ELSEVIER

Agricultural Economics 11 (1994) 237–256

AGRICULTURAL ECONOMICS

Evaluation of external market effects and government intervention in Malaysia's agricultural sector: A computable general equilibrium framework

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Accepted 16 June 1994

Abstract

The purpose of this study is to evaluate the effects of changes in the external trade environment and domestic economic policies on the agricultural development of Malaysia. The scope of this research also includes providing further insights into the strengths and weaknesses of the computable general equilibrium (CGE) methodology for agricultural policy analysis. The first analysis focuses on the export agriculture sector which encompasses Malaysia's two primary agricultural commodities, rubber and palm oil. Heavily dependent on exports of rubber in the 1950s and 1960s, Malaysia has since built a more diversified economy with strong emphasis on manufacturing. Export agriculture, however, is still an important component of the national economy. The second objective examines the influence of domestic policy on agricultural development. The simulation results demonstrate the growing resiliency of the Malaysian economy to external shocks. Also, they point to the domestic economy's ability to buffer internal policy-induced distortions.

In a market economy, intersectoral linkages and the macroeconomic environment have a pervasive influence on agricultural development. As evident in the pattern of agricultural protectionism in the world, these linkages are often poorly understood or ignored in policy analyses and implementation. Most industrialized countries protect and subsidize agriculture while developing countries tax this sector. [1] Such widespread interventions have distorted world agricultural production and prevented it from growing and developing along the lines of comparative advantage among countries.

[1] This trend is so commonly observed that the phenomenon qualifies as a stylized fact of modern economic development (Krueger et al., 1988). However, it is a policy-based commonality. Hence, it is theoretically more easily reversible than tastes, technology, and other institutional factors accounting for structural transformation in the process of economic development.

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SSDI 0169-5150(94)00024-V

An economy-wide, multisectoral framework is needed to analyze the macroeconomic influences, particularly the various inter-relationships that affect agricultural development (Byerlee and Halter, 1974). Of the multisectoral models that have been developed for economy-wide analysis, the computable general equilibrium (CGE) models represent the most advanced analytical tool. The lineage of CGE models can be traced to the input–output models of the early 1950s used for development planning. They have been extensively used on issues involving international trade, development planning, public finance, environmental and resource management, structural adjustment and transition to a market economy.

The purpose of this study is to evaluate the economy-wide and sectoral effects of changes in the external trade environment and domestic economic policies on the agricultural development of Malaysia. Specifically, a static computable general equilibrium model of the Malaysian economy with a disaggregated agricultural sector is formulated to:

1. estimate the effects on output, trade, welfare, and resource allocation of external economic environmental changes in the form of a decline in the agricultural commodity export price;
2. evaluate the economy-wide and sectoral effects of removing agricultural export taxes.

The scope of this research also includes providing further insights into the strengths and weaknesses of the CGE methodology for agricultural policy analysis.

The first analysis focuses on the export agriculture sector which encompasses Malaysia's two primary agricultural commodities, rubber and palm oil. Heavily dependent on exports of rubber in the 1950s and 1960s, Malaysia has since built a more diversified economy with strong emphasis on manufacturing. Export agriculture, however, is still an important component of the national economy.

The second objective examines the influence of domestic policy on agricultural development. Commodity taxes are a major instrument for the government to intervene in domestic markets. This measure is popular because of its ease of implementation and indirectness of its impact. The importance of these indirect effects increases with the strength of intersectoral linkages in the product and factor markets.

Subsequent sections of this paper include a description of the Malaysian economy with emphasis on the agricultural sector, a summary of the use of CGE models for agricultural policy analysis, description of the data used in this study and estimation results. The last section summarizes our results and discusses implications for the development of Malaysia's agricultural sector.

1. Malaysian economy and agricultural sector

Malaysia is located in Southeast Asia with a land area totaling 330,434 km^2 and a population of approximately 18 million people (1990). Its economic performance since gaining independence from the British in 1957 is regarded as among the most successful in Southeast Asia.

Malaysia's impressive economic growth since the 1950s is exemplified by the rise in annual per capita real income from M$821 in 1960 to M$3,675 by 1980, and M$4,424 by 1990. Its annual rate of growth in gross domestic product averaged 5.2% between 1960 and 1970, 8.3% between 1970 and 1980, and 6.1% between 1980 and 1990. These periods of growth correspond to developmental phases that can be characterized as follows. Overly dependent in the 1950s and 1960s on two primary commodities, rubber and tin, the country began its drive toward economic diversification and industrialization after its independence. The enactment of the Pioneer Industries Ordinance in 1958 is considered to have been successful in promoting import-substitution industries based on imported technology and materials. Concurrently, in the 1960s, large-scale land development continually absorbed the growing rural population, reducing poverty and expanding and diversifying agricultural production.

The early industrialization efforts, characterized by import substitution in the light manufacturing sector, continued throughout the 1960s. Since the import-substitution industries were constrained by small domestic markets, the govern-

ment revised its industrialization policies in 1968 by enacting the Investment Incentive Act. This Act shifted the incentive towards export-oriented manufacturing based on domestic materials. By the end of the Second Malaysian Plan (1971–75), the manufacturing sector had increased its share of GDP to 16.4% as compared to 10.4% in 1965 and 8.2% in 1955.

In the early 1980s, the government intensified its industrialization drive with an import-substitution strategy focusing on the heavy industries, e.g., pulp and paper, automobiles, cement and steel billet. This emphasis on resource-based and capital-intensive industries followed an increasingly competitive environment for labor-intensive light manufacturing industries as other developing countries, such as Indonesia and Thailand, embarked on similar export-oriented industrialization.

Over a 35-year span, from 1955 to 1990, the share of agriculture in the gross domestic product has declined from 40% to 19% (Table 1). The structural change in the economy is most distinctive in the growth of the industrial sector where, in 1987, manufacturing overtook agriculture as the leading sector.

The declining importance of agriculture reflects the acceleration in the economic diversification of the country, the downward trend in world demand and prices, and increasing competition from other producer countries. Nevertheless, the agricultural sector remains important not only because it comprises one-fifth of GDP but also because its continuous growth is vital for employment, eradication of poverty and ensuring a balanced development between the urban and rural sectors.

Malaysia is the world's largest producer of natural rubber and palm oil and the third largest producer of cocoa. In 1987, its world share of rubber amounted to 41%, 69% for palm oil and 9% for cocoa. Hence agricultural production in Malaysia is dominated by export crops which comprise about 80% of the cultivated area and 75% of the value of agricultural output.

Agricultural production in Malaysia is labor-intensive and labor costs account for more than 50% of the total production costs of all major export crops. Substitution of capital for labor is limited because rubber tapping and palm oil harvesting have not been successfully mechanized. Hence, labor availability is critical for the expansion of export crops. Currently, there is a general shortage of labor in this subsector, and immigrant labor, both legal and illegal, has been used to meet this shortfall.

Agricultural imports declined in the 1960s; the average annual reduction was 4% in real terms. In the 1970s, imports rose at a rate of about 22% per year largely due to the rapid increase in food imports. Between 1983 and 1988, food imports accounted for 70-80% of total agricultural imports and between 8% and 9% of total merchandise imports.

World prices have a major impact on export earnings and consequently on Malaysia's GDP. It was estimated that reduced agricultural commodity prices in 1985 resulted in a decline of 16% in

Table 1
GDP of Malaysia by industry origin (constant prices)

Sector	Percent of GDP				
	1955	1965	1975	1985	1990
Agriculture, forestry and fishing	40.2	31.5	27.7	20.8	18.9
Mining, quarry, crude oil	6.3	9.0	4.6	10.5	9.7
Manufacturing	8.2	10.4	16.4	19.7	25.2
Construction	3.0	4.5	3.8	4.8	3.5
Services	42.3	44.6	47.5	44.2	42.7
Total	100.0	100.0	100.0	100.0	100.0

Notes: 1955 and 1965 figures are for Peninsular Malaysia only. Base year is 1960 for 1955 and 1965 figures, and 1978 for the remaining years; 1990 figures are preliminary Central Bank of Malaysia estimates. Sources: Money and Banking in Malaysia, and Annual Report 1990, Bank Negara Malaysia, Kuala Lumpur, 1991.

export earnings and 3% in the country's GDP (Abdul Aziz, 1991). The real price of rubber has been declining steadily since 1960 while palm oil showed the greatest decline in the 1980s. Both commodity prices have declined by about 50% since the early 1960s.

2. Use of CGE models for agricultural policy analysis

Computable general equilibrium (CGE) techniques were developed in the early 1970s to solve for both market prices and quantities simultaneously, thus simulating the workings of a competitive market economy. The first applied CGE model was developed by Johansen (1960) to analyze growth and resource allocation issues in the Norwegian economy. Adelman and Robinson (1978) were the first to use a CGE model for a developing country. They used the model to analyze issues of income distribution and poverty incidence in Korea. Subsequent advancement in computing power and solution algorithms have widened the use of CGE models for policy analysis. They have proved to be a valuable analytical tool in the study of public finance, international trade, economic development, macroeconomics and natural resources. [2] In the development literature, multisectoral and multifactor CGE models are widely used to assess trade, industrialization, growth and structural change, urbanization, and, macroeconomic stabilization and distribution issues. [3] More recently, they have been applied to environmental policy analyses and to issues involving trade integration and transition from centrally planned to market economies. [4]

General equilibrium models have also become a popular tool for analyzing issues involving the effects of agricultural price policies and trade liberalization. The focus of these studies varies by country and product aggregates.

World models typically are used to predict changes in trade and production patterns and world market prices. Examples of such models are the World Agricultural Liberalization Study (WALRAS) developed by the Organization for Economic Cooperation and Development (OECD), the Basic Linked System (BLS) developed by the International Institute for Applied Systems Analysis (IIASA), and the Rural Urban North South (RUNS) model by the University of Brussels.

These world general equilibrium models provide a sophisticated treatment of the economic structure of groups of countries with similar characteristics. By contrast, country groups and single country models are able to capture the varying effects of macroeconomic and agricultural pricing policies in countries with different economic structures and policies.

Compared to partial equilibrium and other commodity and sectoral-based models, general equilibrium approaches can better capture the intersectoral and macroeconomic linkages. By considering income and intersectoral resource allocation effects, these general equilibrium models provide a more detailed analysis of the impacts of agricultural and trade policies. However, because of constraints on model size, the level of disaggregation may not be sufficient to represent each market completely. Finally, single country models provide the best means of capturing the full effects of domestic policy changes. An important feature is the ability of single country models to treat agricultural production in detail and model these relationships in world markets. By specifying the social structure, the distribution of gains

[2] Surveys of CGE applications include Shoven and Whalley (1984) on taxation and international trade, de Mello (1988) on trade policy analysis in developing countries, Deverajan (1988) on natural resources and taxation in developing countries and Decaluwe and Martens (1987) on various applications of 26 country models.

[3] Dervis et al. (1982) examined developing issues that include resource allocation, growth, structural change, foreign trade strategies, and the impact of different strategies on income distribution. In addition to these, there are numerous single and multi-country studies on issues covering the 'Dutch Disease' phenomenon, trade and commercial policies and economic integration. See previous footnote for survey articles.

[4] See the forthcoming proceedings on the IIASA's 5th Task Force Meeting on Applied General Equilibrium Modeling held at Luxenburg, Austria, August 27–29, 1991.

and losses within the country is also better represented in a single country approach.

3. Data requirements

The main data requirement of the CGE model is a social accounting matrix (SAM). The SAM is an extension of the input–output table. It forms part of the national accounting system laid out in the United Nations System of National Accounts (UN, 1968) framework which was developed largely by Stone (1961). The SAM is designed to capture, in addition to the product flows, the income and expenditure flows of the economic actors over a specified accounting period, usually

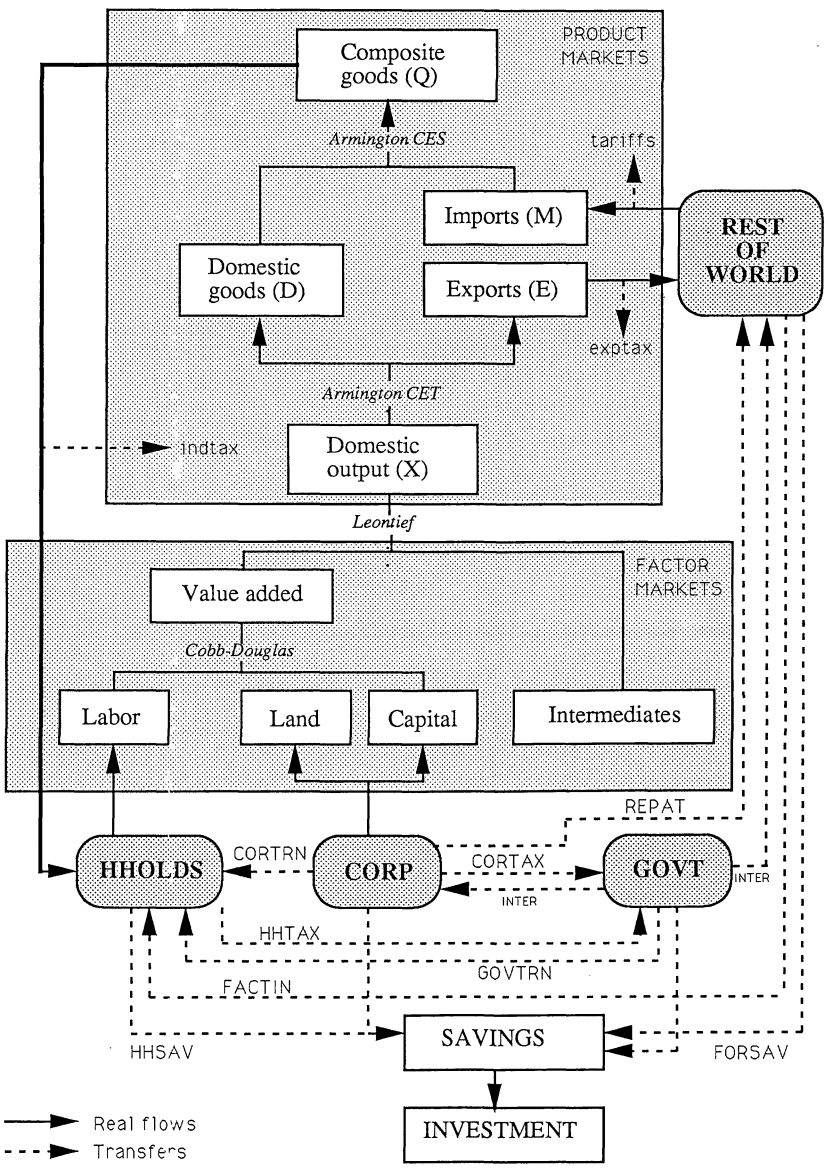

Fig. 1. Schematic representation of the CGE model of Malaysia.

Table 2
Sectoral disaggregation of the Malaysian economy

Sector		1983 IO Table grouping	Industry (commodities)	
1.	AGRIC Food agriculture	1	OTH AGRIC	Coconut estates and smallholdings (coconut, tea, coffee, cocoa, and other food crops)
		6	FISHING	Meat preparation and dairy product manufacturing (meat and meat products, dairy products)
2.	EXAGR Export agriculture	2	RUBBER PLN	Rubber planting (unprocessed rubber, seeds and wood materials)
		3	OIL PALM	Oil palm estates (fresh fruit brunch, kernel and nuts for plating)
		10	OIL AND FATS	Oils and fats processing (palm oil, coconut oil and other vegetable oils)
		26	RUBBER PRO	Rubber processing (processed latex, sheet rubber, block rubber, crepe rubber)
		27	RUBBER PRD	Rubber products industries (tyres, tubes, footwear)
3.	LVSTK Livestock and dairy	4	LIVESTOCK	Livestock farming (pigs, cattle, poultry and other livestock raising)
		8	DAIRY PROD	Dairy production
4.	FORES Forest and forest industries	5	FORESTRY	Forestry and loggin (products)
		19	SAWMILLS	Sawmilling and wood processing (sawmill, plywood, board and other wood products)
		20	FURN FIXT	Furniture industries (wood furniture and fixtures)
		21	PAPER PRNT	Pulp, paper and printing industries (pulp and paper products, printing products)
5.	FPROC Food processing	9	VEG FRUIT	Canning and processing (canned and preserved fruits, vegetables and seafoods)
		11	GRAIN MILL	Grain mills (rice, flour, sage, tapioca and other grain mill products)
		12	BAKER CONF	Bakeries and confectionaries (bakery and confectionary products)
		13	OTH FOODS	Other food manufacturing (ice, sugar, coffee, tea noodles and other food products)
		14	ANMAL FEED	Animal feed manufacturing (animal feeds)
		15	BEVERAGES	Beverages industries (alcoholic and non-alcoholic beverages)
		16	TOBACCO	Tobacco industry (tobacco products)
6.	M + OIL Mining and petroleum	7	MINING	Mining and quarrying (crude oil, natural gas, tin, iron, quarying)
		25	PETROL PRD	Petroleum refineries (petrol, kerosene, LPG, bitumen, asphalt)
7.	MANUF Manufacturing	17	TEXTILES	Textile manufacturing (yarn, cloth and synthetic fabrics, rugs, ropes)
		18	WEARNG APL	Apparel and leather industries (clothing, apparells, leather products)
		22	INDST CHEM	Manufacturing of industrial chemicals (chemicals, fertilizers and pesticides)
		23	PAINTS ETC	Manufacture of paints, varnishes and lacquers
		24	OT CHM PRD	Manufacture of other chemical products (drugs, medicines, soap)
		28	PLSTIC PRD	Plastic industries (plastic products)
		29	GLASS PROD	Pottery, clay and glass manufacturing (ceramics and glass products)
		30	CEMENt	Cement manufacturing (cement, lime and plaster)

Table 2 (continued)

Sector	1983 IO Table grouping	Industry (commodities)	
	32	BASIC MTL	Basic metal industries (iron and steel, tin, machines and equipment)
	33	OTH METAL	Manufacturing of fabricated metal products (tin cans, metal products)
	34	N ELEC MAC	Manufacturing of machinery except electrical (industrial/agricutural machinery)
	35	ELECT MACH	Electrical manufacturing industries (electrom machinery, appliances)
	36	MOTOR VEH	Motor vehicle manufacturing (vehicle bodies, assembly)
	37	OTH TRANSP	Manufacturing and assembly of motorcycles, ships, railroad and aircraft
	38	O MFG PROD	Other manufacturing (Scientific equipment, photographic, jewellery)
8. SERVC Services, construction and utilities	39	ELECTRCITY	Electricity, gas and steam
	40	WATER	Water
	41	CNSTRCTION	Construction
	42	TRADE	Wholesale and retail trade margins
	43		Restaurants and hotel services
	44	TRANSPORT	Land, water and air transport and related services
	45	COMMUNICAT	Communications (post and telecommunications)
	46	FINANCE	Financial institutes' services
	47	INSURANCE	Insurance
	48	DWELLINGS	Real estate and ownership of dwellings
	49	BUSIN SERV	Lega, accounting, dataprocessing, advertising, etc.
	50	PRIV EDUC	Private educational services
	51	PR HEALTH	Private medical, dental and other health services
	52	CULT SERV	Cultural, media and entertainment services
	53	REPAIR VEH	Repair of motor vehicles and motorcycles
	54	PERSON SER	Personal and household services
	55	PUB ADMIN	General public administration
	56	GOV EDUC	Government educational services
	57	GOV HEALTH	Government health services
	58	O GOV SERV	Other government services
	59	PRI NP SER	Private non-profit services (regligious)
	60	OTHER SERV	Miscellaneous personal services

a year, as in the national accounts. Hence the national accounts statistics are used to reconcile the SAM aggregates. The product, factor, income and expenditure flows represent the equilibrium state of the economy which the CGE model seeks to replicate.

The only published SAM, for Malaysia, is for the year 1970 (see Pyatt and Round, 1984). A 1978 SAM was constructed as part of two modeling projects in the Economic Planning Unit (EPU) of the Prime Minister's Department. With the assistance of private consultants, the EPU had prepared a 1983 SAM but unlike the 1978 SAM was not prepared to release it pending its publication in 1992 or 1993. Seeking the latest available data, a preliminary 1983 SAM was derived from the published 1983 input–output table, the 1970 and 1978 SAMs, and other government data sources.

The 1983 input–output table (Malaysia Department of Statistics, 1988a) and the National Accounts Statistics (Malaysia Department of Statistics, 1988b) for 1983 are the principal sources for deriving a SAM that is consistent with the national accounts. To obtain detailed breakdown of the accounts, the 1970 and 1978 SAMs

were used with supplemental data from the Fourth Malaysia Plan (1981–1985), Economic Report of the Ministry of Finance (1986/87), the 1980 Census of Population, and the 1981–83 Labor Force Survey.

The Malaysia SAM has nine major accounts. The first two accounts, 'Activity' and 'Commodity', represent the functioning of the product and factor markets. The first account or 'Activity' represents the producing sector or industry. The second account is 'Commodity' which records the flow of goods and services, both domestic and imported, in the economy.

Accounts 3 to 7 (labor, capital, corporation, household and government) represent a mapping of the flow of funds in an economy. Their transactions are essentially 'transfers' involving no real flows. The remaining accounts (consolidated capital and the rest-of-the-world (ROW)), except for ROW, reflects various transfer payments. These transfers from the column accounts are either voluntary such as savings, or involuntary, for example, tax payments. There is no flow from the row accounts since they do not involve physical flows.

4. Malaysian CGE model

The CGE model incorporates the core neoclassical features of a well-functioning economy that is characterized by: (a) profit and utility maximization by rational producers and consumers; (b) clearing of competitive factor and product markets through price and quantity adjustments; and (c) Pareto-optimal resource allocation.

In the Malaysian CGE model, the economy is disaggregated into eight sectors. There are five primary factors of production (land, capital and three types of labor), three categories of households (rural, urban low wage, and urban high wage), and five institutional actors (households, corporations, government, capital account and rest-of-the-world) which serve as intermediaries in mapping factor income to household income. A schematic representation of this CGE model outlining the main real and financial flows, markets, and economic institutions is shown in Fig. 1.

Import prices are exogenous in the model. This is the 'small country' assumption which implies that the country cannot influence world import prices since its relative import share to total world trade is very small. Effectively, this means that for the country to sell more in the world markets, it must lower the export price.

The eight production sectors are derived from a grouping of commodity classes found in the 1983 input–output tables. The sectoral breakdown reflects the sub-sectors in the agricultural sector and the other major sectors of the economy. The eight sectors and their component industries are shown in Table 2. They consist of three agricultural production sectors, two primary natural resources sectors, two manufacturing sectors distinguishing between food and non-food manufacturing, and the services sector. The three agricultural production sectors are food crops, export crops comprising rubber and palm oil, and livestock and dairy. The two primary sectors are forestry and mining/petroleum which are, respectively, renewable and non-renewable natural resources.

Production is based on constant returns to scale using the Cobb-Douglas production function with five factors of production for the agricultural sectors and four for the non-agricultural sectors. Intermediate inputs are assumed to have a Leontief specification since the fixed coefficients can be derived from the input–output table.

The supply side of the model shares a specification common to a large number of CGE models. A composite good, i.e., a domestic-export goods bundle, is used to model the supply of and demand for the output of each sector. Basically, a CES transformation function uses the relative prices in the domestic and export markets to determine the quantities supplied to each market. This is the Armington specification commonly adopted in CGE trade models to reflect the imperfect substitutability between domestic and exported goods and the cross-hauling of goods observed in the real world.

The demand side has four components, namely, intermediate demand, consumption, government

purchases, and investment which includes stocks. Intermediate demand is based upon fixed input–output coefficients as commonly done in most input–output analysis and CGE modeling. Consumption embodies household expenditures whose functions are derived from utility maximization. Government real spending is exogenous in the sense that the government injects its demands into the economy. This is consistent with the government's active role in the economy as reflected in the five-year national development plans. Stocks or inventory demand are a fixed proportion of domestic output. Investment demand is derived from a capital composition matrix which translates investment demand by sector of destination into investment demand by sector of origin. However, in the model, the composition of investment is assumed to be the same as for final demand to reproduce the GDP breakdown in the national accounts.

The Malaysian CGE model is divided into five equation modules. The first module defines the price system. The second module describes production and total revenue paid out to factors of production. This is followed by a mapping of factor payments to institutional actors in the third module. The demand system of the institutional actors is described in the next module, thus completing the circular flow of income. The final module describes the market clearing and macro 'closure' equations which constitute the 'system constraints' of the model economy.

An equilibrium condition exists for each market. In the product market, equilibrium is defined where supply of composite commodities equals demand. The equilibrating variables for this market are the sectoral prices and quantities. Factor market equilibrium occurs when total factor supply equals demand. Assuming fixed supplies of primary factors, the equilibrating variables are the average factor prices. In this model specification, the various labor categories, in response to wage differential changes, can freely migrate across sectors but not between categories. In the foreign exchange market, an equilibrium relationship is established between the exchange rate and the current account balance. Either variable can be endogenized in the model to serve as the equilibrating variable. The 'neoclassical closure' is the savings-investment balance or when savings is equal to investment. Aggregate savings has four components: household savings, government savings, corporate savings and foreign savings. Only government savings is determined endogenously. The model is 'savings-driven' whereby aggregate investment is determined by aggregate savings.

The equilibrating conditions for the three major macro balances are savings-investment, government budget and the trade balance. One of these equilibrium conditions can be eliminated by Walras' Law. As in most CGE models, the savings-investment balance is dropped.

The CGE model is implemented using the SAM database and a solution algorithm that can compute equilibrium prices and quantities. The General Algebraic Modeling System (GAMS) is used to implement the system of non-linear equations. [5] The GAMS package is widely used for implementing CGE models because of its ease of use and implementability on a wide variety of computers.

The model needs were calibrated to the 1983 base year data set. The calibration involves the input of elasticity values and the derivation of shift and share parameters for the production and aggregate functions. Ideally, such values should be based on econometric estimates. [6] Since they are not available for Malaysia, the elasticity values are based on those employed in the Cameroon model (see Deverajan et al., 1991) and two other CGE studies of the Malaysian economy (Khor, 1982; Wong, 1987). The Cameroon model used a sectoral classification closest to this Malaysian model. The values used for comparable sectors in the other two Malaysian models serve as checks to ensure that the elasticities adopted were representative.

[5] An introduction to the GAMS modeling approach is given by Meeraus (1983). The GAMS package is described in Brooke et al. (1988). Condon et al. (1987) provide a detailed discussion of how to implement a CGE model on GAMS. An updated version is provided by Deverajan et al. (1991).

[6] Jorgenson and Wilcoxen (1990) employ econometric estimates of such parameters in an environmental issue-oriented CGE model of the U.S.

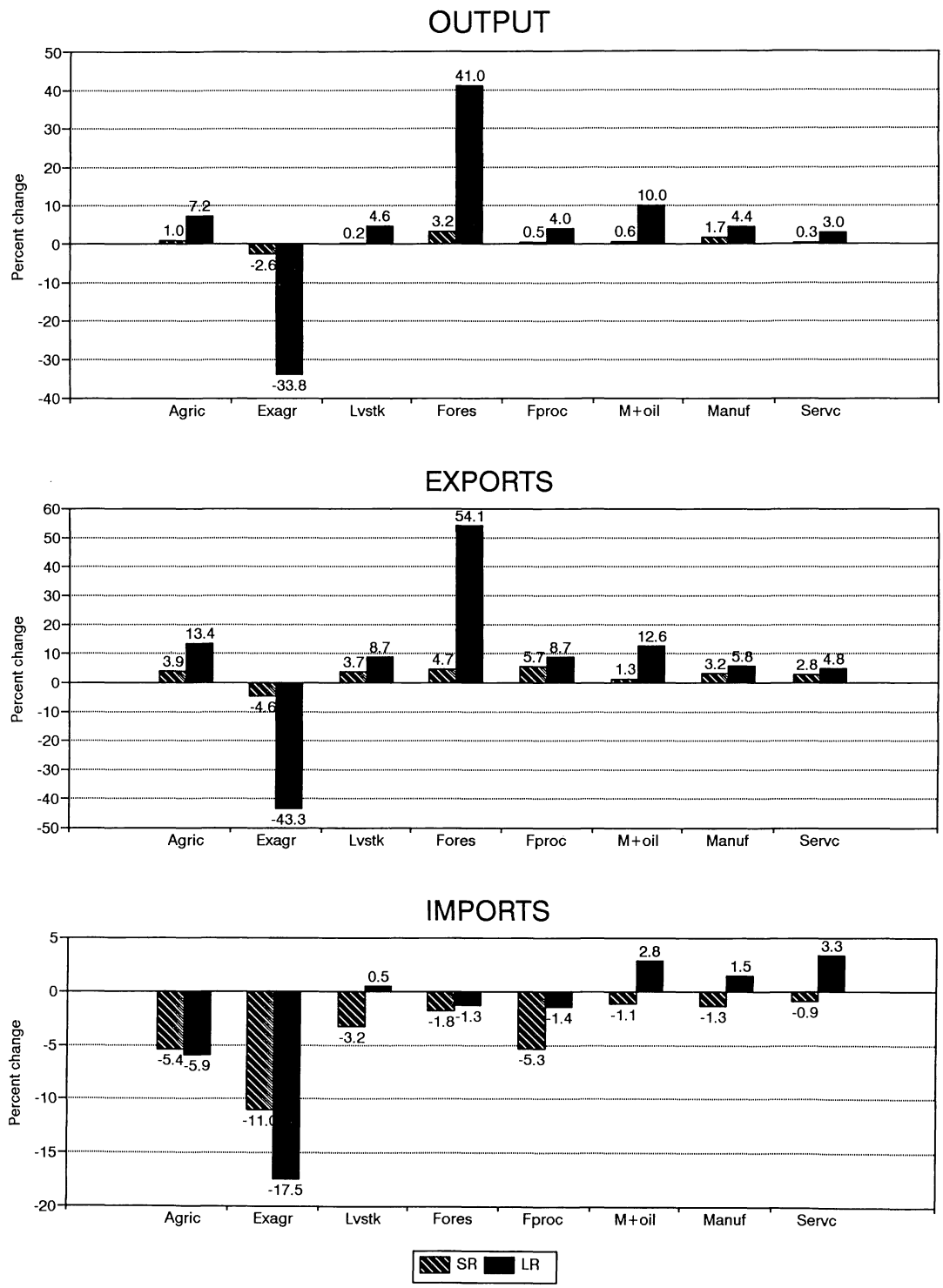

Fig. 2. Effects of agricultural export price decline on sectoral output and trade.

The calibration of the shift and share parameters follows the standard CGE procedure of using the base year data to solve for the parameters. Once calibrated properly, the model should reproduce the benchmark data set.

5. Policy experiments and estimation results

Using the benchmark solution, the model is then used to examine two policy experiments. First, a decline in world prices for Malaysian agricultural primary commodity exports, a 15% decline in world prices for the export agriculture sector is simulated in this experiment. As presented in the literature review, the real prices of rubber and palm oil have declined about 50% between 1960 and 1990. CGE models are appropriate for medium to long-term analysis of structural change. Assuming an average medium period of eight years, the actual rate of decline between 1960 and 1990 amounts to about 15% per period. The second experiment involves the removal of agricultural export taxes. Agricultural export taxes are eliminated to examine the implications of removing the tax burden on the export agriculture sector.

Each experiment uses the flexible exchange rate and neoclassical ('savings-driven') closure rule as the reference. [7] Short run and long run versions of the model are generated based on the type of factor market closure. In the short run version, total labor supply is considered to be fixed but labor is sectorally mobile, while capital stocks and land are fixed. This set of assumptions is based on the premise that in the short term, land and capital stocks cannot be converted into other uses even though their relative profitability has changed. In the long run, total factor supplies are fixed but all factors are assumed to be sectorally mobile. This implies a complete adjustment of factor mix in the long term in response to market signals.

[7] Because of space limitations, simulations with different market closures were not shown. However, these results can be provided in detail upon request to the authors.

6. Commodity export price decline scenario

Economy-wide effects. Model results from this external shock are shown in Table 3. Although the 15% decline in the prices of agricultural exports has a minimal impact on Malaysia's GDP, it changes the agricultural terms of trade, thus affecting income distribution. Real GDP shows increases of 0.4% in the short term and 3.3% in the long term. This increase is due to the increased levels of output and exports in the other sectors as resources are attracted away from the declining export agriculture sector and respond positively to the exchange rate depreciation associated with adjustments in the foreign exchange account.

The agriculture export price decline also results in a 2.9% loss in the external terms of trade. Agricultural terms of trade declines by 4.7%. Rural household income decreases by 2.9%, as opposed to 1.7% and 1.8% declines experienced by the urban low wage and urban high wage groups, respectively.

Sectoral effects. As expected, domestic output of export agriculture decreases by 2.6%, while agricultural exports contract by 4.6%. Consistent with the general equilibrium framework of analysis, output and trade in other sectors of the economy adjust to the decline in the export agriculture sector and the ensuing exchange rate adjustment (Fig. 2). The currency depreciation encourages exports and discourages imports in the other sectors. Except for export agriculture, the export–import balance in other agricultural sectors improves more than in the non-agricultural sectors.

The decline in agricultural exports does not stimulate domestic demand. This is an indication of the low substitutability of agricultural export commodities for goods in the domestic markets. The long-term impact on sectoral production is more pronounced. Export agriculture experiences a 33.8% output reduction compared with a 2.6% decline in the short run. The other sectors expand between 3% and 41% compared to a range of 0.2–3.2% in the short term as they attract resources from the declining export agriculture sector (Fig. 2). In the short run, domestic prices

Table 3
Economy-wide, output and trade effects from a 15% decline in agricultural export prices

Variables	Base year value [a]	Percentage change base year value:	
		Short run	Long run
Economy-wide variables	(million ringgit except for prices and terms of trade)		
Exchange rate	1.00	3.6	2.4
Domestic goods price	1.00	-1.6	-1.7
Composite goods price	1.00	0.0	-0.4
Real GDP	69 941	0.4	3.3
Balance of trade	1 639	3.7	58.7
External terms of trade	125	-2.9	0.1
Ag terms of trade	100	-4.7	-2.7
Aggregate savings	26 466	-0.1	5.0
Government revenue	19 590	0.2	5.5
Government savings	1 413	8.2	83.3
Rural household income	11 014	-2.9	-1.3
Urban low wage income	15 961	-1.7	2.4
Urban high wage income	15 961	-1.8	1.0
Domestic output	(million ringgit)		
Food agriculture	5 018	1.0	7.2
Export agriculture	16 699	-2.6	-33.8
Livestock	4 346	0.2	4.6
Forestry	8 826	3.2	41.0
Food processing	6 737	0.5	4.0
Mining and petroleum	17 286	0.6	10.0
Manufacturing	24 174	1.7	4.4
Services	48 059	0.3	3.0
Export value	(million ringgit)		
Food agriculture	452	3.9	13.4
Export agriculture	7 901	-4.6	-43.3
Livestock	91	3.7	8.7
Forestry	4 790	4.7	54.1
Food processing	601	5.7	8.7
Mining and petroleum	8 241	1.3	12.6
Manufacturing	8 829	3.2	5.8
Services	4 890	2.8	4.8
Import value	(million ringgit)		
Food agriculture	1 535	-5.4	-5.9
Export agriculture	416	-11.0	-17.5
Livestock	676	-3.2	0.5
Forestry	1 020	-1.8	-1.3
Food processing	2 385	-5.3	-1.4
Mining and petroleum	5 816	-1.1	2.8
Manufacturing	31 087	-1.3	1.5
Services	0	-0.9	3.3
Domestic prices			
Food agriculture	1.00	-1.6	-7.7
Export agriculture	1.00	-8.1	16.3
Livestock	1.00	-2.2	-4.1
Forestry	1.00	0.0	-20.1
Food processing	1.00	-1.0	-1.7
Mining and petroleum	1.00	2.3	-2.7
Manufacturing	1.00	0.4	-0.6
Services	1.00	-2.0	-1.5

Table 3 (continued)

Variables	Base year value [a]	Percentage change base year value:	
		Short run	Long run
Composite prices			
Food agriculture	1.00	-0.3	-5.3
Export agriculture	1.00	-7.6	15.6
Livestock	1.00	-1.4	-3.2
Forestry	1.00	0.7	-15.9
Food processing	1.00	0.2	-0.6
Mining and petroleum	1.00	2.8	-0.7
Manufacturing	1.00	2.5	1.4
Services	1.00	-2.0	-1.5
Producer prices			
Food agriculture	1.00	-1.2	-6.8
Export agriculture	1.00	-9.9	3.4
Livestock	1.00	-2.1	-4.0
Forestry	1.00	2.0	-7.3
Food processing	1.00	-0.6	-1.3
Mining and petroleum	1.00	2.9	-0.2
Manufacturing	1.00	1.6	0.5
Services	1.00	-1.4	-1.1
Capital stocks	(million ringgit)		
Food agriculture	6826	0.0	-1.3
Export agriculture	23531	0.0	-39.0
Livestock	3678	0.0	-3.8
Forestry	8017	0.0	32.4
Food processing	9179	0.0	4.1
Mining and petroleum	23130	0.0	9.9
Manufacturing	28564	0.0	4.5
Services	139684	0.0	2.0
Land	('000 ha)		
Food agriculture	1348	0.0	26.4
Export agriculture	3224	0.0	-21.9
Livestock	100	0.0	23.2
Forestry	469	0.0	69.7
Rural labor	('000 workers)		
Food agriculture	650	6.2	9.9
Export agriculture	1023	-12.2	-32.1
Livestock	54	2.5	7.2
Forestry	134	13.7	47.5
Food processing	21	6.3	16.0
Mining and petroleum	50	11.4	22.4
Manufacturing	108	9.5	16.4
Services	1199	3.9	13.7
Urban unskilled labor	("000 workers)		
Food agriculture	61	1.2	-3.4
Export agriculture	74	-16.4	-40.3
Livestock	3	-2.4	-5.8
Forestry	76	8.3	29.7
Food processing	51	1.3	2.0
Mining and petroleum	33	6.1	7.6
Manufacturing	291	4.3	2.3
Services	993	-1.0	-0.1

Table 3 (continued)

Variables	Base year value [a]	Percentage change base year value:	
		Short run	Long run
Urban skilled labor	('000 workers)		
Food agriculture	4	1.6	-3.7
Export agriculture	18	-16.0	-40.5
Livestock	1	-2.0	-6.1
Forestry	24	8.7	29.2
Food processing	15	1.7	1.6
Mining and petroleum	12	6.6	7.3
Manufacturing	35	4.7	2.0
Services	341	-0.6	-0.4
Labor wage rate	(ringgit) Average for all categories of labor.		
Food agriculture	1 120	-0.7	-1.2
Export agriculture	1 159	-17.9	-38.9
Livestock	3 058	-4.2	-3.7
Forestry	5 424	6.2	32.6
Food processing	6 130	-0.6	4.3
Mining and petroleum	7 745	4.1	10.1
Manufacturing	5 805	2.3	4.7
Services	6 342	-2.8	2.2
Land rental rate	('000 ringgit per ha)		
Food agriculture	0.864	-0.7	-21.8
Export agriculture	0.851	-17.9	-21.8
Livestock	4.464	-4.2	-21.8
Forestry	1.888	6.2	-21.8
Capital rental rate	(100 percent)		
Food agriculture	0.341	-0.7	0.1
Export agriculture	0.159	-17.9	0.1
Livestock	0.243	-4.2	0.1
Forestry	0.221	6.2	0.1
Food processing	0.159	-0.6	0.1
Mining and petroleum	0.338	4.1	0.1
Manufacturing	0.165	2.3	0.1
Services	0.061	-2.8	0.1

[a] 1983 US$/Ringgit exchange rate is 2.32 (IMF International Financial Statistics, International Monetary Fund).

of the agricultural sectors generally decline while those in the non-agricultural sectors rise, as shown in Table 3 and Fig. 2. These changes are manifested in the deterioration of the agricultural terms of trade as discussed earlier.

Sectoral changes in factor demand and prices are generally consistent with changes in the product markets. The decline in labor demand (rural labor −12.2%, urban unskilled −16.4% and urban skilled −16.0%) in the export agricultural sector is consistent with lower output as well as a reduction in wage rates, which decline by 17.9%. The sharp labor cutback, in spite of a short-term output decline of only 2.6%, suggests a high labor–capital ratio in the sector's factor utilization.

The large long-term effect on labor demand (rural labor −32.1%, urban unskilled −40.3% and urban skilled −40.5%) in the export agriculture sector is a magnification of the short-term impact. The reduced labor demand is consistent with the 17.9% reduction in labor wage rates in the short run and the 38.9% reduction in the long run. The forestry, petroleum, and manufacturing sectors are the major beneficiaries from the reduction in labor usage in the export agricultural sector.

7. Removal of agricultural export taxes

Economy-wide effects. The removal of agricultural export taxes increases the agricultural

Table 4
Economy-wide, output and trade effects from the removal of agricultural export taxes

Variables	Base year value [a]	Percentage change base year value	
		Short run	Long run
Economy-wide variables	(million ringgit except for prices and terms of trade)		
Exchange rate	1.00	-1.7	-1.6
Domestic goods price	1.00	0.8	0.7
Composite goods price	1.00	0.0	0.0
Real GDP	69 941	-0.2	-1.0
Balance of trade	1 639	-40.7	-55.2
External terms of trade	125	0.0	-0.9
Ag terms of trade	100	2.2	0.7
Aggregate savings	26 466	-2.2	-3.8
Government revenue	19 590	-3.1	-4.6
Government savings	1 413	-45.5	-65.5
Rural household income	11 014	1.4	0.8
Urban low wage income	15 961	0.9	-0.2
Urban high wage income	15 961	0.9	0.0
Domestic output	(million ringgit)		
Food agriculture	5 018	-0.4	-2.1
Export agriculture	16 699	1.0	8.4
Livestock	4 346	-0.1	-1.0
Forestry	8 826	-1.2	-4.3
Food processing	6 737	-0.2	-1.2
Mining and petroleum	17 286	-0.3	-5.0
Manufacturing	24 174	-0.8	-2.0
Services	48 059	-0.1	-0.8
Export value	(million ringgit)		
Food agriculture	452	-1.8	-4.2
Export agriculture	7 901	1.7	10.6
Livestock	91	-1.7	-2.6
Forestry	4 790	-1.7	-5.5
Food processing	601	-2.7	-3.6
Mining and petroleum	8 241	-0.6	-6.7
Manufacturing	8 829	-1.5	-2.9
Services	4 890	-1.3	-1.8
Import value	(million ringgit)		
Food agriculture	1 535	2.8	2.9
Export agriculture	416	5.2	6.1
Livestock	676	1.7	0.7
Forestry	1 020	1.1	1.3
Food processing	2 385	2.8	1.8
Mining and petroleum	5 816	0.6	-0.2
Manufacturing	31 087	0.7	0.0
Services	0	0.5	-0.7
Domestic prices			
Food agriculture	1.0	0.8	2.4
Export agriculture	1.0	3.6	-1.9
Livestock	1.0	1.1	1.2
Forestry	1.0	0.1	3.2
Food processing	1.0	0.5	0.6
Mining and petroleum	1.0	-1.0	2.1
Manufacturing	1.0	-0.1	0.5
Services	1.0	1.0	0.6

Table 4 (continued)

Variables	Base year value [a]	Percentage changebase year value:	
		Short run	Long run
Composite prices			
Food agriculture	1.0	0.1	1.4
Export agriculture	1.0	3.4	-1.9
Livestock	1.0	0.7	0.8
Forestry	1.0	-0.3	2.2
Food processing	1.0	-0.1	0.0
Mining and petroleum	1.0	-1.3	0.6
Manufacturing	1.0	-1.2	-0.9
Services	1.0	1.0	0.6
Producer prices			
Food agriculture	1.0	0.5	2.0
Export agriculture	1.0	4.4	0.2
Livestock	1.0	1.0	1.1
Forestry	1.0	-0.6	1.6
Food processing	1.0	0.3	0.4
Mining and petroleum	1.0	-1.4	0.4
Manufacturing	1.0	-0.7	-0.3
Services	1.0	0.7	0.4
Capital stocks	(million ringgit)		
Food agriculture	6826	0.0	0.1
Export agriculture	23531	0.0	10.8
Livestock	3678	0.0	1.2
Forestry	8017	0.0	-2.7
Food processing	9179	0.0	-1.2
Mining and petroleum	23130	0.0	-4.9
Manufacturing	28564	0.0	-2.0
Services	139684	0.0	-0.4
Land	('000 ha)		
Food agriculture	1348	0.0	-6.1
Export agriculture	3224	0.0	4.0
Livestock	100	0.0	-5.0
Forestry	469	0.0	-8.7
Rural labor	('000 workers)		
Food agriculture	650	-2.6	-2.9
Export agriculture	1023	4.8	7.5
Livestock	54	-0.9	-1.8
Forestry	134	-4.9	-5.6
Food processing	21	-2.5	-4.1
Mining and petroleum	50	-4.9	-7.7
Manufacturing	108	-3.9	-4.8
Services	1199	-1.5	-3.3
Urban unskilled labor	('000 workers)		
Food agriculture	61	-0.6	0.4
Export agriculture	74	6.9	11.2
Livestock	3	1.1	1.5
Forestry	76	-3.0	-2.3
Food processing	51	-0.5	-0.8
Mining and petroleum	33	-2.9	-4.6
Manufacturing	291	-2.0	-1.6
Services	993	0.5	0.0

Table 4 (continued)

Variables	Base year value [a]	Percentage changebase year value:	
		Short run	Long run
Urban skilled labor	('000 workers)		
Food agriculture	4	-0.8	0.4
Export agriculture	18	6.7	11.1
Livestock	1	0.9	1.5
Forestry	24	-3.2	-2.4
Food processing	15	-0.7	-0.8
Mining and petroleum	12	-3.1	-4.6
Manufacturing	35	-2.2	-1.6
Services	341	0.3	-0.1
Labor wage rate	(ringgit) Average for all categories of labor.		
Food agriculture	1 120	0.4	0.3
Export agriculture	1 159	8.0	11.0
Livestock	3 058	2.2	1.4
Forestry	5 424	-2.0	-2.5
Food processing	6 130	0.5	-1.0
Mining and petroleum	7 745	-2.0	-4.8
Manufacturing	5 805	-1.0	-1.8
Services	6 342	1.5	-0.2
Land rental rate	('000 ringgit per ha)		
Food agriculture	0.864	0.4	6.7
Export agriculture	0.851	8.0	6.7
Livestock	4.464	2.2	6.7
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Food processing	0.159	0.5	0.2
Mining and petroleum	0.338	-2.0	0.2
Manufacturing	0.165	-1.0	0.2
Services	0.061	1.5	0.2

[a] 1983 US$/Ringgit exchange rate is 2.32 (IMF International Financial Statistics, International Monetary Fund).

terms of trade by 2.2% in the short term and 0.7% in the long term (Table 4). However this policy does not affect the external terms of trade. There is currency appreciation of 1.7% and 1.6% in the short and long-term exchange rates. This currency appreciation has an adverse impact on the trade balance which deteriorates by 40.7% and 55.2% in the short and long-term simulation, respectively. The removal of the export taxes reduces government revenue by 3.1% (4.6%) and government savings by 45.5% (65.5%) in the short (long) term. The improvement in the agricultural terms of trade has a positive impact on rural household income which increases by 1.4% compared to 0.9% for the urban household groups.

Sectoral effects. The output of the agricultural export sector expands by 1.0% in the short run, while all other sectors contract because of reduced exports. The long-term impact on output is more pronounced as illustrated in Fig. 3. In the long run, output of the export agriculture sector increases by 8.4%, while the other sectors shrink. As expected, the removal of export taxes expands this sector's exports (1.7% and 10.6%, respectively, in the short run and long run).

Imports in all sectors rise expectedly with an appreciation in the exchange rate. The increases in imports vary between sectors with export agriculture exhibiting the largest increase of 5.2% (6.1%). Changes in domestic sectoral demand are

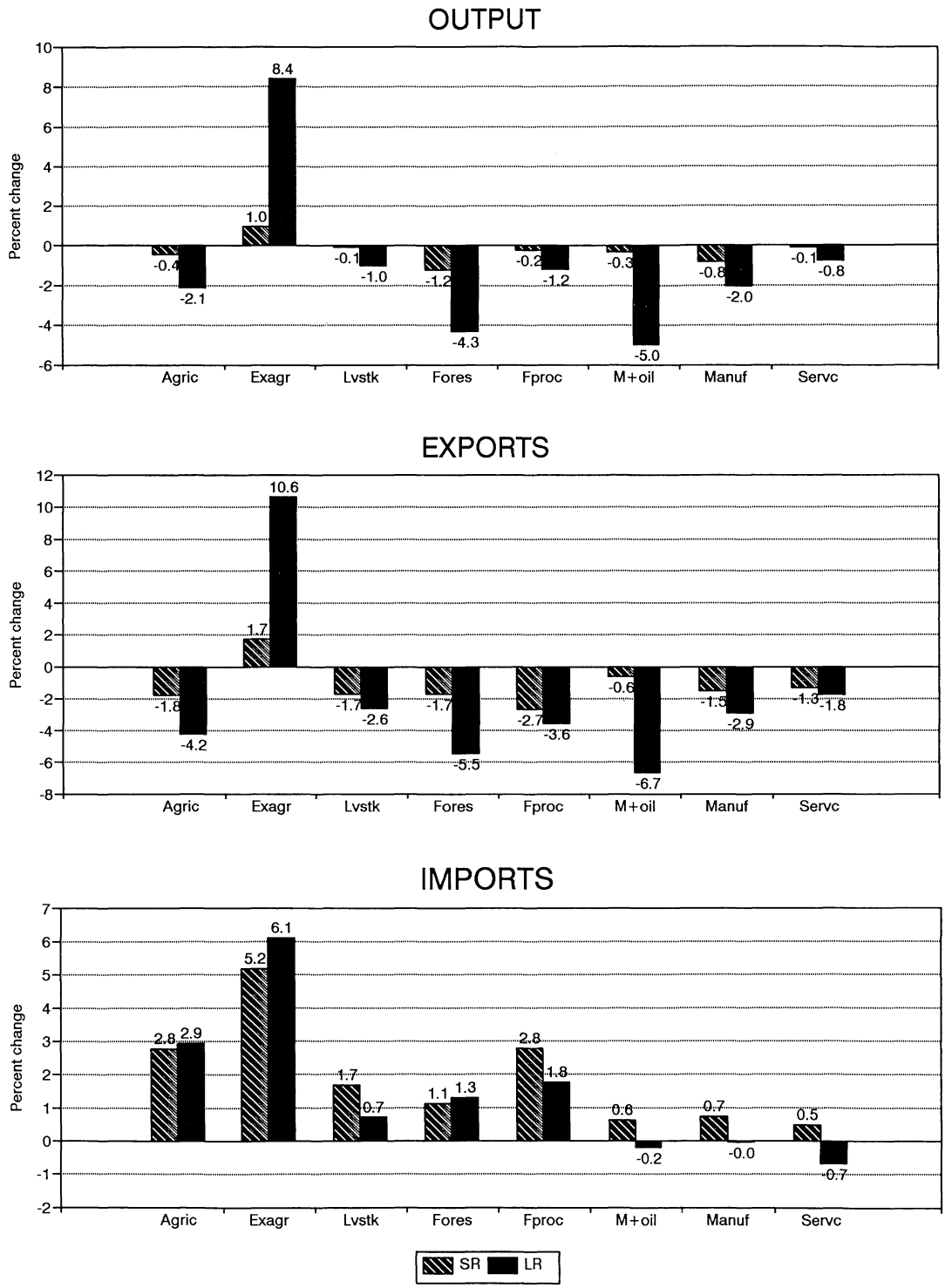

Fig. 3. Effects of removal of agricultural export taxes on output and trade.

very small in the short term although in the long term, export agriculture demand expands at the expense of all the other sectors.

The removal of the export taxes results in increases in domestic price, composite price and producer price (with magnitudes of 3.6%, 3.4% and 4.4%, respectively) of export agricultural commodities. These price increases stem from the removal of export taxes which increase the price received by producers for exports. Consequently, more production is geared towards exports, thus increasing the pressure on the price of domestic goods.

The pattern in sectoral labor demand usually reflects changes in sectoral output. Labor demand in the export agriculture sector expands by 18.5% in the short term and 29.8% in the long term. These factor demand increases are consistent with the 1% and 8.4% increases in output, respectively. Corresponding to the reduced outputs in the other sectors, their labor demands also decline. The forestry, mining and manufacturing sectors experience relatively large reductions in labor demand, between 8% and 11%, while the food agriculture, food processing and services sectors are moderately or slightly affected.

A similar pattern of changes is found in the demand for capital and land. As shown in Table 4, the export agriculture sector expands at the expense of the other land-using sectors. In competing for land, export agriculture expands its land use by 4%, while the forestry, food agriculture and livestock sectors experience losses of 8.7%, 6.1% and 5.0%, respectively.

8. Summary and conclusions

This research developed an eight-sector, single period, agricultural-focused CGE model of Malaysia, using 1983 as the base year. The model was then used to analyze the comparative static effects of an external shock scenario and a domestic policy shift on the Malaysian economy, concentrating on changes in prices, production, trade, resource allocation and income.

The external shock, a 15% decline in agricultural commodity export prices, and the policy change of eliminating agricultural export taxes, have minimal effects on Malaysia's gross domestic product. This result demonstrates the growing resilience of the increasingly diversified Malaysian economy to external shocks. Also, it points to the domestic economy's ability to buffer internal policy-induced distortions.

For the elimination of agricultural export taxes, as expected, the export agriculture sector benefits. Its output increases by 1% in the short term and 8.4% in the long term. These gains are obtained at the expense of the other sectors.

The decline in agricultural commodity export prices has significant long-term effects, especially on the export agriculture sector. The sector's output decreases by 2.6% in the short term and 33.8% in the long term. The corresponding effects on the sector's exports are a contraction of 4.6% in the short run and 43.3% in the long run. The other agricultural sectors benefit from the decline in export agriculture. Food agriculture registers a short-term output increase of 1% and a long-term increase of 7.2% while exports increase by 3.9% and 13.4%, respectively. Output of the livestock and food processing sectors both increase by less than 1% in the short term and by 4.6% and 4.0% in the long term. Their exports also show short-term increases of 3.7% and 5.7%, respectively, and 8.7% in the long term.

The CGE model has provided a quantification of the general equilibrium effects of an economic shock and a policy shift separately. The potential strength of this type of analysis lies in the intersectoral linkages that are incorporated in the supply–demand equilibrium in both the product and factor markets. The multisectoral and economy-wide approach is necessary for analyzing changes in policies and the macro environment. The micro foundations, that is, the incorporation of behavioral relationships based on economic theory and the use of data that are consistent with the national accounts, add to the strength of the CGE model as an experimental tool for economics. The research provided here can serve as a foundation for future work in regional modeling and analysis.

The findings highlight the importance of the underlying assumptions and relationships of the

model as well as the economy-wide impacts on a sector specific change. What the CGE model attempts to do is to quantify the significance of intersectoral and macroeconomic linkages. In an open economy that is highly dependent upon external trade and capital flows, the exchange rate mechanism is particularly significant as shown by the results. The quantitative estimates however are not easily verifiable and this constitutes one of the major criticisms of the application of CGE modeling results. Nevertheless, they provide a useful indication of the direction and magnitude of the economy-wide and sectoral impacts of changes in the variable of interest.

Compared to partial equilibrium and other commodity and sectoral-based models, general equilibrium approaches can better capture the intersectoral and macroeconomic linkages. However, general equilibrium models such as the CGE have drawbacks which include extensive input data requirements, dependence on the type of 'macro closure', and the absence of technological progress. In its current state, the CGE methodology is more useful as a heuristic tool which provides opportunities to learn more about the structure, functioning, and performance of an economy from a macro-perspective. As a computable model, the CGE approach offers potential as a diagnostic tool for designing hypotheses for empirical testing.

References

Abdul Aziz, A.R., 1991. Impact of pricing, taxation, and trade policies on Malaysian agriculture. Report 37, Malaysian Institute of Economic Research.

Adelman and S. Robinson, 1978. Income distribution policy in developing countries: a case study of Korea. Stanford University Press, California.

Brooke, A., D. Kendrik and A. Meeraus, 1988. GAMS: A User's Guide. Scientific Press, Redwood City, CA.

Byerlee, D. and A.N. Halter, 1974. A macro-economic model for agricultural sector analysis. Am. J. Agric. Econ., 56: 520–533.

Condon, T., H. Dahl and S. Deverajan, 1987. Implementing a computable general equilibrium model on GAMS: the Cameroon model. Report DRD290, World Bank, Washington, DC.

Decaluwe, B. and A. Martens, 1987. Developing countries and general equilibrium models: a review of the empirical literature. IDRC Report IDRC-MR155e, International Development Research Center, Ottawa, Ontario, Canada.

de Mello, J., 1988. Computable general equilibrium models for trade policy analysis in developing countries: a survey. J. Policy Modeling, 10: 469–503.

Dervis, K., J. de Mello and S. Robinson, 1982. General Equilibrium Models for Development Policy. Cambridge University Press.

Deverajan, S., 1988. Natural resources and taxation in computable general equilibrium models of developing countries. J. Policy Modeling, 10: 505–528.

Deverajan, S., J.D. Lewis and S. Robinson, 1991. From stylized to applied models: building multisectoral CGE models for policy analysis (mimeo).

Johansen, L., 1960. A Multisectoral Study of Economic Growth. North-Holland, Amsterdam.

Jorgenson, D.W. and P.J. Wilcoxen, 1990. Intertemporal general equilibrium modeling of U.S. environmental regulation. J. Policy Modeling, 12: 715–744.

Khor, H.E., 1982. Income distribution and unemployment in Malaysia: a dual economy CGE model. Ph.D. Dissertation, Princeton University, New Jersey.

Krueger, A.O., M. Schiff and A. Valdes, 1988. Agricultural incentives in developing countries: measuring the effect of sectoral and economy-wide policies. World Bank Econ. Rev., 2(1): 255–271.

Malaysia Department of Statistics, 1988a. 1983 Input–Output Tables. Kuala Lumpur.

Malaysia Department of Statistics, 1988b. National Accounts Statistics 1983. Kuala Lumpur.

Meeraus, A., 1983. An algebraic approach to modeling. J. Econ. Dynamics Control, 5: 81–108.

Pyatt, G. and J.I. Round, 1984. Improving the macroeconomic data base: a SAM for Malaysia, 1970. World Bank Staff Working Paper 646, Washington, DC.

Shoven, J.B. and J. Whalley, 1984. Applied general equilibrium models of taxation and international trade. J. Econ. Lit. 22: 1007–1051.

Stone, R., 1961. Social accounts at the regional level: a survey. In: W. Isard and W.H. Cumberland (Editors) Regional Economic Planning: Techniques of Analysis. Organization for Economic Cooperation and Development, Paris.

UN, 1968. A System of National Accounts, Series F. No. 2 Rev. 2. United Nations, Washington, DC.

Wong, Y.F., 1987. Price effects of a windfall gain in Malaysia. Ph.D. Dissertation, University of Hawaii, Honolulu.