# APPENDICES

APPENDIX A: ALGEBRAIC SPECIFICATION OF THE GENERAL EQUILIBRIUM MODEL

The general equilibrium model described below follows the logic of the circular flow of income in a small open economy. The algebraic specification of the transactions of production activities, households, government, and the rest of the world and are summarised in algebraic form below. The transactions are summarised in figure A1.

Figure A1: A schematic representation of the model
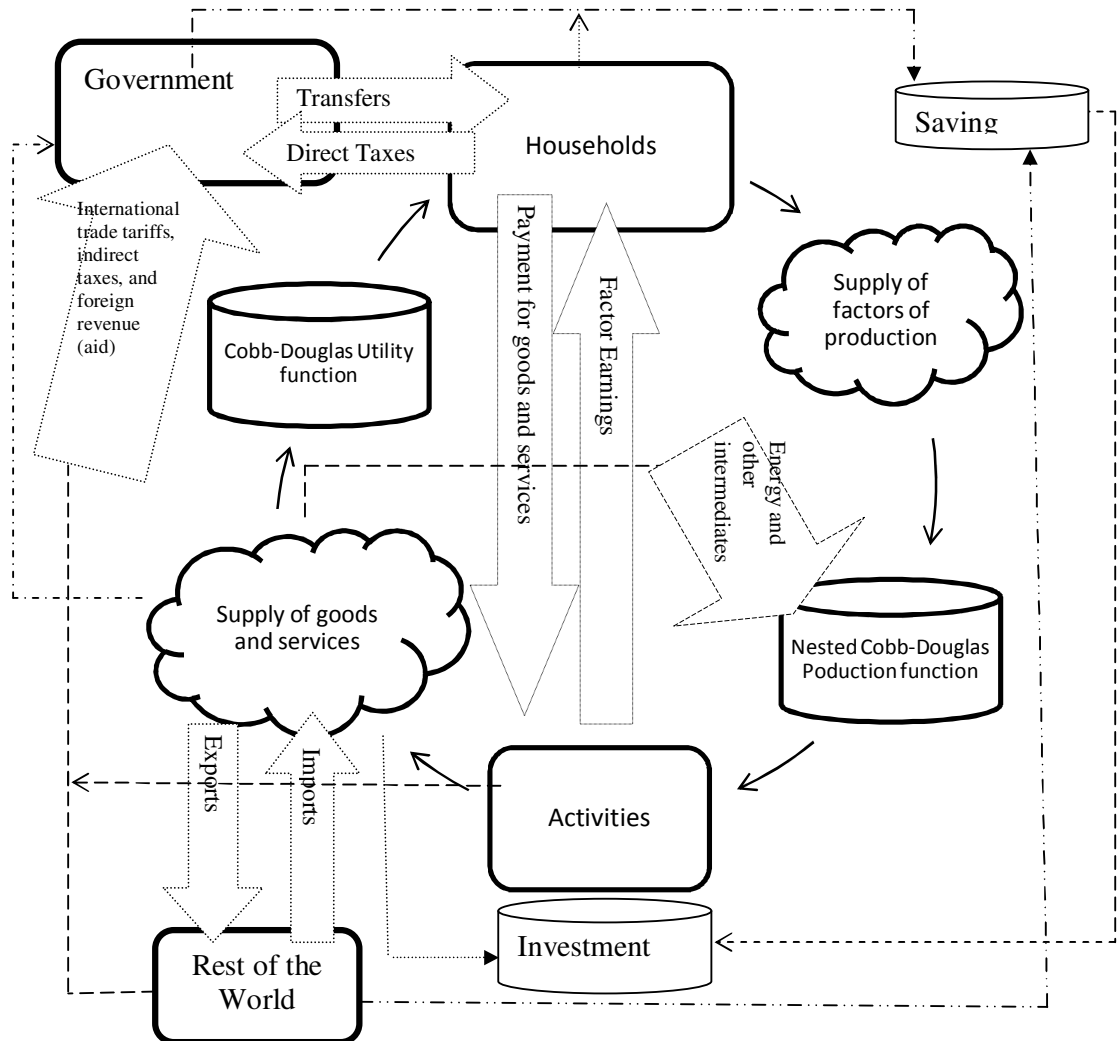
a) Household behaviour

Households have uniform Cobb-Douglas preferences that differ only in expenditure shares. The objective of each household h is to maximize utility U^h from the consumption of goods and services subject to resource constraint:

$$\max U^h(c) = \prod_{i=1}^{n} c_i^{\gamma_{ih}} \quad s.t. \quad y^h = pc^h \tag{A1}$$

Where $c = (c_1, c_2, \ldots, c_n)$ is a vector of goods and services, $p = (p_1, p_2, \ldots, p_n)$ is a goods prices corresponding to vector c, γ_{ih} is the share of commodity i in household $h's$ expenditure and y^h is household $h's$ consumption expenditure.

Household consumption expenditure depends on factor earnings, savings, transfers to the rest of the world, transfers from the government and direct taxes paid by the household. Factor earnings by household h, denoted y_h^F depend on initial endowment of factors of production,

$$y_h^F = \sum_f \left(r_f \times \iota_f^h \times SS^f \right) \tag{A2}$$

Where r_f is the price of factor, is f, SS^f the total supply of factor f and ι_f^h is the share of household $h's$ endowment of factor f. Factor earnings are taxable and household $h's$ direct tax obligation is given as:

$$DTAX^h = \tau_h^d y_h^F \tag{A3}$$

Where τ_h^d is the direct tax rate on household h.

Household saving are also a function of factor earnings, and exogenous transfers from government:

$$S^h = s_h \times \left(y_h^F + TR_h^G \right) \tag{A4}$$

Where s_h is household $h's$ marginal propensity to save out of factor earnings and exogenous transfers from government, TR_h^G.

In Lofgren (2001), capital factor earnings were first distributed to enterprises and then transferred to households and the rest of the world. In this study, all capital earnings are transferred directly to households which then pass on the earnings to the rest of the world. For simplicity, household transfers to the rest of the world are fixed at the initial level and are thus treated as exogenous. As a consequence, household $h's$ disposable income is given as:

$$y_h^d = \left(1 - \tau_h^d - s_h\right)y_h^F + \left(1 - s_h\right)TR_h^G - BOP^h \qquad\qquad A5$$

Where BOP^h is household $h's$ transfers to the rest of the world.

b) Production activities and commodities

Production activities have nested Cobb-Douglas production technology for aggregating inputs at two levels, the energy aggregation stage and the output aggregation stage (equations 5.1 and 5.4 in the text). Government imposes indirect taxes on production activities on ad valorem basis and the tax obligation for sector j is calculated as follows:

$$CTAX_j = \tau_j^c \times p_j \times Q_j \qquad\qquad A6$$

Where τ_j^c is the tax rate on activity j and Q_j is gross output.

c) International trade

Malawi is a small open economy that cannot influence international market prices for its exports and imports. Thus, import and export prices in local currency are respectively a function of foreign prices and the exchange rate:

$$p_j^m = EXR \times P_j^{Wm} \qquad\qquad A7$$

$$p_j^x = EXR \times P_j^{Wx} \qquad\qquad\text{A8}$$

Where p_j^m and p_j^x are local currency prices of imports and exports, respectively, EXR is the exchange rate, P_j^{Wm} and P_j^{Wx} are, respectively, the exogenous import and export prices in foreign currency units.

Import demand and export supply functions are also a function of local currency prices and the exchange rate:

$$C_j^M = \overline{C}_j^M \times \left(\frac{p_j^m}{EXR} \right) \qquad\qquad\text{A9}$$

$$C_j^X = \overline{C}_j^X \left(\frac{EXR}{p_j^x} \right) \qquad\qquad\text{A10}$$

Where C_j^M and C_j^X are import demand and export supply values, respectively, while $\overline{C}_j^M$ and $\overline{C}_j^X$ are initial import demand and export supply values, respectively.

The other exchanges between the rest of the world and local institutions include foreign savings and foreign direct transfers to government. Thus, the balance of payments equation is specified as:

$$\sum_h BOP^h = \sum_j \left(C_j^X - C_j^M \right) + \left(S^F + EXR \times R^{FG} \right) \qquad\qquad\text{A11}$$

Where S^F and R^{FG} are foreign savings and foreign direct transfers to government, respectively.

d) Government

Government consumes goods and services in fixed proportion depending on indirect taxes, direct taxes, import tariffs, transfers from the rest of the world, government savings and government transfers to households.

$$G_j = \eta_j \times \left[\sum_j CTAX_j + \sum_j MTAX_j + \sum_h \left(DTAX^h - TRANS^h \right) + EXR \times R^{FG} - S^G \right]$$

A12

Where G_j is government consumption of the jth commodity, η_j is the share of the jth commodity in government expenditure, S^G is government saving, and the import tariff on commodity j is given as:

$$MTAX_j = \tau_j^m \times p_j^m \times C_j^M$$

A13

Where τ_j^m is import tariff rate on commodity j.

Government saving is a function of the marginal propensity to save out of the net revenue from taxes, foreign direct transfers and government transfers to households:

$$S^G = s_g \left[\sum_j \left(\tau_j^c \times p_j \times Q_j \right) + \sum_j \left(\tau_j^m \times p_j^m \times C_j^M \right) + \sum_h \left(\tau_h^d y_h^F - TRANS^h \right) + EXR \times R^{FG} \right]$$

A14

Where s_g is the government's marginal propensity to save.

e) Investment behaviour

Investment for the jth activity is a function of a fixed share of investment expenditure and supply of loanable funds which consists of household savings, government saving and foreign savings:

$$I_j = \omega_j \times \left[S^G + \sum_h S^h + \left(EXR \times R^{FG} \right) \right] \qquad \text{A15}$$

Where I_j and ω_j are investment demand and share of commodity j in investment expenditure, respectively.

f) Market clearing conditions

i. Goods market equilibrium

The goods market is in equilibrium when for each product, the sum of net domestic production and net imports are equal to the sum of household consumption demand, intermediate demand, investment demand and net exports:

$$p_j \left(1 + \tau_j^c \right) \times Q_j = \sum_h C_j^h + I_j + G_j + \sum_i ID_{ji} + p_j^x C_j^X - p_j^m \left(1 + \tau_j^m \right) C_j^M \qquad \text{A16}$$

Where ID_{ji} is intermediate demand for sector $j's$ output.

ii. Factor market equilibrium

Since production activities have constant returns to scale technology, implying that factors are paid their marginal products, demand for factor f is by sector j is given as:

$$Z_f^j = \frac{\alpha_f^j \times \left(p_j \times Q_j \right)}{r_f} \qquad \text{A17}$$

Where Z_f^j is the quantity of factor f and α_f^j is the Cobb-Douglas elasticity of output with respect to the factor.

It is assumed that households will supply more factors for higher factor prices, and that there is no unemployment (except voluntary unemployment). The economy is therefore at full

employment and as such factor markets are in equilibrium when the sum of factor demands by production sectors is equal to the supply of factors by households:

$$\sum_j Z_f^j = SS^f$$ A18

APPENDIX B: GENERAL EQUILIBRIUM RESULTS

Table B 1: Change (%) in household utility

Household category	Benchmark Utility value	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Representative household (fictitious utility):	3787.7	-0.4	-1.1	1.0	1.0	0.7	1.1
Rural agriculture less than 0.5 ha landholding	343.9	-0.7	-1.2	0.9	1.1	0.8	1.0
Rural agriculture between 0.5 ha and 1.0 ha landholding	426.8	-0.9	-1.6	0.9	1.6	1.3	1.1
Rural agriculture between 1.0 ha and 2.0 ha landholding	500.5	-0.9	-1.5	0.8	1.1	0.7	1.0
Rural agriculture between 2.0 ha and 5.0 ha landholding	303.7	-0.8	-1.4	0.7	6.9	7.5	2.2
Rural agriculture more than 5.0 ha landholding	161.0	0.3	0.0	1.0	2.3	2.3	1.3
Rural non-agriculture no education	119.9	-0.3	-1.2	1.7	-0.4	-1.2	1.3
Rural non-agriculture low education	172.4	-0.4	-1.1	1.6	-0.5	-1.1	1.2
Rural non-agriculture medium education	336.0	-0.6	-1.1	0.8	-0.3	-0.8	0.7
Rural non-agriculture high education	61.3	-0.7	-0.7	-0.6	0.4	0.6	-0.3
Urban agriculture	209.2	0.2	-0.1	0.8	2.3	2.3	1.2
Urban non-agriculture no education	45.0	1.0	0.7	2.0	1.1	0.8	1.8
Urban non-agriculture low education	192.0	-0.3	-1.3	1.8	-0.8	-1.8	1.3
Urban non-agriculture medium education	388.9	0.0	-0.7	1.5	-0.3	-1.0	1.2
Urban non-agriculture high education	527.2	-0.2	-0.8	1.0	-0.5	-1.1	0.8

Note: SIM1 = Simulation 1   No revenue neutrality = When environmental revenues are not recycled
SIM2 = Simulation 2   Reduced direct taxes = When environmental tax revenues are used to reduce direct taxes
SIM3 = Simulation 3

Table B 2: Changes (%) in relative factor prices

Relative Factor Prices	Benchmark	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
No education agricultural labour	1	0.0	0.0	0.0	0.0	0.0	0.0
No education non-agricultural labour	1	1.0	1.0	1.3	0.1	0.0	1.0
Low education agricultural labour	1	0.0	0.0	0.0	0.0	0.0	0.0
Low education non-agricultural labour	1	0.8	0.7	1.3	-0.1	-0.2	1.0
Medium education agricultural labour	1	0.0	0.0	0.0	0.0	0.0	0.0
Medium education non-agricultural labour	1	0.2	0.4	0.0	-0.8	-0.7	-0.2
High education agricultural labour	1	0.0	0.0	0.0	0.0	0.0	0.0
High education non-agricultural labour	1	-0.7	-0.1	-1.7	-1.6	-1.2	-1.7
Small-scale land	1	-0.3	-0.2	-0.4	-0.3	-0.2	-0.4
Large-scale land	1	0.8	0.8	0.7	0.6	0.6	0.6
Capital agricultural small-scale	1	-0.2	-0.3	0.0	-0.1	-0.2	0.0
Capital agriculture large-scale	1	1.1	1.1	0.7	0.6	0.6	0.6
Capital non-agriculture	1	-0.4	-1.0	0.8	-1.5	-2.3	0.3

Table B 3: Changes (%) in savings and investment

	Benchmark Value (Million MKW)	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Government Saving	**2946.24**	-20.5	-14.9	-30.3	-27.9	-23.9	-30.2
Foreign Saving	**3964.00**	0.0	0.0	0.0	0.0	0.0	0.0
Household saving:	**351.66**	-0.2	-0.2	0.0	-0.1	-0.2	0.0
Rural agriculture more than 5.0 ha landholding	7.47	0.1	0.1	0.0	1.4	1.6	0.3
Rural non-agriculture high education	6.27	-0.6	0.0	-1.5	-0.3	0.3	-1.3
Urban agriculture	1.25	0.1	0.2	-0.1	1.5	1.9	0.3
Urban non-agriculture low education	32.87	-0.3	-0.8	0.8	-1.3	-2.0	0.4
Urban non-agriculture medium education	115.35	0.0	-0.3	0.5	-1.0	-1.4	0.2
Urban non-agriculture high education	188.45	-0.3	-0.5	0.0	-1.3	-1.6	-0.2
Investment	**7261.90**	-7.0	-5.0	-10.2	-9.7	-8.3	-10.2

Table B 4: Changes (%) in production by sector

SECTOR	Benchmark	No revenue neutrality			Reduced direct taxes		
		Sim 1	Sim 2	Sim 3	Sim 1	Sim 2	Sim 3
Maize (only small-scale)	5095.4	-0.9	-0.6	-1.2	-1.0	-0.7	-1.2
Tea and coffee	2308.6	5.2	5.1	5.3	5.3	5.2	5.2
Sugar growing (only large-scale)	260.9	-3.8	-2.2	-6.5	-5.6	-4.3	-6.5
Tobacco growing	8680.4	1.5	1.6	0.9	1.6	1.8	1.0
Fisheries	335.7	0.2	0.2	0.6	1.3	1.5	0.8
Livestock and poultry	1532.3	-2.9	-3.6	-1.1	-2.2	-2.8	-1.3
Forestry	662.2	1.4	1.8	0.5	0.8	1.2	0.5
Other crops	9078.6	0.3	0.1	0.6	0.6	0.5	0.7
Mining	707.9	-2.2	-3.8	3.6	-1.7	-3.1	2.7
Meat products	1653.0	-1.9	-3.0	0.6	-0.4	-1.2	0.5
Dairy products	528.1	1.1	1.3	0.8	2.1	2.4	1.1
Grain milling	7625.9	-0.3	-0.3	-0.2	0.7	0.9	0.0
Bakeries and confectioneries	423.9	-4.4	-5.6	0.5	-3.1	-4.0	-0.2
Sugar production	1601.8	-0.5	-0.7	0.6	1.1	1.2	0.6
Beverages and tobacco	3066.1	-7.3	-9.6	1.9	-5.5	-7.4	-0.1
Textiles and wearing apparel	2300.6	9.0	6.5	13.3	10.6	8.6	13.1
Wood products and furniture	1874.9	3.4	4.0	2.4	3.8	4.4	2.7
Paper and printing	1858.2	-7.2	-3.5	-13.5	-9.8	-6.6	-13.2
Chemicals	2159.1	14.1	17.5	8.9	12.2	15.3	9.6
Soaps, detergents and toiletries	1741.1	-32.1	-57.2	3.5	-32.7	-57.8	-2.2
Rubber products	448.8	44.5	42.1	53.6	47.5	46.1	53.2
Non-metallic mineral products	503.9	5.8	-2.7	33.0	3.7	-4.4	28.6
Fabricated metal products	1988.5	13.2	15.3	9.7	11.4	13.2	10.2
Plant and machinery	1173.4	116.0	111.3	123.8	116.5	112.1	124.0
Electricity and water	2862.1	3.8	4.8	2.6	2.4	3.1	2.6
Construction	3226.3	-8.6	-7.0	-11.1	-11.2	-10.1	-11.2
Oil distribution	583.8	3.6	3.7	3.8	3.8	3.9	3.8
Agricultural distribution	3331.6	4.4	4.5	3.8	4.6	4.8	3.9
Other distribution	8323.4	2.2	2.0	2.8	2.4	2.2	2.7
Hotels, bars, and restaurants	2774.6	-5.2	-5.2	-4.5	-5.0	-4.9	-4.7
Telecom and transportation	3417.9	-0.3	1.9	-4.8	-0.6	1.5	-4.0
Banking and insurance	2461.8	4.0	4.2	2.4	5.3	5.8	2.9
Business services	1396.3	-19.4	-12.8	-31.6	-25.8	-20.6	-30.9
Public services	6203.8	-1.6	-0.9	-2.8	-0.7	0.0	-2.3
Personal and social services	2164.0	-4.0	-3.0	-5.9	-5.0	-4.2	-5.7

Table B 5: Changes (%) in household disposable income

	Benchmark value (million MKW)	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Representative household disposable income:	**46340.66**	**0.1**	**0.1**	**0.2**	**0.8**	**0.9**	**0.3**
Rural agriculture less than 0.5 ha landholding	3430.05	0.1	0.2	0.1	1.4	1.7	0.4
Rural agriculture between 0.5 ha and 1.0 ha landholding	3916.99	0.1	0.2	0.1	2.2	2.5	0.6
Rural agriculture between 1.0 and 2.0 ha landholding	4630.19	0.1	0.1	0.1	1.6	1.8	0.4
Rural agriculture between 2.0 ha and 5.0 ha landholding	3164.07	-0.1	-0.1	-0.1	7.2	8.3	1.6
Rural agriculture more than 5.0 ha landholding	1743.92	0.1	0.1	0.0	1.4	1.7	0.3
Rural non-agriculture no education	1360.13	0.6	0.6	0.8	0.1	0.0	0.7
Rural non-agriculture low education	1700.29	0.5	0.5	0.8	0.0	-0.2	0.6
Rural non-agriculture medium education	4114.42	0.1	0.3	0.0	-0.1	0.0	0.0
Rural non-agriculture high education	833.03	-0.6	0.0	-1.5	0.0	0.6	-1.2
Urban agriculture	3044.10	0.1	0.2	-0.1	1.6	1.9	0.3
Urban non-agriculture no education	700.44	0.7	0.7	0.8	0.1	0.0	0.7
Urban non-agriculture low education	2813.49	-0.3	-0.9	0.9	-1.4	-2.2	0.5
Urban non-agriculture medium education	6325.66	0.0	-0.3	0.5	-1.0	-1.4	0.2
Urban non-agriculture high education	8563.88	-0.3	-0.5	0.0	-1.3	-1.7	-0.2

Table B 6: Changes (%) in sectoral output and GDP

		No revenue neutrality			Reduced direct taxes		
	Benchmark Value (Million MKW)	SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Total domestic output	**94354.7**	**-0.3**	**-0.3**	**0.4**	**-0.8**	**-0.9**	**0.2**
Mining	707.9	0.7	0.7	0.6	0.8	0.9	0.6
Agriculture	27954.0	5.0	3.2	8.5	5.3	3.7	8.1
Manufacturing	28947.3	-2.2	-3.8	3.6	-1.7	-3.1	2.7
Services	30657.1	-0.5	0.2	-1.9	-0.6	0.1	-1.7
Utilities	2862.1	3.8	4.8	2.6	2.4	3.1	2.6
Construction	3226.3	-8.6	-7.0	-11.1	-11.2	-10.1	-11.2
Real GDP	**53676.09**	0.31	0.22	0.45	0.31	0.23	0.45

Table B 7: Changes (%) in non-environmental tax revenue and government consumption

		No revenue neutrality			Reduced direct taxes		
	Benchmark Value (Million MKW)	SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Government Revenue	8628.67	6.4	7.3	0.4	6.1	6.8	1.8
Government Consumption	7198.55	-19.8	-14.3	-29.3	-26.7	-22.6	-29.1

Table B 8: Net environmental revenue from environmental regulation

		No revenue neutrality			Reduced direct taxes		
	Benchmark Value (Million MKW)	SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Total net revenue from environmental regulation:	**0.00**	**293.6**	**390.3**	**-259.6**	**323.4**	**408.0**	**-128.8**
Total emission tax revenue	0.00	555.7	649.3	0.0	579.33	659.56	123.45
Total biomass tax revenue	0.00	6.8	12.6	0.0	6.86	12.60	12.81
Subsidy on hydroelectricity	0.00	-268.9	-271.5	-259.6	-262.78	-264.20	-265.02

Table B 9: Changes (%) in relative commodity prices

		No revenue neutrality			Reduced direct taxes		
Relative Commodity Prices	Benchmark	SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Maize (only small-scale)	1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3
Tea and coffee	1	-1.1	-1.1	-1.3	-1.8	-1.9	-1.4
Sugar growing (only large-scale)	1	-2.2	-2.2	-2.3	-2.8	-2.9	-2.4
Tobacco growing	1	-0.2	-0.2	-0.2	-0.9	-1.0	-0.4
Fisheries	1	-0.1	0.0	-0.4	-0.3	-0.2	-0.4
Livestock and poultry	1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1
Forestry	1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Other crops	1	0.0	0.0	0.0	-0.1	-0.1	0.0
Mining	1	1.9	2.4	0.2	1.0	1.4	0.3
Meat products	1	0.3	0.4	-0.1	0.0	0.0	-0.1
Dairy products	1	-0.5	-0.7	-0.2	-1.4	-1.6	-0.5
Grain milling	1	-0.1	-0.1	-0.2	-0.4	-0.4	-0.3
Bakeries and confectioneries	1	1.5	1.8	-0.1	0.8	1.0	0.1
Sugar production	1	0.2	0.2	-0.2	-0.8	-0.9	-0.3
Beverages and tobacco	1	5.0	6.9	-1.8	4.3	5.8	-0.4
Textiles and wearing apparel	1	-1.5	-1.0	-2.4	-2.2	-1.8	-2.4
Wood products and furniture	1	-2.5	-2.5	-2.3	-3.1	-3.3	-2.5
Paper and printing	1	-0.5	-0.7	-0.4	-1.5	-1.8	-0.6
Chemicals	1	-2.6	-2.6	-2.8	-3.5	-3.6	-3.0
Soaps, detergents and toiletries	1	16.7	29.3	-1.9	16.7	29.0	1.0
Rubber products	1	-2.0	-1.9	-2.7	-2.9	-2.9	-2.8
Non-metallic mineral products	1	-0.5	1.2	-5.7	-1.0	0.4	-5.0
Fabricated metal products	1	-3.1	-3.2	-3.1	-4.0	-4.3	-3.3

Relative Commodity Prices	Benchmark	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Plant and machinery	1	-5.9	-6.1	-5.7	-6.7	-7.0	-5.9
Electricity and water	1	-2.7	-2.6	-3.1	-3.6	-3.6	-3.2
Construction	1	0.5	1.2	-1.2	-0.4	0.2	-1.1
Oil distribution	1	0.8	0.9	0.2	-0.2	-0.3	0.1
Agricultural distribution	1	0.0	0.0	0.1	-0.9	-1.1	-0.1
Other distribution	1	-0.5	-0.6	-0.1	-1.5	-1.7	-0.4
Hotels, bars, and restaurants	1	0.3	0.5	-0.4	-0.6	-0.5	-0.4
Telecom and transportation	1	-0.6	-0.7	-0.4	-1.6	-1.9	-0.7
Banking and insurance	1	-0.6	-0.6	-0.4	-1.6	-1.8	-0.7
Business services	1	-0.3	-0.3	-0.2	-1.3	-1.5	-0.4
Public services	1	-0.6	-0.4	-0.7	-1.5	-1.5	-0.8
Personal and social services	1	-0.1	0.0	-0.1	-1.0	-1.1	-0.3
Exchange rate	1	0.2	0.2	0.0	-0.5	-0.6	-0.1

Table B 10: Shadow prices of carbon emissions and biomass fuel, hydropower subsidy and equivalent percentage changes in carbon emissions, fuelwood demand and hydroelectricity demand

	Benchmark values	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Tax on carbon emissions in Million MKW per Megaton	**0.00**	**1.72**	**2.15**	**0.00**	**1.79**	**2.18**	**0.36**
Tax (%) on fuelwood per Megaton	**0.00**	**13.0**	**24.0**	**0.0**	**13.0**	**24.0**	**24.0**
Subsidy (%) on hydropower per Mega-Btu	**0.00**	**-12.5**	**-12.5**	**-12.2**	**-12.5**	**-12.5**	**-12.5**
Total carbon emissions (Megatons)	343.52143	-6.0	-12.0	1.1	-6.0	-12.0	0.0
Total fuelwood demand (Megatons)	53.49462	-1.6	-2.2	0.1	-1.3	-1.9	-0.2
Total hydroelectricity demand (Mega-Btu)	173.61	5.6	4.9	7.5	6.0	5.5	7.3

Table B 11: Total environmental improvement in terms of carbon emissions abated

Total Environmental Improvements:	Benchmark Value in Megatons of Carbon	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Direct carbon abatement	0.00	-20.6	-41.2	3.6	-20.6	-41.2	0.0
Biomass use forgone	0.00	-0.9	-1.2	0.1	-4.6	-6.4	-0.8
Total net carbon abated	0.00	-21.0	-41.8	3.7	-22.9	-44.4	-0.4

Table B 12: Changes (%) in aggregate industrial carbon emissions

Industry	Benchmark value in Megatons	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Mining	7.90	-0.5	-0.8	0.8	-0.4	-0.7	0.6
Agriculture	1.53	0.1	0.1	0.1	0.2	0.2	0.1
Manufacturing	316.32	-6.5	-13.0	1.2	-6.5	-13.0	0.0
Services	7.88	0.9	1.0	0.9	1.0	1.0	0.9
Construction	9.89	-1.8	-1.4	-2.3	-2.4	-2.1	-2.4

Table B 13: Changes (%) in sectoral carbon emissions

Production Activity	BENCHMARK Value in Megatons	No revenue-neutral			Reduced direct taxes		
		SIM1	SIM2	SIM3	SIM1	SIM2	SIM3
Tea and coffee	0.28	0.4	0.4	0.4	0.4	0.4	0.4
Sugar growing (only large-scale)	0.03	-0.8	-0.4	-1.3	-1.1	-0.9	-1.3
Tobacco growing	0.51	0.2	0.2	0.1	0.2	0.2	0.1
Fisheries	0.53	0.0	0.0	0.1	0.2	0.2	0.1
Livestock and poultry	0.18	-0.4	-0.5	-0.1	-0.3	-0.4	-0.2
Mining	7.90	-0.5	-0.8	0.8	-0.4	-0.7	0.6
Meat products	5.23	-0.2	-0.4	0.1	-0.1	-0.2	0.1
Grain milling	6.73	0.0	0.0	0.0	0.0	0.1	0.0
Bakeries and confectioneries	4.10	-1.0	-1.3	0.1	-0.7	-0.9	0.0
Sugar production	0.10	-0.1	-0.1	0.1	0.2	0.2	0.1
Beverages and tobacco	116.68	-1.8	-2.4	0.4	-1.4	-1.8	0.0
Textiles and wearing apparel	2.95	1.0	0.8	1.5	1.2	1.0	1.5
Paper and printing	3.50	-2.7	-1.3	-5.2	-3.7	-2.5	-5.0
Chemicals	2.60	1.5	1.9	1.0	1.3	1.7	1.1
Soaps, detergents and toiletries	148.35	-13.1	-26.4	1.2	-13.4	-26.8	-0.8
Rubber products	2.87	15.1	14.4	17.8	16.0	15.6	17.7
Non-metallic mineral products	16.44	0.5	-0.2	2.5	0.3	-0.4	2.2
Fabricated metal products	3.26	2.5	2.9	1.8	2.2	2.5	1.9
Plant and machinery	3.51	13.7	13.3	14.4	13.7	13.4	14.4
Construction	9.89	-1.8	-1.4	-2.3	-2.4	-2.1	-2.4
Oil distribution	2.95	1.2	1.2	1.2	1.2	1.3	1.2
Agricultural distribution	4.04	1.2	1.3	1.1	1.3	1.4	1.1
Other distribution	0.89	-1.2	-1.2	-1.0	-1.2	-1.2	-1.1
TOTAL	**343.52**	**-6.0**	**-12.0**	**1.5**	**-6.0**	**-12.0**	**1.5**

Table B 14: Changes (%) in aggregate biomass fuel demand

Industry	Benchmark value in Megaton	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Agriculture	11.03	0.2	0.2	0.2	0.2	0.2	0.2
Manufacturing	42.46	-2.1	-2.9	0.1	-1.8	-2.4	-0.3

Table B 15: Changes (%) in aggregate hydropower demand

Industry	Benchmark value in Mega-Btu	No revenue neutrality			Reduced direct taxes		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Mining	11.87	-0.5	-0.8	0.8	-0.4	-0.7	0.6
Agriculture	11.54	0.1	0.1	0.1	0.2	0.2	0.1
Manufacturing	137.20	7.0	6.2	9.4	7.6	6.9	9.1
Services	10.48	0.9	0.9	0.9	0.9	0.9	0.9
Construction	2.53	-1.8	-1.4	-2.3	-2.4	-2.1	-2.4

Table B 16: Changes (%) in sectoral demand for biomass fuel

Production Activity	Benchmark Value in Megatons	No revenue-neutral			Recycled to Direct Tax		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Tea and coffee	3.12	0.4	0.4	0.4	0.4	0.4	0.4
Sugar growing (only large-scale)	0.41	-0.8	-0.4	-1.3	-1.1	-0.9	-1.3
Tobacco growing	7.50	0.2	0.2	0.1	0.2	0.2	0.1
Sugar production	1.48	-0.1	-0.1	0.1	0.2	0.2	0.1
Beverages and tobacco	37.27	-1.8	-2.4	0.4	-1.4	-1.8	0.0
Paper and printing	2.62	-2.7	-1.3	-5.2	-3.7	-2.5	-5.0
Soaps, detergents and toiletries	1.05	-13.1	-26.4	1.2	-13.4	-26.8	-0.8
Fabricated metal products	0.03	2.5	2.9	1.8	2.2	2.5	1.9
TOTAL	**53.49**	**-1.6**	**-2.2**	**0.1**	**-1.3**	**-1.9**	**-0.2**

Table B 17: Changes (%) in sectoral demand for hydropower in Btu

	Benchmark value in Mega-Btu	No revenue-neutral			Recycled to Direct Tax		
		SIM 1	SIM 2	SIM 3	SIM 1	SIM 2	SIM 3
Tea and coffee	3.19	0.4	0.4	0.4	0.4	0.4	0.4
Sugar growing (only large-scale)	0.29	-0.8	-0.4	-1.3	-1.1	-0.9	-1.3
Tobacco growing	5.25	0.2	0.2	0.1	0.2	0.2	0.1
Fisheries	0.99	0.0	0.0	0.1	0.2	0.2	0.1
Livestock and poultry	1.82	-0.4	-0.5	-0.1	-0.3	-0.4	-0.2
Mining	11.87	-0.5	-0.8	0.8	-0.4	-0.7	0.6
Meat products	1.02	-0.2	-0.4	0.1	-0.1	-0.2	0.1
Grain milling	4.61	0.0	0.0	0.0	0.0	0.1	0.0
Bakeries and confectioneries	1.38	-1.0	-1.3	0.1	-0.7	-0.9	0.0
Sugar production	1.32	-0.1	-0.1	0.1	0.2	0.2	0.1
Beverages and tobacco	35.40	-1.8	-2.4	0.4	-1.4	-1.8	0.0
Textiles and wearing apparel	1.29	1.0	0.8	1.5	1.2	1.0	1.5
Paper and printing	1.42	-2.7	-1.3	-5.2	-3.7	-2.5	-5.0
Chemicals	3.22	1.5	1.9	1.0	1.3	1.7	1.1
Soaps, detergents and toiletries	2.75	-13.1	-26.4	1.2	-13.4	-26.8	-0.8
Rubber products	67.30	15.1	14.4	17.8	16.0	15.6	17.7
Non-metallic mineral products	12.10	0.5	-0.2	2.5	0.3	-0.4	2.2
Fabricated metal products	2.89	2.5	2.9	1.8	2.2	2.5	1.9
Plant and machinery	2.50	13.7	13.3	14.4	13.7	13.4	14.4
Construction	2.53	-1.8	-1.4	-2.3	-2.4	-2.1	-2.4
Oil distribution	0.60	1.2	1.2	1.2	1.2	1.3	1.2
Agricultural distribution	5.21	1.2	1.3	1.1	1.3	1.4	1.1
Other distribution	4.24	0.6	0.6	0.8	0.6	0.6	0.7
Hotels, bars, and restaurants	0.43	-1.2	-1.2	-1.0	-1.2	-1.2	-1.1
TOTAL	**173.61**	**5.6**	**4.9**	**7.5**	**6.0**	**5.5**	**7.3**

Table B 18: Changes in labour intensive and capital intensive sectoral outputs

Sector	Share of labour in value added	Share of capital in value added	Benchmark output in MKW million	Non revenue-neutral Average output Simulations 1 & 2	% Change in Output	Distributed to households Average output Simulations 1 & 2	% Change in output
Forestry	0.8	0.2	662.2	672.6	1.6	668.8	1.0
Public services	0.8	0.2	6203.8	6126.2	-1.3	6179.8	-0.4
Fisheries	0.8	0.2	335.7	336.5	0.2	340.5	1.4
Non-metallic mineral products	0.8	0.2	503.9	511.6	1.5	502.3	-0.3
Mining	0.8	0.2	707.9	686.5	-3.0	690.8	-2.4
Wood products and furniture	0.7	0.3	1874.9	1944.4	3.7	1951.2	4.1
Hotels, bars, and restaurants	0.7	0.3	2774.6	2630.7	-5.2	2636.8	-5.0
Banking and insurance	0.6	0.4	2461.8	2561.9	4.1	2597.5	5.5
Oil distribution	0.6	0.4	583.8	604.9	3.6	606.4	3.9
Personal and social services	0.6	0.4	2164.0	2087.9	-3.5	2064.8	-4.6
Livestock and poultry	0.6	0.4	1532.3	1482.6	-3.2	1493.8	-2.5
Other distribution	0.6	0.4	8323.4	8501.7	2.1	8514.4	2.3
Other crops	0.6	0.1	9078.6	9098.4	0.2	9130.6	0.6
Agricultural distribution	0.6	0.4	3331.6	3479.9	4.4	3488.5	4.7
Business services	0.6	0.4	1396.3	1171.5	-16.1	1072.4	-23.2
Maize (only small-scale)	0.6	0.0	5095.4	5057.6	-0.7	5052.3	-0.8
Telecom and transportation	0.5	0.5	3417.9	3444.3	0.8	3433.1	0.4
Total output for labour intensive sectors			**50448.1**	**50399.2**	**-0.1**	**50423.7**	**0.0**
Change (overall)				**-48.9**		**-24.4**	
Plant and machinery	0.5	0.5	1173.4	2506.6	113.6	2514.6	114.3
Electricity and water	0.4	0.6	2862.1	2984.8	4.3	2940.9	2.8
Construction	0.4	0.6	3226.3	2975.5	-7.8	2883.8	-10.6
Bakeries and confectioneries	0.4	0.6	423.9	402.9	-5.0	408.9	-3.5
Fabricated metal products	0.4	0.6	1988.5	2272.0	14.3	2233.4	12.3
Textiles and wearing apparel	0.4	0.6	2300.6	2478.9	7.8	2520.7	9.6
Grain milling	0.4	0.6	7625.9	7602.3	-0.3	7686.4	0.8
Sugar production	0.4	0.6	1601.8	1592.4	-0.6	1619.7	1.1
Meat products	0.4	0.6	1653.0	1612.1	-2.5	1639.4	-0.8
Dairy products	0.4	0.6	528.1	534.5	1.2	539.9	2.2
Chemicals	0.3	0.7	2159.1	2500.0	15.8	2456.3	13.8
Tobacco growing	0.3	0.4	8680.4	8817.4	1.6	8828.8	1.7
Tea and coffee	0.3	0.4	2308.6	2427.2	5.1	2429.2	5.2
Sugar growing (only large-scale)	0.2	0.5	260.9	252.9	-3.0	248.0	-4.9
Soaps, detergents and toiletries	0.2	0.8	1741.1	964.0	-44.6	952.5	-45.3
Beverages and tobacco	0.2	0.8	3066.1	2806.9	-8.5	2867.6	-6.5
Paper and printing	0.1	0.9	1858.2	1758.5	-5.4	1705.1	-8.2
Rubber products	0.1	0.9	448.8	643.1	43.3	658.7	46.8
Total output for capital intensive sectors			**43906.6**	**45132.0**	**2.8**	**45133.9**	**2.8**
Change (overall)				**1225.3**		**1227.3**	

Table B 19: Export supply and import demand (%) changes

Sector/Flows		Non revenue-neutral			Distributed to households		
Export Supply:	*Benchmark Values*	*SIM 1*	*SIM 2*	*SIM 3*	*SIM 1*	*SIM 2*	*SIM 3*
Maize (only small-scale)	128.9	1.5	1.5	1.1	-0.7	-1.1	0.6
Tea and coffee	1659.4	5.4	5.2	5.5	5.5	5.4	5.5
Tobacco growing	8579.6	1.6	1.7	0.9	1.7	1.9	1.0
Fisheries	20.5	1.1	0.8	1.7	-0.9	-1.3	1.1
Livestock and poultry	0.4	0.9	0.9	0.4	-1.2	-1.5	0.0
Other crops	2005.5	0.6	0.6	0.0	-1.5	-1.8	-0.3
Grain milling	32.4	1.2	1.1	1.0	-0.5	-0.8	0.6
Sugar production	550.1	0.0	-0.2	0.8	1.2	1.3	0.8
Beverages and tobacco	121.5	-17.2	-22.9	7.5	-17.0	-21.9	1.2
Textiles and wearing apparel	608.2	6.9	5.0	10.1	7.0	5.3	9.7
Wood products and furniture	75.9	11.2	11.6	9.8	11.4	11.9	10.2
Paper and printing	141.7	2.7	3.5	1.5	4.2	5.3	1.8
Chemicals	38.2	11.9	11.8	12.3	13.2	13.3	12.6
Soaps, detergents and toiletries	84.7	-45.8	-64.0	8.0	-47.1	-64.7	-4.2
Rubber products	347.4	9.1	8.5	11.6	10.2	9.9	11.5
Non-metallic mineral products	9.5	2.8	-3.9	26.3	2.3	-3.8	22.2
Fabricated metal products	13.2	14.3	14.8	13.4	15.7	16.5	14.0
Plant and machinery	419.4	28.3	29.3	26.2	29.5	30.8	27.2
Hotels, bars and restaurants	756.1	-0.5	-1.4	1.5	0.5	-0.2	1.2
Telecom and transportation	885.5	3.2	3.6	1.7	4.7	5.4	2.2
Banking and insurance	1224.5	3.1	3.2	1.8	4.5	4.9	2.3
Business services	319.3	1.9	2.1	0.7	3.4	3.8	1.2
Total Exports	*18021.9*	*2.0*	*0.6*	*6.6*	*2.1*	*0.9*	*5.6*
Import Demand:	*Benchmark Values*	*SIM 1*	*SIM 2*	*SIM 3*	*SIM 1*	*SIM 2*	*SIM 3*
Maize (only small-scale)	1774.2	-1.5	-1.5	-1.1	0.7	1.1	-0.6
Tea and coffee	8.4	-5.1	-5.0	-5.3	-5.2	-5.1	-5.2
Fisheries	6.1	-1.1	-0.8	-1.7	0.9	1.3	-1.1
Livestock and poultry	4.3	-0.8	-0.9	-0.4	1.2	1.5	0.0
Other crops	59.3	-0.6	-0.6	0.0	1.6	1.8	0.3
Meat products	696.7	0.7	1.0	-0.5	1.9	2.2	0.0
Dairy products	125.8	-2.7	-3.3	-0.9	-3.5	-4.3	-1.4
Grain milling	471.8	-1.1	-1.1	-1.0	0.5	0.8	-0.6
Bakeries and confectioneries	157.2	5.3	6.7	-0.4	5.4	6.6	0.8
Sugar production	189.2	0.0	0.2	-0.8	-1.2	-1.3	-0.8
Beverages and tobacco	159.5	20.8	29.7	-7.0	20.5	28.0	-1.2
Textiles and wearing apparel	1615.7	-6.4	-4.7	-9.2	-6.6	-5.0	-8.8
Wood and furniture	262.5	-10.1	-10.4	-9.0	-10.2	-10.6	-9.3
Paper and printing	729.8	-2.7	-3.4	-1.5	-4.0	-5.1	-1.8
Chemicals	3597.0	-10.7	-10.5	-10.9	-11.7	-11.8	-11.2
Soaps, detergents and toiletries	275.4	84.4	177.6	-7.4	89.2	183.7	4.4
Rubber products	852.2	-8.4	-7.8	-10.4	-9.2	-9.0	-10.3
Non-metallic mineral products	458.6	-2.7	4.1	-20.8	-2.2	4.0	-18.2
Fabricated metal products	1335.6	-12.5	-12.9	-11.8	-13.6	-14.2	-12.3
Plant and machinery	4671.8	-22.1	-22.7	-20.8	-22.8	-23.5	-21.4
Hotels, bars and restaurants	1712.8	0.5	1.5	-1.5	-0.5	0.2	-1.2
Telecom and transportation	2025.7	-3.1	-3.5	-1.6	-4.5	-5.1	-2.2
Banking and insurance	1695.7	-3.0	-3.1	-1.8	-4.3	-4.7	-2.3
Business services	857.8	-1.9	-2.0	-0.7	-3.3	-3.7	-1.2
Total Imports	**23743.0**	**0.6**	**5.3**	**-5.3**	**0.8**	**5.3**	**-4.4**

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