welfare and offset the welfare-reducing effects associated with the fallen terms of trade in the absence of optimal export taxes.

Devaluation of the official exchange rate would induce additional trade with the rest of the world irrespective of the assumptions of the nominal wage rigidity. But the sectoral adjustments would vary under the two assumptions about the labour market. When aggregate employment is fixed, only a few sectors including jute and jute textiles, the major traditional exportables, would expand. When nominal wages are fixed at the base-year rates, all sectors except cotton textiles, ready-made garments and leather, would expand. Aggregate value-added would increase considerably in this situation compared to the decline in the earlier case. Devaluation of the exchange rate reduces the exchange rate premium which, in turn, reduces the export subsidy under the Export Performance Benefit Scheme. Ready-made garments and leather, the two major non-traditional exportables and the recipients of very high Benefit entitlements and export subsidies, would contract under both the assumptions about the labour market.

A contraction in the domestic money supply appeared to be welfare worsening irrespective of the assumption of nominal wage rigidity. Simulation results, however, suggest that the sources of welfare loss and the effects on foreign trade are sensitive to assumptions about nominal wage rigidity. When nominal wages are flexible, and aggregate employment is fixed, a reduction in the supply of domestic money would lead to an expansion of trade but to a deterioration in the international terms of trade. The loss from the deteriorating terms of trade would more than offset the indirect gains associated with the transfer of additional government revenue, and hence, would lead to a loss of households' aggregate welfare. When nominal wages are instead fixed and aggregate employment changes, a contraction in money supply would raise the aggregate involuntary unemployment because of wage stickiness and the consequent high post-reform real wages. The reduced money supply would, in this situation, lead to the contraction of trade but to an improvement in the international terms of trade. The gain from improved terms of trade would, however, be insignificant compared to the loss of welfare ensuing from additional involuntary unemployment. Also, the contractionary impacts of reduced money supply would lead to a fall in government revenue. Government would impose a lump-sum tax on the households or reduce its lump-sum transfer to the households. Households' total income and aggregate welfare, as a result, would fall. As a result of monetary contraction, the performance of the domestic industries would be much worse in case of the fixed nominal wages than in the case of fixed employment.

Simulations of the devaluation of the official exchange rate and increases in money supply have suggested that a devaluation of approximately 2 per cent or a contraction of domestic money supply by 2 to 2.5 per cent would unify the exchange rates. As indicated above, when aggregate employment is fixed, both devaluation and money supply contraction would reduce welfare. In such circumstances, unification of the exchange rates appears to be welfare worsening. A nominal contraction (or expansion) always degenerates (or produces) a Keynesian stimulus under conditions of sticky nominal wages in the presence of involuntary employment. As such, a contraction in the domestic money supply would be welfare worsening, and a devaluation which is equivalent to a monetary expansion would be welfare augmenting under the fixed-nominal-wage assumption. But a 2 per cent devaluation which would unify the exchange rates would raise households' welfare by an amount which is only 0.14 per cent of the base-year GDP at market prices.

The model results have shown that under the fixed employment assumption, devaluation of the official exchange rate when accompanied by an expansionary monetary policy might retain the *status quo* because these two policies produce opposing effects. Under the fixed nominal wage assumption, this might not be the case. Both devaluation and expansionary monetary policy could be expansionary and welfare augmenting. The assumption of wage rigidity, however, has been crucial in such a situation. The positive effects of devaluation and/or money supply expansion would be neutralised by an economy-wide exogenous increase in nominal wages. All these results emphasise the importance of the appropriate mix of policies.

As expected, the radial reduction of tariffs has been welfare improving. Both exports and GDP at market prices have risen irrespective of the assumption about nominal wage rigidity. Domestic industries have been exposed to increased international competition as nominal protection fell. Discrimination against exports has been reduced. This has improved resource allocation in the economy. Sugar, paper and chemicals - three highly protected large industries - have contracted under both the fixed nominal wages and fixed aggregate employment assumptions. Another highly protected sector, edible oil, has also contracted in both cases. All other industries, under the Keynesian closure, have expanded, drawing additional employment from the unemployed reservoir at the fixed nominal wages. When aggregate labour has been fixed, industries' performance has not looked very encouraging. Ready-made garments, jute-textiles and leather, three major export-oriented industries, could still expand along with fish and cotton textiles. Aggregate value-added increased in both the cases of fixed and flexible employment.

Simulation results, however, suggest that the welfare gains from radial reduction in tariffs are quite small: only 0.11 per cent of base-year GDP under the assumption of nominal wage rigidity and 0.02 per cent of the base-year GDP under the exogenously fixed aggregate employment assumption. The static welfare gains from the reduction in nominal protection, that is, the true costs of protection might be higher than the model results suggest if some of the key assumptions of the model are relaxed.

Relaxing perfect competition and constant returns to scale assumptions and allowing instead a monopoly or oligopolistic market structure, and increasing returns to scale, similar tariff reductions might produce greater welfare gains (Harris 1984, Rodrik 1988). Simulations with tariff cuts when both labour and capital are mobile between sectors, might result in higher production and consumption gains also

(Hartigan and Tower 1982). Tariff reduction leads to deteriorating terms of trade when domestic exports and goods produced by other countries are assumed to be imperfect substitutes, thus depressing the welfare gains. The Armington assumption of imperfect substitutes between imports and domestically produced goods also limits the gains from tariff cuts. The database used understates the nominal protection accorded to the import-substituting industries, and hence to understate the gains from proportional tariff cuts.

Understandably, the radial reduction of the Export Performance Benefit entitlement rates has been welfare worsening. The fall in welfare as percentage of the base-year GDP, however, appears to be insignificant. Simulation results show that a 10 per cent across-the-board reduction in the Benefit entitlement rates would reduce household consumption and hence their welfare by 0.001 per cent of the base-year GDP when aggregate employment is fixed, and by 0.01 per cent of the base-year GDP when nominal wages are fixed. Declines in exports and GDP at purchaser prices are also small. The assumption of nominal wage rigidity would only affect the magnitudes of the falls. Export-oriented industries would contract as subsidies under the Export Performance Benefit Scheme are curtailed.

Simultaneous reductions in the Benefit entitlement rates and tariffs by the same percentage, on the other hand, appeared to be welfare augmenting. All exports except jute experience a rise. This seems to reveal the inadequacy of the Benefit Scheme in overcoming the adverse effects of tariff protection on exports. Also, the result shows that a reduction in the subsidies under the Scheme has to be accompanied by a reduction in nominal protection to raise welfare and exports.

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