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MACRO POLICIES AND THE FOOD SECTOR IN BANGLADESH: A GENERAL EQUILIBRIUM ANALYSIS

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Abstract

Trade liberalization in the early 1990s in Bangladesh has enabled the private sector to respond with market-stabilizing inflows of rice and wheat following major production shortfalls. At the same time, easing of restrictions on foreign investment, combined with substantial depreciation of the Taka, have enabled exports of the labor-intensive ready-made garment industry to expand significantly. Moreover, recently discovered natural gas resources might be exploited, creating new revenues for the country. A proper assessment of the impact of such policies and economic developments on the poor requires a comprehensive framework to analyze interactions between different sectors, and linkages between macro and micro levels. In this paper we develop a computable general equilibrium model (CGE) with special treatment of the rice and wheat sectors, and we use it to simulate the impact of (i) a decline in rice production due to floods, (ii) a cut in food aid of wheat, and (iii) increased revenues from the exploitation of natural gas resources. The results suggest that most households benefit from more liberalized rice and wheat trade, particularly after rice production shocks. Impacts of a decline in wheat food aid are relatively modest, as food aid imports are not large enough to have major macroeconomic effects. The simulations of natural gas export revenues suggest that the extent of disincentives to agriculture will depend on whether or not the resulting real exchange rate appreciation is sufficient to lower the import parity price of rice enough so that domestic prices are affected. Finally, all three simulations show that the effects of economic shocks on women's labor and female headed poor households can differ significantly from the effects on men's labor and other households.

[1] An earlier version of this paper was presented at the third annual FMRSP (Food Management and Research Support Project) workshop, held in Dhaka on February 6, 2001.

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1. Introduction

Many of the policy measures affecting the welfare of the poor during the 1990s in Bangladesh involved external trade and investment. Trade liberalization in the early 1990s has enabled the private sector to respond with market-stabilizing inflows of rice and wheat following major production shortfalls. At the same time, easing of restrictions on foreign investment, combined with substantial depreciation of the Taka, have enabled exports of the labor-intensive ready made garment industry to expand significantly. A proper assessment of the impact of these policies on the poor requires a comprehensive framework to analyze interactions between different sectors, and linkages between macro and micro levels.

The objective of this paper is to provide such framework by constructing a computable general equilibrium (CGE) model of Bangladesh. The model is designed to capture important features of the rice and wheat sectors and is used to analyze the impact of external shocks and domestic policy changes on the food sector. It is based on a 1993-94 social accounting matrix (SAM) which distinguishes two different kind of rice technology and has fairly disaggregated labor markets and socio-economic groups, permitting detailed analysis of household welfare and poverty.

The paper is organized as follows. Section 2 provides a brief description of the SAM and discusses the specific features of the applied model of Bangladesh. Section 3 reports the results of a series of model simulations and section 4 concludes.

2. Data and model

Computable general equilibrium (CGE) models are economywide models that are extensively used for policy analysis in developing countries. The applied Bangladesh model[1] presented in this paper was constructed with the objective of analyzing the impact of some external shocks on the food sector. Its foreign sector is modeled so that a regime

[1] A complete mathematical model statement, based on Löfgren (2001), is provided in Appendix 1. SAM and model are implemented in the GAMS software and are available on request from the authors.

switch between tradability and non-tradability for rice and wheat is allowed, reflecting the specific features that these two sectors have in Bangladesh. It is our plan to develop the model further for analyses in a wider range of areas, including other trade and tax policies, as well as gender issues.

2.1. The Bangladesh 1993-94 SAM[2]

The model is based on a 1993-94 social accounting matrix (SAM) for Bangladesh, which uses a 1993-94 IO table (BIDS 1998) and some information from another SAM[3] (Khondaker 1999), while further developing its labor market features and household structure.[4] A cross entropy estimation method was applied to balance the original SAM (Robinson, Cattaneo and El-Said 2001). Figure 1 shows the disaggregation of factors, households, and activities in the SAM and the model.

Employment in the SAM is measured in hours[5] and includes both paid employment and non-paid employment. Female working hours constitute about 24 percent of total hours spent in market activities, mostly in agriculture (66 percent), where women constitute the vast majority of unpaid household labor, personal and household services (12 percent), where women work as maids, and textiles (8 percent), the ready made garment factories. Male hours are more spread than female hours across sectors, but mainly concentrated in agriculture (44 percent), trade (20 percent) and transports (8 percent). Female wages are lower than male wages in all educational categories in each activity, but the gap is smaller in the ready made garment sector, which is by far the most female intensive sector in the economy. More than half of the workforce in agriculture does not have any

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[2] The SAM was built as part of a collaboration between IFPRI and a DFID-funded IDS project, coordinated by Adrian Wood, in which Marzia Fontana was the main researcher. A full documentation of the SAM is forthcoming in Fontana and Wobst (2001).

[3] We would like to thank Bazlul Haque Khondaker for sharing with us all his data and work.

[4] The main source for the income generation and distribution processes from activities to factors and from factors to household was a recent labor force survey (BBS 1995).

[5] Measuring employment in hours is useful in that it allows us to take into account more accurately differences in time spent in market activities by different labor categories (which is particularly relevant for gender analysis), or even by the same labor category in different activities. It also allows us to record people involved in more than one activity, both in the market and in the non-market sphere, an possibly to capture underemployment, which is widespread in Bangladesh.

education, while financial services is the sector with the highest proportion of highly educated workers.

Figure 1: Disaggregation of factors, institutions, and activities

Set	Elements
Labor (8)	• Female (four categories according to educational level: no, low, medium, and high) • Male (four categories according to educational level: no, low, medium, and high)
Other factors (2)	• Land (only in agriculture) • Non-agricultural capital
Households (9)	• Rural agricultural (three land holding sizes: < 0.5 ha, 0.5-2.49, and > 2.5 ha) • Rural non-agricultural (three categories according to land ownership and gender of the household's head) • Urban (three categories according to the educational level of the household's head: no and low ed, medium, and high)
Other institutions (3)	• Enterprises • Government • Rest of the world
Agricultural activities (10)	• Crops (*Aman*, *Boro*, Grains, Jute, Commercial crops, Other crops) • Non-crop (Fishing, Livestock, Poultry, Forestry)
Non-agricultural activities (32)	• Industry (Rice milling, Ata & flour, Food, Tobacco, Leather, Jute textiles, Yarn, Mill clothing, Garments, Other textiles, Wood & paper, Chemicals, Fertilizers, Petroleum, Clay, Steel, Machinery, Other industries) • Services (Electricity & water, Urban building, Rural building, Construction, Trade, Transport, Communications, Hotels, Housing, Health, Education, Public administration, Financial services, Other personal services)

Income distribution is quite unequal: urban educated household receive 28 percent of total income but constitute only 7 percent of the total working population, while landless and marginal farmers receive only 5 percent of total income despite comprising 18 percent of the working population. These latter households derive their income exclusively from labor, mostly uneducated labor (about 70 percent), while, by contrast, about 70 percent of the urban educated households' income comes from capital. Small farmers and large farmers are the only groups receiving income from land.[6]

2.2. Modeling framework and system constraints

CGE models provide a comprehensive account of the circular flow of payments in the economy, describing a simultaneous general equilibrium in all markets. They are particularly useful in analyzing linkages between different producing sectors, and between macro and micro levels. Moreover, CGE models allow assessment of the disaggregated impact of changes in policies and exogenous shocks on sectoral structure, household welfare, and income distribution.

Like most other CGE models, the applied Bangladesh CGE model is solved in a comparative static mode. It provides a simulation laboratory for controlled experiments, changing policies and other exogenous conditions, and measuring the impact of these changes. Each solution provides a full set of economic indicators, including household incomes; prices, supplies, and demands for factors and commodities (including foreign trade); and macroeconomic data. Most of the model parameters are set endogenously in a manner that assures that the base solution to the model exactly reproduces the values in the SAM—the model is "calibrated" to the SAM. The remaining parameters— a set of production, income, and trade elasticities — are set exogenously. The model is structured in the tradition of trade-focused CGE models of developing countries described in Dervis, de Melo, and Robinson (1982).

The rest of this section explains how the model treats production, domestic institutions (households, enterprises, and the government), the rest of the world and foreign trade. The so-called system constraints (the markets for commodities and factors, and macro balances for savings-investment and the current account of the rest of the world) are also described.

[6] This was the choice we had to make, due to time constraints. However it would be possible to construct a more realistic map of the allocation of land. Data indicate that non-agricultural households, and even some urban households, own land.

Production Activities

The activities are the production sectors that receive their revenue from selling the commodities they produce. These revenues are used to pay for the production inputs: purchases of intermediate inputs and payments of wages (or rents) to primary factors. The model assumes that the activities maximize profits subject to production functions with neoclassical substitutability for factors and fixed coefficients for intermediate inputs.[7] Each activity in the model produces a single commodity.[8] In most cases, the activity is the sole producer of its commodity. The only exception is the commodity paddy which is produced by two activities (associated with different production technologies representing *aman* and *boro* cropping). *Aman* constitutes about 44 percent of total rice production, is rain-fed and slightly more labour intensive than *boro*, which is an irrigated crop with higher fertilizer inputs and higher yields.[9]

Domestic Institutions

The factor incomes generated in the production process are paid in fixed shares to the enterprises (for capital) and the households (for labor and land). The enterprises, which are the owners of the stocks of capital, use part of their incomes to pay direct taxes and save; remaining enterprise incomes are split in fixed shares among the households. The households receive the bulk of their incomes from the factors (labor, land, and capital) they own (either directly or indirectly, via the enterprises). They use these incomes to pay taxes, save, and consume (according to demand functions derived from utility maximization).[10]

As part of its current operations, the government receives direct taxes (from households and enterprises) and indirect taxes (import tariffs and sales taxes). The government uses this revenue to buy a fixed consumption bundle (including the services of the government

[7] Substitutability between factors is modeled with CES (constant elasticity of substitution) functions which permit the specification of activity-specific substitution elasticities over a wider range of values.
[8] The model can also handle the case where activities produce more than one commodity but this phenomenon is not represented in the Bangladesh SAM.
[9] The relatively small non-irrigated *aus* season rice crop is also included in *boro*.
[10] For household consumption, the demand functions are of the LES (linear expenditure system) type.

bureaucrats), transfer money to households, and save. The nominal value of the transfers is indexed to the consumer price index (CPI) of the model. Government savings represent the surplus between government revenues, on the one hand, and transfers and consumption expenditures, on the other hand.[11]

System constraints: markets and macro balances

The real and nominal flows that were described above may be seen as driven by decisions made by individual agents (households, enterprises, and the government). In addition, the model has to specify mechanisms through which the modeled economy satisfies real and nominal system-wide constraints that are not considered by the individual agents. The real constraints represent the domestic commodity and factor markets; the nominal constraints represent two macro balances: the current account balance of the rest of the world and the savings-investment balance. The mechanisms through which these constraints are met are often referred to as "closure rules" of the model.

The supply in each commodity market is a composite of imports and domestic output sold domestically. The demand consists of final demands (for consumption and investment) and intermediate demands (from the production activities). Variations in the price of domestic output supplied to the domestic market assure equilibrium in the domestic output market, while variations in import quantities assure equilibrium in the market for imported commodities.

For factor markets, the model generally assumes that total quantities supplied are fixed, while the prices of the factors (their wages or rents) equilibrate the sectoral quantities demanded with these supply quantities, *i.e.*, factors are mobile among productive sectors.[12] Given the rather short-term nature of the analysis, as well as the comparative

[11] In addition, the model assumes that the government investment/development budget is part of overall private investment operations. Therefore, the over-all budget deficit (covering both government current and investment operations) may be computed as the difference between government investment and government savings.

[12] The model permits the user to impose alternative specifications with unemployment of selected factors (at fixed wages) and different degrees of mobility of a given factor between different activities (*e.g.*, fixing the quantities of land demanded by different cropping activities as in our Bangladesh case).

static approach, this treatment applies to all eight labor categories in our Bangladesh model, but not to the two non-labor factors, land and non-agricultural capital. Instead, sectoral demand for land and capital is fixed and the markets equilibrate through explicit distortion factors that allow for price differentials among land (capital) rents in different sectors, *i.e.*, land and capital are immobile among productive sectors.

In the current account balance of the rest of the world, the basic assumption is that foreign savings (the current account deficit) are fixed; the exchange rate (the price of foreign exchange) is the equilibrating variable. Given that all non-trade items (transfers to or from domestic institutions) are fixed, fixing foreign savings is equivalent to fixing the trade deficit.

For the savings-investment balance, the model treats the investment decision as given: the economy allocates fixed quantities of a set of commodities for investment purposes. Given this, the value of savings has to adjust to assure that it equals the investment value. The basic approach is to let the marginal propensity to save vary for the domestic non-government institutions.

2.3 Special treatment of foreign trade

Imperfect substitutability of foreign trade

In our model, the rest of the world pays transfers to households that are fixed in foreign currency. In addition, the rest of the world supplies imports and demands exports. The export and import quantities are endogenous to the model: it is assumed that Bangladesh is able to export or import any desired quantity at international prices that are fixed in foreign currency (the "small-country" assumption).

For most commodities, the model also assumes that there are quality differences between commodities that enter foreign trade and those that are produced for domestic use. On the domestic demand side, these quality differences are captured by the assumption of imperfect substitutability between imports and domestic output supplied to the domestic market (in a manner that parallels the way in which capital and labor typically are treated as imperfect substitutes in production). More specifically, if a commodity is imported, all domestic demands—household and government consumption, investment demand, and intermediate demand—are for the same composite commodity. The optimal ratio between the quantities of imports and domestic output that make up each composite commodity is determined by the relative prices of imports and domestic output—the so-called Armington assumption (Armington 1969). Similarly, on the domestic production side, quality differences are captured by the assumption of imperfect transformability between domestic output that is exported and sold domestically. According to this formulation, the export/domestic sales ratio for domestic output is influenced by the relevant relative prices.

This treatment of domestic demand and production grants the domestic price system a certain realistic degree of independence from international prices, and dampens export and import responses to relative price changes. The degree of demand and supply response to changes in these relative prices (and the degree of independence of the domestic prices system from international prices) depends on the values of the set of CES and CET trade elasticities specified.

Regime switch between tradability and non-tradability for rice and wheat

Import and export behavior is specified differently for two commodities in the model: rice and wheat. In the 1993-94 base data, rice is not internationally traded, while one third of total grain consumption (mostly wheat) is imported as food aid through government interventions. For these two commodities the Armington specification would not be appropriate for several reasons. First, if a commodity is not traded in the base data (as it is the case for rice) it will always remain a non-tradable in the standard CGE[13], and there would be no way of inducing imports. Second, if a commodity is traded, its composition is directly determined through the relative price of its domestic demand component over

[13] In addition, if the share of imports in the composite commodity is small, the absolute value of change will be small compared to the total demand value of the composite good, even when the substitution elasticity is very high.

the domestic price of its import component. Moreover, an Armington specification does not allow for any market imperfections or government interventions—like government imports of food aid, which are observed in Bangladesh's wheat market.

To allow a regime switch between non-tradability and tradability we have incorporated a treatment of perfect substitutability into our Bangladesh model. The Armington function is thus replaced by the following quantity equation for the commodities that should be perfect substitutes:

$$QQ_c = QD_c + QM_c \qquad c \in CPS \qquad (1)$$

$$\begin{bmatrix} composite \\ commodity \\ c \end{bmatrix} = \begin{bmatrix} domestic \\ supply \\ of\ c \end{bmatrix} + \begin{bmatrix} imports \\ of\ c \end{bmatrix}$$

where

$c \in C$	set of commodities
$c \in CPS (\subset C)$	set of imported commodities with perfect substitutability
QQ_c	quantity of composite commodity c
QD_c	quantity of domestic supply of commodity c
QM_c	quantity of imports of commodity c

In addition, a wedge is defined between the demand price of domestic supply, PDD_C, and the domestic import price (import parity price), PM_C, and an inequality condition between these two prices is imposed.[14]

$$PM_c \geq PDD_c \qquad c \in CPS \qquad (2)$$

$$\begin{bmatrix} domestic\ import \\ (parity)\ price \\ of\ c \end{bmatrix} = \begin{bmatrix} demand\ \ price\ of \\ domestic\ supply \\ of\ c \end{bmatrix}$$

[14] Which changes the non-linear programming problem into a mixed-complementarity problem.

where

PM_c domestic price of import c

PDD_c demand price of domestic supply c

The inequality is associated with the quantity value of imports: as long as PDD_C is less than PM_C imports, QM_C, are zero; as soon as PDD_C equals PM_C imports become perfect substitutes with domestic supply and equation (1) applies. The initial wedge between PDD_C and PM_C can be interpreted as a non-tariff trade barrier imposed by the government through import regulations. Though the government may seek to protect the domestic rice and grain markets during a regular year from foreign food influx, it may well encourage foreign imports during deficit years when self-sufficiency in food supply is not given—as in the case of a flood. This issue is the object of one of our main simulations in this paper.

The export side of commodities with perfect substitutability is treated in an analogous fashion, substituting the constant elasticity of transformation (CET) function that usually determines the split of total sectoral output into exports and domestic supply as imperfect substitutes by the following quantity equation;

$$QX_c = QD_c + QE_c$$

$$\begin{bmatrix} output \\ of\ c \end{bmatrix} = \begin{bmatrix} domestic \\ supply \\ of\ c \end{bmatrix} + \begin{bmatrix} exports \\ of\ c \end{bmatrix} \qquad c \in CPS \qquad (3)$$

where

QX_c quantity of output of commodity c

QE_c quantity of exports of commodity c

and establishing a wedge between domestic supply price, PDS_C, and domestic export (parity) price, PE_C, as well as an inequality between these two prices:

$$PDS_c \geq PE_c$$

$$\begin{bmatrix} \textit{domestic supply} \\ \textit{price of } c \end{bmatrix} = \begin{bmatrix} \textit{domestic export} \\ (\textit{parity}) \textit{ price} \\ \textit{of } c \end{bmatrix} \qquad c \in CPS \qquad (4)$$

where

PE_c domestic price of export c

PDS_c domestic supply price of commodity c

As long as the domestic supply price, PDS_C, exceeds the domestic export (parity) price, PE_C, no commercial exports occur; as soon as the two prices are equal, domestic supply, QD_C, and exports, QE_C, will behave as perfect substitutes.

To eliminate the second undesired effect of the Armington specification—the continuous substitution of domestic supply and imports with respect to their relative prices described above—the model defines an additional government import variable QMG_C and a commercial import variable QMC_C, and introduces the following equality:

$$QM_c = QMC_c + QMG_c$$

$$\begin{bmatrix} \textit{total} \\ \textit{imports} \\ \textit{of } c \end{bmatrix} = \begin{bmatrix} \textit{commercial} \\ \textit{imports} \\ \textit{of } c \end{bmatrix} + \begin{bmatrix} \textit{government} \\ \textit{imports} \\ \textit{of } c \end{bmatrix} \qquad c \in CM \qquad (5)$$

where

$c \in CM (\subset C)$ set of imported commodities c

QMC_c quantity of commercial imports of commodity c

QMG_c quantity of government imports of commodity c

To account for food aid operations controlled by the government, the government import variable, QMG_C, can be fixed at any desired level while the commercial import variable, QMC_C, adjusting to satisfy equation (5). In the base run of the applied CGE model of

Bangladesh, QMG_C for the commodity grains is fixed at the initial total import level, while private imports of grains are initialized at zero.

Furthermore, the Bangladesh model allows for a combination of the two features, *i.e.*, fixed government imports in the grain sector, while the sector is modeled with perfect substitutability for commercial imports. In this market environment, if the domestic price is below import parity, a *marginal* reduction of government imports would not lead to an increase in commercial imports to substitute for the decrease of imports in this sector. However, a *gradual* reduction of government imports will cause the domestic demand price to increase and to converge towards the domestic import (parity) price. If the quantity reduction is large enough the import parity price will be reached and the commercial imports will be treated as perfect substitute with domestic supply of grains. This too will be simulated in one of the experiments described in the following section.

3. Simulation results

In this section we describe three possible shocks and policy changes, mainly focusing on the effects in the rice and wheat sectors. In each case, we concentrate on what happens to food production and demand, and to the welfare[15] of different socio-economic groups.

3.1 Rice production decline due to floods

Bangladesh is a country prone to floods, which cause severe damages to the agricultural sector with serious implications for poverty. To simulate the effects of a flood we model a 9 percent decline in (total factor) productivity in the rice sector, both the rain-fed *aman* sector and the irrigated *boro*[16], which account for 44 percent and 56 percent respectively of total paddy production in the 1993-94 base data. The simulation is run under two different trade regimes: in the first scenario, market-clearing domestic prices for rice are lower than import prices and hence private sector rice imports are not occurring (as is the

[15] Real private consumption is used as welfare measure in all experiments, which is appropriate in a model setting where all prices adjust relative to the fixed consumer price index, CPI.
[16] Because floods in Bangladesh generally damage only the monsoon season *aman* crop, adaptations of the model specification, with consideration of seasonality, are planned.

case in the base 1993-94 SAM), while in the second scenario, import parity does hold, and imports are allowed to come in.

Under the first scenario, the productivity decline in rice reduces its output by 4.1 percent (6.1 percent for *aman* and 2.6 percent for *boro*). Production declines by less than 10 percent because higher producer prices provide incentives for increased production (implicitly on non-flood affected fields). Labor demanded by the *aman* and *boro* increases by 6.5 and 15.7 percent, respectively, to compensate for the loss in total factor productivity. The consumer price of rice increases by 13.4 percent due to the reduction of rice supply. Consumer prices of most other commodities decline. However, households reduce consumption of other goods so as to minimize reductions in their consumption of rice.[17]

Table 1 - Rice production and demand

		(percentage changes from base case levels)	
	Base case (Taka bn 1993 prices)	**No import parity** (%)	**Import parity** (%)
***Aman* production**	85.0	-6.1	-6.5
***Boro* production**	108.1	-2.6	-3.6
Total production	193.1	-4.1	-4.9
Consumer price	1.0	13.4	10.5
Rural demand	149.8	-3.9	-3.2
Urban demand	69.6	-5.1	-4.3
Imports*	0.0	0.0	1.6

* as share of total consumption in the base case
Source: Model simulations

Gross domestic product declines by 1 percent, as productivity in the rice sector, and thus the economy overall, has declined. Due to this decline in national income the demand for imports decreases by 0.5 percent; consequently the real exchange rate appreciates by 3 percent and total exports decrease by 0.8 percent. Returns to land increase significantly

[17] Since consumer demand for rice is price-inelastic, the value of total expenditures on rice rises when the price of rice increases, leaving less resources for consumption of other commodities.

(by 16 percent). Despite the quantity of rice produced declines by 4 percent, its value increases by about 18 percent due to the price rise, which translates into much higher returns to the fixed factor (land), while wages decline. Women's wages fall more than men's wages. Demand for rice declines slightly more in the urban areas (5 percent) than in the rural areas (4 percent) where households increase slightly their consumption of wheat (by 1 percent), while in urban areas wheat consumption also declines.

In terms of households' welfare, the only two groups which clearly benefit from the shock are medium and large farmers. These average gains in welfare for the two groups of farmers mask implicit differences between farmers who suffer crop losses due to the flood and farmers not directly affected by flood waters, who enjoy the benefits of higher producer prices of rice without a crop productivity decline. Real private consumption increases, especially for large farmers (by 9 percent). The marginal farmers and poor rural woman headed households are badly hit (both experience a decline in consumption of about 5 percent). This is likely to exacerbate income inequality in the rural areas. Urban households are also negatively affected although by a lesser extent (a decline in private consumption of about 3 percent).

Table 2 - Private consumption by household

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	**No import parity** (%)	**Import parity** (%)
Landless and marginal	72.5	-5.3	-4.5
Small farmers	133.7	3.5	2.8
Large farmers	138.5	9.4	7.5
Non-ag rural female poor	10.1	-6.1	-5.1
Non-ag rural male poor	118.8	-4.7	-4.1
Non-ag rural rich	77.3	-6.1	-5.1
Urban low educated	130.8	-3.4	-3.0
Urban medium educated	119.4	-4.0	-3.4
Urban highly educated	272.3	-2.7	-2.4

Source: Model simulations

Under the second scenario, when rice imports are allowed, domestic prices of rice rise only to the import parity level, increasing by 10.5 percent instead of 13.4 percent as in the first scenario. Given the relatively less favorable price incentives, domestic production of rice declines more than in the first scenario: *aman* declines by 6.5 percent and *boro* decline by 3.6 percent. Private sector rice imports equal to 3.6 billion Taka (2 percent of base year consumption) help to raise the total import bill by 2.0 percent. Thus a mild depreciation of the real exchange rate (by 0.1 percent) is required to encourage more exports to finance the rice imports.[18] As a consequence, there is some moderate output increase in the most export-oriented sectors such as ready made garments (which was declining instead in the first scenario), although the overall decline in GDP is the same as in the first scenario. Returns to land increase less (by 13 percent instead of 16 percent) and there is no deterioration in female/male relative wages (largely because of the moderate increase in the garment sector, which is by far the most female labor-intensive sector in the economy).

In terms of households' welfare, changes are similar to the first scenario, but smaller in magnitude. Medium and large farmers benefit less, while all other households are less negatively affected, resulting in smaller regressive overall effects. Thus the model simulations suggest that most households benefit from a policy of allowing private imports of rice, particularly after rice production shocks.

3.2 Cut in food aid

In this experiment, abolition of government (non commercial) imports of wheat is simulated under two different scenarios. In the first scenario, there is no corresponding change in foreign savings (suggesting that the government might keep receiving the same amount of foreign aid as before), while in the second scenario foreign savings are reduced by the same nominal amount as the cut in wheat imports.

In the first scenario, the decline in imports without offsetting change in foreign savings causes a slight appreciation of the exchange rate by 0.3 percent so that exports decline marginally in all sectors (by 0.4 percent on average). Food imports other than wheat increase and wheat imports decline only by about 9 percent, as most of private imports substitute for food aid. Demand for wheat flour slightly declines, less in rural (0.8

[18] Our model closure requires that the trade balance be restored.

percent) than in urban areas (1 percent). Domestic production of wheat increases (by 4.5 percent), while output in all other sectors declines, albeit very slightly. There is no much change in returns to factors nor is there any significant redistribution of welfare.

Under the second scenario, with an offsetting decline in foreign savings, the exchange rate depreciates by 3 percent causing exports to rise by 4 percent. The highest increases, although moderate, are in exports of agricultural product and light manufacturing. The decline in wheat imports (11.9 percent) is higher than in the first scenario (as devaluation discourages substitution of private imports for food aid). Imports of other agricultural products, as well as processed food and light manufacturing, decline, which was not the case in the first scenario. Domestic production of wheat increases more (by 5.4 percent instead of 4.5 percent). Production of jute and commercial crops (relatively more tradable) also increases, while rice production moderately declines. Because of the

Table 3 - Wheat production and demand

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	**Unchanged foreign savings** (%)	**Reduction in foreign savings** (%)
Wheat production	9.4	4.5	5.4
Prices	1.0	3.4	4.9
Rural demand	6.3	-0.8	-1.3
Urban demand	3.0	-1.0	-1.6
Food aid	4.7	0.0	0.0
Private imports*		45.5	44.1
Total imports	4.7	-9.1	-11.9

* as share of total consumption in the base case
Source: Model simulations

Overall, the elimination of wheat food aid does not cause a big negative shock at the sectoral or macro level. Private imports substitute for government imports to a certain extent so that wheat imports decrease by only 9 percent and 12 percent respectively, and domestic production of grains also increases.

Table 4 - Private consumption by household

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	Unchanged foreign savings (%)	Reduction in foreign savings (%)
Landless and marginal	72.5	0.0	-0.3
Small farmers	133.7	0.1	0.0
Large farmers	138.5	0.2	0.1
Non-ag rural female poor	10.1	-0.1	-0.2
Non-ag rural male poor	118.8	0.0	-0.3
Non-ag rural rich	77.3	-0.1	-0.8
Urban low educated	130.8	0.0	-0.5
Urban medium educated	119.4	-0.1	-0.5
Urban highly educated	272.3	-0.1	-0.6

Source: Model simulations

3.3 Increased foreign exchange inflow

Large resources of natural gas have been recently discovered in Bangladesh. Opinions differ as to the potential impact of investment in this new sector, including possible adverse effects resulting from Dutch disease, *i.e.*, an appreciation of the real exchange rate that adversely affects other tradable sectors. We simulate a rise in foreign savings by 100 percent, equal to about 11.5 percent of total exports in the base case (or about 1 percent of GDP). This causes an appreciation of the exchange rate by 7 percent. Exports decline by 11 percent, while imports increase by less than 1 percent. Exports fall especially in leather, jute-textile, and ready made garments, with thus negative effects for the emerging outward oriented textile industries. Imports increase by about 6 percent for agricultural products, processed food, and light manufacturing products, while they decline in mill clothing and other textiles (which are almost exclusively used as intermediate input by the ready made garments sector whose exports and output fall). As a result, output declines significantly in the garment industry (9 percent) but increases moderately in agriculture (grains, other crops, poultry), construction, and most services because of the rise in domestic demand resulting from the higher capital inflow. Rice production marginally increases and no imports occur, because its domestic price does not rise to import parity level. Households and government increase their consumption, financed through a reduction in domestic savings (which is not sustainable if increased foreign exchange influx is not permanent).

Table 5 – Rice production and demand

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	Two-fold increase in foreign savings (%)
***Aman* production**	85.0	0.2
***Boro* production**	108.1	0.4
Total production	193.1	0.3
Prices	1.0	0.4
Rural demand	149.8	0.3
Urban demand	69.6	0.4
Imports	0.0	0.0

Source: Model simulations

Table 6 – Wheat production and demand

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	Two-fold increase in foreign savings (%)
Wheat production	9.4	0.8
Prices	1.0	-0.6
Rural demand	6.3	0.5
Urban demand	3.0	0.7

Source: Model simulations

In terms of returns to factors, the average profit rate increases relative to land rental and wages. Moreover, the wage of women, relative to men, declines, as garments are being displaced by the gas sector. All socio-economic groups benefit from this shock in terms of their real consumption. However the greatest welfare gains are for the relatively well off, especially in urban areas.

Table 7 - Private consumption by household

(percentage changes from base case levels)

	Base case (Taka bn 1993 prices)	Two-fold increase in foreign savings (%)
Landless and marginal	72.5	0.6
Small farmers	133.7	0.4
Large farmers	138.5	0.6
Non-ag rural female poor	10.1	0.2
Non-ag rural male poor	118.8	0.6
Non-ag rural rich	77.3	1.4
Urban low educated	130.8	0.9
Urban medium educated	119.4	0.9
Urban highly educated	272.3	1.2

Source: Model simulations

4. Conclusions

The objective of this paper was to analyze the impact of different external shocks and policy changes on the rice and wheat sector in Bangladesh, using a computable general equilibrium (CGE) model. Further work is planned on both data and model specification, however some useful lessons can be drawn from our first results. We simulated the impact of (i) a decline in rice production due to floods, (ii) a cut in food aid of wheat, and (iii) increased revenues which might result from the exploitation of natural gas resources. The results suggest that most households benefit from more liberalized rice and wheat trade, particularly after rice production shocks. Impacts of a decline in wheat food aid are relatively modest, as food aid imports are not large enough to have major macroeconomic effects. The simulations of natural gas export revenues suggest that the extent of disincentives to agriculture will depend on whether or not the resulting real exchange rate appreciation is sufficient to lower the import parity price of rice enough so that domestic prices are affected. Finally, all three simulations show that the effects of economic shocks on women’s labor and female headed poor households can differ significantly from the effects on men’s labor and other households.

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APPENDIX

Table A.1: Mathematical summary statement for the Malawi CGE model

SETS

Symbol	Explanation	**Symbol**	Explanation
$a \in A$	activities	$c \in CMX(\subset CM)$	imported commodities with domestic production
$c \in C$	commodities	$c \in CMNX(\subset CM)$	imported commodities without domestic production
$c \in CX(\subset C)$	domestically produced commodities	$c \in CT(\subset C)$	domestic trade inputs (distribution commodities)
$c \in CE(\subset C)$	exported commodities (with domestic production)	$f \in F$	factors
$c \in CPS(\subset C)$	Perfect substitutes for both export and imports	$i \in I$	institutions (households, enterprises, government, and rest of world)
$c \in CNE(\subset C)$	non-exported commodities (with domestic production)	$i \in ID(\subset I)$	domestic institutions (households, enterprises, and government
$c \in CM(\subset C)$	imported commodities	$i \in IDNG(\subset ID)$	domestic non-government institutions (households and enterprises)
$c \in CNM(\subset C)$	non-imported commodities	$h \in H(\subset IDNG)$	households

PARAMETERS

aac_c	shift parameter for domestic commodity aggregation function	$qdst_c$	quantity of stock change
ad_a	efficiency parameter in the CES production function	$\overline{qg}_c$	base-year quantity of government demand
aq_c	Armington function shift parameter	$qginv_c$	quantity of government investment demand
at_c	CET function shift parameter	$\overline{qinv}_c$	base-year quantity of private investment demand
cpi	consumer price index	$shrtr_{ii'}$	share of domestic inst. i in income of domestic non-government inst. i’
$cwts_c$	weight of commodity c in the CPI	$shry_{if}$	share of domestic institution i in income of factor f
ica_{ca}	quantity of c as intermediate input per unit of activity a	ta_a	tax rate for activity a
$icd_{c'c}$	quantity of commodity *c’* as trade input per unit of *c* produced and sold domestically	te_c	export tax rate
$ice_{c'c}$	quantity of commodity *c’* as trade input per exported unit of *c*	tm_c	import tariff rate
$icm_{c'c}$	quantity of commodity *c’* as trade input per imported unit of *c*	tq_c	rate of sales tax
pwe_c	export price (foreign currency)	$\overline{tr}_{ii'}$	transfer from institution i to institution i’
pwm_c	import price (foreign currency)		

Greek Letters

α_{fa}	share of value-added to factor f in activity a	γ_{ch}	subsistence consumption of commodity c for household h
β_{ch}	marginal share of consumption spending of household on commodity c	θ_{ac}	yield of output c per unit of activity a

δ^{a}_{fa}	CES production function share parameter for factor f in activity a	ρ^{a}_{a}	CES production function exponent
δ^{ac}_{ac}	share parameter for domestic commodity aggregation function	ρ^{ac}_{c}	domestic commodity aggregation function exponent
δ^{q}_{c}	Armington function share parameter	ρ^{q}_{c}	Armington function exponent
δ^{t}_{c}	CET function share parameter	ρ^{t}_{c}	CET function exponent

EXOGENOUS VARIABLES

$\overline{FSAV}$	foreign savings (FCU)	$\overline{TY}_{i}$ or $\overline{TY}_{f}$	direct tax rate for domestic institution i or factor f
$\overline{GADJ}$	government consumption adjustment factor	$\overline{WFDIST}_{fa}$	wage distortion factor for factor f in activity a
$\overline{IADJ}$	investment adjustment factor		

ENDOGENOUS VARIABLES

EG	government expenditures	QF_{fa}	quantity demanded of factor f from activity a
EH_{h}	consumption spending for household	QG_{c}	government consumption demand for commodity
EXR	exchange rate (LCU per unit of FCU)	QH_{ch}	quantity consumed of commodity c by household h
$GOVSHR$	government consumption share in nominal absorption	$QINT_{ca}$	quantity of commodity c as intermediate input to activity a
$GSAV$	government savings	$QINV_{c}$	quantity of investment demand for commodity
$INVSHR$	investment share in nominal absorption	QM_{c}	quantity of imports of commodity
MPS_{i}	marginal propensity to save for domestic non-government institution	QMC_{c}	quantity of commercial imports of c
PA_{a}	activity price (unit gross revenue)	QMG_{c}	quantity of government imports of c
PDD_{c}	demand price for commodity produced and sold domestically	QQ_{c}	quantity of goods supplied to domestic market (composite supply)
PDS_{c}	supply price for commodity produced and sold domestically	QT_{c}	quantity of commodity demanded as trade input
PE_{c}	export price (domestic currency)	QX_{c}	aggregated quantity of domestic output of commodity
PM_{c}	import price (domestic currency)	$QXAC_{ac}$	quantity of output of commodity c from activity a
PQ_{c}	composite commodity price	$TABS$	total nominal absorption
PVA_{a}	value-added price (factor income per unit of activity)	$TR_{ii'}$	transfers from domestic non-government institution I' to domestic institution i
PX_{c}	aggregate producer price for commodity	WF_{f}	economy-wide factor wage
$PXAC_{ac}$	producer price of commodity c for activity a	YF_{if}	transfer of income to domestic institution i from factor f
QA_{a}	quantity (level) of activity	YG	government revenue
QD_{c}	quantity sold domestically of domestic output	YI_{i}	income of domestic non-government institution
QE_{c}	quantity of exports		

EQUATIONS*

#	Equation	Domain	Description
Price Block			
1	$PM_c = pwm_c \cdot (1+tm_c) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c}$ $\begin{bmatrix} import \\ price \\ (LCU) \end{bmatrix} = \begin{bmatrix} import \\ price \\ (FCU) \end{bmatrix} \cdot \begin{bmatrix} tariff \\ adjust- \\ ment \end{bmatrix} \cdot \begin{bmatrix} exchange\ rate \\ (LCU\ per \\ FCU) \end{bmatrix} + \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ import\ unit \end{bmatrix}$	$c \in CM$	Import Price
2	$PE_c = pwe_c \cdot (1-te_c) \cdot EXR - \sum_{c' \in CT} PQ_{c'} \cdot ice_{c'c}$ $\begin{bmatrix} export \\ price \\ (LCU) \end{bmatrix} = \begin{bmatrix} export \\ price \\ (FCU) \end{bmatrix} \cdot \begin{bmatrix} tax \\ adjust- \\ ment \end{bmatrix} \cdot \begin{bmatrix} exchange\ rate \\ (LCU\ per \\ FCU) \end{bmatrix} - \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ export\ unit \end{bmatrix}$	$c \in CE$	Export Price
3	$PM_c \geq PDD_c$ $\begin{bmatrix} domestic\ import \\ (parity)\ price \\ of\ c \end{bmatrix} = \begin{bmatrix} demand\ price\ of \\ domestic\ supply \\ of\ c \end{bmatrix}$	$c \in CPS$	Price inequality condition for imported perfect substitutes
4	$PDS_c \geq PE_c$ $\begin{bmatrix} domestic\ supply \\ price\ of\ c \end{bmatrix} = \begin{bmatrix} domestic\ export \\ (parity)\ price \\ of\ c \end{bmatrix}$	$c \in CPS$	Price inequality condition for exported perfect substitutes
5	$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c}$ $\begin{bmatrix} domestic \\ demand \\ price \end{bmatrix} = \begin{bmatrix} domestic \\ supply \\ price \end{bmatrix} + \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ unit\ of \\ domestic\ sales \end{bmatrix}$	$c \in CX$	Demand price of domestic non-traded goods
6	$PQ_c \cdot QQ_c = (PDD_c \cdot QD_c + PM_c \cdot QM_c) \cdot (1+tq_c)$ $\begin{bmatrix} absorption \end{bmatrix} = \left(\begin{bmatrix} domestic\ demand\ price \\ times \\ domestic\ sales\ quantity \end{bmatrix} + \begin{bmatrix} import\ price \\ times \\ import\ quantity \end{bmatrix} \right) \cdot \begin{bmatrix} sales\ tax \\ adjustment \end{bmatrix}$	$c \in C$	Absorption
7	$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_c \cdot QE_c$ $\begin{bmatrix} producer\ price \\ times\ domestic \\ output\ quantity \end{bmatrix} = \begin{bmatrix} domestic\ supply\ price \\ times \\ domestic\ sales\ quantity \end{bmatrix} + \begin{bmatrix} export\ price \\ times \\ export\ quantity \end{bmatrix}$	$c \in CX$	Domestic Output Value

8	$$PA_a = \sum_{c\in CX} PXAC_{a\,c} \cdot \theta_{a\,c}$$ $$\begin{bmatrix} activity \\ price \end{bmatrix} = \begin{bmatrix} producer\ prices \\ times\ yields \end{bmatrix}$$	$a\in A$	Activity Price
9	$$PVA_a = PA_a \cdot (1 - ta_a) - \sum_{c\in C} PQ_c \cdot ica_{c\,a}$$ $$\begin{bmatrix} value\text{-} \\ added \\ price \end{bmatrix} = \begin{bmatrix} activity \\ price \\ net\ of\ tax \end{bmatrix} - \begin{bmatrix} intermediate \\ input\ cost \\ per\ activity \\ unit \end{bmatrix}$$	$a\in A$	Value-added Price

Production and commodity block

10	$$QA_a = ad_a \cdot \left(\sum_{f\in F} \delta^a_{f\,a} \cdot QF_{f\,a}^{-\rho^a_a} \right)^{-\frac{1}{\rho^a_a}}$$ $$\begin{bmatrix} activity \\ level \end{bmatrix} = CES \begin{bmatrix} factor \\ inputs \end{bmatrix}$$	$a\in A$	Activity Production function
11	$$W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot ad_a \cdot \left(\sum_{f\in F} \delta^a_{fa} \cdot QF_{fa}^{-\rho^a_a} \right)^{-\frac{1}{\rho^a_a} - 1} \cdot \delta^a_{fa} \cdot QF_{fa}^{-\rho^a_a}$$ $$\begin{bmatrix} marginal\ cost \\ of\ factor\ f \\ in\ activity\ a \end{bmatrix} = \begin{bmatrix} marginal\ revenue \\ product\ of\ factor \\ f\ in\ activity\ a \end{bmatrix}$$	$a\in A$ $f\in F$	Factor Demand
12	$$QINT_{c\,a} = ica_{c\,a} \cdot QA_a$$ $$\begin{bmatrix} intermediate \\ demand \end{bmatrix} = f \begin{bmatrix} activity \\ level \end{bmatrix}$$	$a\in A$ $c\in C$	Intermediate Demand
13	$$QXAC_{a\,c} = \theta_{a\,c} \cdot QA_a$$ $$\begin{bmatrix} \text{activity-specific} \\ \text{production of} \\ \text{commodity c} \end{bmatrix} = f \begin{bmatrix} activity \\ level \end{bmatrix}$$	$a\in A$ $c\in CX$	Output Function
14	$$QX_c = aac_a \cdot \left(\sum_{a\in A} \delta^{ac}_{a\,c} \cdot QXAC_{a\,c}^{-\rho^{ac}_c} \right)^{-\frac{1}{\rho^{ac}_c - 1}}$$ $$\begin{bmatrix} aggregate \\ production\ of \\ commodity\ c \end{bmatrix} = CES \begin{bmatrix} activity\text{-}specific \\ production\ of \\ commodity\ c \end{bmatrix}$$	$c\in CX$	Output Aggregation Function

15	$PXAC_{a\,c} = PX_c \cdot aac_c \cdot \left(\sum_{a \in A} \delta_{a\,c}^{ac} \cdot QXAC_{a\,c}^{-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}}-1} \cdot \delta_{a\,c}^{ac} \cdot QXAC_{a\,c}^{-\rho_c^{ac}-1}$ $\left[\begin{matrix} \textit{marginal cost of} \\ \textit{commodity c} \\ \textit{from activity a} \end{matrix} \right] = \left[\begin{matrix} \textit{marginal revenue} \\ \textit{product of} \\ \textit{commodity c} \\ \textit{from activity a} \end{matrix} \right]$	$a \in A$ $c \in C$	First-Order Condition for Output Aggregation Function
16	$QQ_c = aq_c \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + (1-\delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$ $\left[\begin{matrix} \textit{composite} \\ \textit{supply} \end{matrix} \right] = f \left[\begin{matrix} \textit{import quantity, domestic} \\ \textit{use of domestic output} \end{matrix} \right]$	$c \in CMX$	Composite Supply (Armington) Function
17	$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}}$ $\left[\begin{matrix} \textit{import –} \\ \textit{domestic} \\ \textit{demand ratio} \end{matrix} \right] = f \left[\begin{matrix} \textit{domestic –} \\ \textit{import} \\ \textit{price ratio} \end{matrix} \right]$	$c \in CMX$	Import-Domestic Demand Ratio
18	$QQ_c = QD_c + QM_c$ $\left[\begin{matrix} \textit{composite} \\ \textit{commodity} \\ c \end{matrix} \right] = \left[\begin{matrix} \textit{domestic} \\ \textit{supply} \\ \textit{of } c \end{matrix} \right] + \left[\begin{matrix} \textit{imports} \\ \textit{of } c \end{matrix} \right]$	$c \in CPS$	Composite commodity aggregation for perfect substitutes
19	$QQ_c = QD_c$ $\left[\begin{matrix} \textit{composite} \\ \textit{supply} \end{matrix} \right] = \left[\begin{matrix} \textit{domestic use of} \\ \textit{domestic output} \end{matrix} \right]$	$c \in CNM$	Composite Supply for Non-Imported Commodities
20	$QQ_c = QM_c$ $\left[\begin{matrix} \textit{composite} \\ \textit{supply} \end{matrix} \right] = \left[\textit{imports} \right]$	$c \in CMNX$	Composite Supply for Non-Produced Imports
21	$QX_c = at_c \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1-\delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$ $\left[\begin{matrix} \textit{domestic} \\ \textit{output} \end{matrix} \right] = CET \left[\begin{matrix} \textit{export quantity, domestic} \\ \textit{use of domestic output} \end{matrix} \right]$	$c \in CE$	Output Transformation (CET) Function
22	$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1-\delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t-1}}$ $\left[\begin{matrix} \textit{export-} \\ \textit{domestic} \\ \textit{supply ratio} \end{matrix} \right] = f \left[\begin{matrix} \textit{export-} \\ \textit{domestic} \\ \textit{price ratio} \end{matrix} \right]$	$c \in CE$	Export-Domestic Supply Ratio

23	$QX_c = QD_c + QE_c$ $\begin{bmatrix} \text{output} \\ \text{of } c \end{bmatrix} = \begin{bmatrix} \text{domestic} \\ \text{supply} \\ \text{of } c \end{bmatrix} + \begin{bmatrix} \text{exports} \\ \text{of } c \end{bmatrix}$	$c \in CPS$	Domestic sales and export supply for perfect substitutes
24	$QX_c = QD_c$ $\begin{bmatrix} \text{domestic} \\ \text{output} \end{bmatrix} = \begin{bmatrix} \text{domestic sales of} \\ \text{domestic output} \end{bmatrix}$	$c \in CNE$	Output Transformation for Non-Exported Commodities
25	$QM_c = QMC_c + QMG_c$ $\begin{bmatrix} \text{total} \\ \text{imports} \\ \text{of } c \end{bmatrix} = \begin{bmatrix} \text{commercial} \\ \text{imports} \\ \text{of } c \end{bmatrix} + \begin{bmatrix} \text{government} \\ \text{imports} \\ \text{of } c \end{bmatrix}$	$c \in CM$	Total import quantity
26	$QT_c = \sum_{c' \in C'} \left(icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'} \right)$ $\begin{bmatrix} \text{demand} \\ \text{for trade} \\ \text{inputs} \end{bmatrix} = \begin{bmatrix} \text{sum of trade} \\ \text{inputs demanded for} \\ \text{imports, exports, and} \\ \text{domestic sales} \end{bmatrix}$	$c \in CT$	Demand for Trade Inputs

Institution block

27	$YF_{i\,f} = shry_{i\,f} \cdot \left(1 - \overline{TY}_f\right) \cdot \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a}$ $\begin{bmatrix} \text{income of} \\ \text{institution } i \\ \text{from factor } f \end{bmatrix} = \begin{bmatrix} \text{share of income} \\ \text{of factor } f \text{ to} \\ \text{institution } i \end{bmatrix} \cdot \begin{bmatrix} \text{income of factor } f \\ \text{(net of tax)} \end{bmatrix}$	$i \in ID$ $f \in F$	Factor Income
28	$YI_i = \sum_{f \in F} YF_{i\,f} + \sum_{i' \in IDNG'} TR_{i\,i'} + \overline{tr}_{i\,gov} + EXR \cdot \overline{tr}_{i\,row}$ $\begin{bmatrix} \text{income of} \\ \text{institution } i \end{bmatrix} = \begin{bmatrix} \text{factor} \\ \text{income} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from other} \\ \text{institutions} \end{bmatrix} + \begin{bmatrix} \text{government} \\ \text{transfers} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from RoW} \end{bmatrix}$	$i \in IDNG$	Institution Income
29	$TR_{i\,i'} = shrtr_{i\,i'} \cdot (1 - MPS_{i'}) \cdot (1 - \overline{TY}_{i'}) \cdot \left(YI_{i'} - EXR \cdot \overline{tr}_{row\,i'}\right)$ $\begin{bmatrix} \text{transfer from} \\ \text{institution } i' \text{ to } i \end{bmatrix} = \begin{bmatrix} \text{share of income} \\ \text{of institution } i' \\ \text{transfered to } i \end{bmatrix} \cdot \begin{bmatrix} \text{income of institution } i' \\ \text{net of savings, direct taxes,} \\ \text{and transfers to RoW} \end{bmatrix}$	$i \in ID$ $i' \in IDNG$	Intra-Institutional Transfers
30	$EH_h = \left(1 - \sum_{i \in ID} shrtr_{i\,h}\right) \cdot \left(1 - MPS_h\right) \cdot (1 - \overline{TY}_h) \cdot \left(YI_h - EXR \cdot \overline{tr}_{row\,h}\right)$ $\begin{bmatrix} \text{household disposable} \\ \text{income (for consumption)} \end{bmatrix} = \begin{bmatrix} \text{household income} \\ \text{net of savings, direct taxes,} \\ \text{and transfers to RoW} \\ \text{and other institutions} \end{bmatrix}$	$h \in H$	Household Consumption Expenditures

31	$$QH_{c\,h} = \gamma_{c\,h} + \frac{\beta_{c\,h} \cdot \left(EH_h - \sum_{c \in C} PQ_c \cdot \gamma_{c\,h} \right)}{PQ_c}$$ $$\begin{bmatrix} \textit{quantity of} \\ \textit{household demand} \\ \textit{for commodity } c \end{bmatrix} = f \begin{bmatrix} \textit{household} \\ \textit{disposable} \\ \textit{income, price} \end{bmatrix}$$	$c \in C$ $h \in H$	Household Consumption Demand
32	$$QINV_c = \overline{qinv}_c \cdot \overline{IADJ}$$ $$\begin{bmatrix} \textit{private investment} \\ \textit{demand for} \\ \textit{commodity } c \end{bmatrix} = \begin{bmatrix} \textit{base-year private} \\ \textit{investment times} \\ \textit{adjustment factor} \end{bmatrix}$$	$c \in C$	Private Investment Demand
33	$$QG_c = \overline{qg}_c \cdot \overline{GADJ}$$ $$\begin{bmatrix} \textit{government} \\ \textit{consumption} \\ \textit{demand for} \\ \textit{commodity } c \end{bmatrix} = \begin{bmatrix} \textit{base-year government} \\ \textit{consumption} \\ \textit{times} \\ \textit{adjustment factor} \end{bmatrix}$$	$c \in C$	Government Consumption Demand
34	$$YG = \sum_{f \in F} YF_{gov\,f} + \sum_{i \in I} \overline{TY}_i \cdot YI_i + \sum_{i \in IDNG} TR_{gov\,i} \cdot YI_i + EXR \cdot \overline{tr}_{gov\,row}$$ $$+ \sum_{f \in F} \overline{TY}_f \cdot \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{fa} \cdot QF_{fa}$$ $$+ \sum_{c \in C} tq_c \left(PDD_c \cdot QD_c + PM_c QM_c \right) + \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a$$ $$+ \sum_{c \in C} tm_c \cdot EXR \cdot pwm_c \cdot QM_c + \sum_{c \in C} te_c \cdot EXR \cdot pwe_c \cdot QE_c$$ $$\begin{bmatrix} \textit{government} \\ \textit{revenue} \end{bmatrix} = \begin{bmatrix} \textit{factor} \\ \textit{income} \end{bmatrix} + \begin{bmatrix} \textit{direct taxes} \\ \textit{from} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{transfers from} \\ \textit{domestic} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{RoW} \end{bmatrix}$$ $$+ \begin{bmatrix} \textit{direct taxes} \\ \textit{from factors} \end{bmatrix} + \begin{bmatrix} \textit{sales} \\ \textit{tax} \end{bmatrix} + \begin{bmatrix} \textit{activity} \\ \textit{tax} \end{bmatrix} + \begin{bmatrix} \textit{import} \\ \textit{tariffs} \end{bmatrix} + \begin{bmatrix} \textit{export} \\ \textit{taxes} \end{bmatrix}$$		Government Revenue
35	$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in IDNG} \overline{tr}_{i\,gov} + EXR \cdot \overline{tr}_{row\,gov}$$ $$\begin{bmatrix} \textit{government} \\ \textit{spending} \end{bmatrix} = \begin{bmatrix} \textit{government} \\ \textit{consumption} \end{bmatrix} + \begin{bmatrix} \textit{transfers to} \\ \textit{domestic} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{to RoW} \end{bmatrix}$$		Government Expenditures
36	$$GSAV = YG - EG$$ $$\begin{bmatrix} \textit{government} \\ \textit{savings} \end{bmatrix} = \begin{bmatrix} \textit{government} \\ \textit{revenue} \end{bmatrix} - \begin{bmatrix} \textit{government} \\ \textit{expenditures} \end{bmatrix}$$		Government Savings

System Constraint Block

37	$\sum_{a\in A} QF_{f\,a} = \overline{QFS}_{f}$ $\begin{bmatrix}\textit{demand for}\\ \textit{factor } f\end{bmatrix} = \begin{bmatrix}\textit{supply of}\\ \textit{factor } f\end{bmatrix}$	$f \in F$	Factor Market
38	$QQ_c = \sum_{a\in A} QINT_{c\,a} + \sum_{h\in H} QH_{c\,h} + QG_c + QT_c$ $+QINV_c + qginv_c + qdst_c$ $\begin{bmatrix}\textit{composite}\\ \textit{supply}\end{bmatrix} = \begin{bmatrix}\textit{intermediate}\\ \textit{use}\end{bmatrix} + \begin{bmatrix}\textit{household}\\ \textit{consumption}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{consumption}\end{bmatrix} + \begin{bmatrix}\textit{trade}\\ \textit{input use}\end{bmatrix}$ $+\begin{bmatrix}\textit{private}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{stock}\\ \textit{change}\end{bmatrix}$	$c \in C$	Composite Commodity Markets
39	$\sum_{c\in C} pwm_c \cdot QM_c + \sum_{i\in ID} \overline{tr}_{row\,i} = \sum_{c\in C} pwe_c \cdot QE_c + \sum_{i\in ID} \overline{tr}_{i\,row} + \overline{FSAV}$ $\begin{bmatrix}\textit{import}\\ \textit{spending}\end{bmatrix} + \begin{bmatrix}\textit{transfers}\\ \textit{to RoW}\end{bmatrix} = \begin{bmatrix}\textit{export}\\ \textit{revenue}\end{bmatrix} + \begin{bmatrix}\textit{transfers}\\ \textit{from RoW}\end{bmatrix} + \begin{bmatrix}\textit{foreign}\\ \textit{savings}\end{bmatrix}$		Current Account Balance for RoW (in Foreign Currency)
40	$\sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c + \sum_{c\in C} PQ_c \cdot qginv_c$ $= \sum_{i\in IDNG} MPS_i \cdot \left(1-\overline{TY}_i\right) \cdot \left(YI_i - EXR \cdot \overline{tr}_{row\,i}\right) + GSAV + EXR \cdot \overline{FSAV}$ $\begin{bmatrix}\textit{private}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{stock}\\ \textit{change}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{investment}\end{bmatrix} = \begin{bmatrix}\textit{non-govern-}\\ \textit{ment savings}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{savings}\end{bmatrix} + \begin{bmatrix}\textit{foreign}\\ \textit{savings}\end{bmatrix}$		Savings-Investment Balance
41	$\sum_{c\in C} PQ_c \cdot cwts_c = cpi$ $\begin{bmatrix}\textit{price times}\\ \textit{weights}\end{bmatrix} = \begin{bmatrix}\textit{CPI}\end{bmatrix}$		Price Normalization
42	$TABS = \sum_{h\in H}\sum_{c\in C} PQ_c \cdot QH_{c\,h} + \sum_{c\in C} PQ_c \cdot QG_c + \sum_{c\in C} PQ_c \cdot QINV_c$ $+\sum_{c\in C} PQ_c \cdot qdst_c + \sum_{c\in C} PQ_c \cdot qginv_c$ $\begin{bmatrix}\textit{total}\\ \textit{absorption}\end{bmatrix} = \begin{bmatrix}\textit{household}\\ \textit{consumption}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{consumption}\end{bmatrix} + \begin{bmatrix}\textit{private}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{stock}\\ \textit{change}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{investment}\end{bmatrix}$		Total Absorption
43	$INVSHR \cdot TABS = \sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qginv_c + \sum_{c\in C} PQ_c \cdot qdst_c$ $\begin{bmatrix}\textit{investment-}\\ \textit{absorption}\\ \textit{ratio}\end{bmatrix} \cdot \begin{bmatrix}\textit{total}\\ \textit{absorption}\end{bmatrix} = \begin{bmatrix}\textit{private}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{government}\\ \textit{investment}\end{bmatrix} + \begin{bmatrix}\textit{stock}\\ \textit{change}\end{bmatrix}$		Ratio of Investment to Absorption

44	$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c$ $\begin{bmatrix} \textit{government} \\ \textit{consumption-} \\ \textit{absorption} \\ \textit{ratio} \end{bmatrix} \cdot \begin{bmatrix} \textit{total} \\ \textit{absorption} \end{bmatrix} = \begin{bmatrix} \textit{government} \\ \textit{consumption} \end{bmatrix}$		Ratio of Government Consumption to Absorption

Note: *The mathematical statement is simplified in that it does not include domain controls for variables.

Table A.2: Structure of the Bangladesh economy by activity (as % of total)

	GDP f.c.	Production	Labor	Capital	Land
AAman	3.9	3.5	5.2		13.0
ABoro	4.5	4.4	5.4		17.0
AGrains	0.3	0.4	0.5		0.9
AJute	0.5	0.4	0.7		1.1
AComCrop	0.8	0.8	0.5		4.6
AOthCrop	3.6	3.5	1.9		21.3
ALivesto	2.7	2.8	4.3		6.7
APoultry	0.6	0.7	0.8		1.9
AOthFish	2.8	3.1	0.4		20.7
AForest	2.3	2.8	1.5		12.8
ARiceMil	2.0	9.2	0.6	4.0	
AAtaFlou	0.3	0.7	0.0	0.7	
AOthFood	1.7	3.4	0.6	3.4	
ALeather	0.2	0.6	0.1	0.4	
AJuteTex	0.3	0.8	0.5	0.2	
AYarn	0.4	0.7	0.7	0.3	
AMilClot	0.2	0.4	0.2	0.3	
ACloth	1.4	2.3	2.8	0.5	
AGarment	1.5	2.8	2.9	0.5	
AOthText	0.1	0.1	0.2	0.0	
ATobP	0.5	0.5	0.2	1.1	
AWoodP	0.6	1.1	1.2	0.3	
AChem	0.7	1.2	0.8	0.8	
AFerti	0.1	0.5	0.1	0.2	
APetroP	0.6	0.7	0.0	1.3	
AClayP	0.3	0.4	0.4	0.3	
ASteel	0.6	1.2	0.6	0.8	
AMachin	0.3	0.4	0.3	0.3	
AMiscInd	0.7	0.7	0.4	1.1	
AUrbBuil	1.7	2.0	1.8	2.0	
ARurBuil	7.5	6.3	0.6	16.6	
AConst	0.7	1.1	1.4	0.3	
AUtility	2.4	1.7	1.1	4.3	
ATradeS	16.2	10.9	28.5	8.6	
ATransS	13.8	10.2	11.0	20.7	
AHous	7.0	4.8		16.2	
AHealth	0.8	0.8	0.7	1.2	
AEdu	1.8	1.3	3.6	0.6	
APubAdm	2.5	1.9	4.7	1.1	
AFinS	5.5	4.8	2.6	10.1	
AOthS	3.9	2.2	8.4	0.7	
AHotel	0.6	0.9	0.9	0.4	
AComm	0.7	0.4	0.8	0.8	
Tot Agriculture	22.2	22.5	21.3	100.0	100.0
Tot Non-Agriculture	77.8	77.5	78.7		
Total	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations from Fontana and Wobst (2001)

Table A.3: Structure of the Bangladesh economy by commodity

	Composition (% of total)			Exports (% of output)	Imports (% of absorption)	CET elasticity	CES elasticity
	Exports	Imports	Absorption				
CPaddy			7.2				
CGrains		2.6	0.5		33.3	2.0	0.8
CJute			0.4				
CComCrop	0.0	4.3	1.0	0.0	26.5	2.0	0.8
COthCrop	0.3	1.1	3.3	0.4	2.3	2.0	0.8
CLivesto	0.1	0.9	2.6	0.1	2.0	2.0	0.8
CPoultry		0.0	0.7		0.1		0.8
COthFish	7.7		2.9	10.0		2.0	
CForest			2.6				
CRiceMil			8.4			2.0	0.8
CAtaFlou		0.0	0.7		0.2		0.8
COthFood	4.9	2.3	3.5	5.7	6.9	2.0	0.8
CLeather	11.0	0.1	0.6	69.4	2.5	2.0	0.8
CJuteTex	11.1	0.1	0.8	53.0	2.3	2.0	0.8
CYarn	0.1	5.5	1.1	0.7	34.2	2.0	0.8
CMilClot	0.0	15.1	1.4	0.2	71.1	2.0	0.8
CCloth			2.1				
CGarment	60.8	0.5	2.6	87.5	8.1	2.0	0.8
COthText	1.0	1.6	0.2	37.7	61.2	2.0	0.8
CTobP	0.0	0.1	0.8	0.0	0.4	2.0	0.8
CWoodP	0.0	2.1	1.2	0.0	13.7	2.0	0.8
CChem	0.2	10.3	2.0	0.7	37.3	2.0	0.8
CFerti	0.7	1.2	0.5	6.2	14.7	2.0	0.8
CPetroP	0.3	9.7	1.5	1.9	48.1	2.0	0.8
CClayP	0.2	5.3	0.8	2.1	44.0	2.0	0.8
CSteel	0.1	11.5	2.0	0.2	39.5	2.0	0.8
CMachin	0.4	21.1	2.0	4.4	74.0	2.0	0.8
CMiscInd	0.9	4.7	1.1	5.1	36.0	2.0	0.8
CUrbBuil			1.8				
CRurBuil			5.7				
CConst			1.0				
CUtility			1.7				
CTradeS			10.0				
CTransS			9.4				
CHous			4.4				
CHealth			0.7				
CEdu			1.2				
CPubAdm			1.7				
CFinS			4.4				
COthS			2.0				
CHotel			0.9				
CComm			0.4				
Total	100.0	100.0	100.0				

Source: Authors' calculations from Fontana and Wobst (2001)

Table A.4: Structure of production by activity

	% of total VA			Input (% of gross output)	Supply elasticity
	Labor	Capital	Land		
AAman	57.4		42.6	42.3	0.1
ABoro	51.8		48.2	47.7	0.4
AGrains	63.7		36.3	56.2	0.2
AJute	69.0		31.0	46.2	0.2
AComCrop	27.4		72.6	47.6	0.8
AOthCrop	23.5		76.5	48.2	1.5
ALivesto	68.5		31.5	50.4	0.2
APoultry	59.9		40.1	56.3	0.3
AOthFish	6.3		93.7	53.5	4.0
AForest	28.0		72.0	58.5	0.8
ARiceMil	12.5	87.5		89.1	1.2
AAtaFlou	6.9	93.1		78.9	2.0
AOthFood	14.4	85.6		74.3	0.9
ALeather	18.8	81.2		84.8	1.2
AJuteTex	66.6	33.4		81.3	0.4
AYarn	71.8	28.2		70.9	0.1
AMilClot	45.1	54.9		69.4	0.2
ACloth	84.1	15.9		68.5	0.1
AGarment	84.9	15.1		73.1	0.5
AOthText	93.1	6.9		64.2	0.1
ATobP	14.2	85.8		48.2	2.0
AWoodP	80.3	19.7		69.5	0.1
AChem	49.5	50.5		70.2	0.2
AFerti	41.8	58.2		87.6	0.2
APetroP	0.2	99.8		56.5	0.2
AClayP	54.3	45.7		63.0	0.2
ASteel	41.9	58.1		73.6	0.3
AMachin	43.3	56.7		66.6	0.2
AMiscInd	28.9	71.1		52.6	0.6
AUrbBuil	47.2	52.8		57.7	0.4
ARurBuil	3.7	96.3		39.1	6.0
AConst	84.0	16.0		68.0	0.1
AUtility	20.5	79.5		28.4	2.0
ATradeS	76.8	23.2		24.5	0.2
ATransS	34.8	65.2		31.3	1.2
AHous		100.0		25.0	0.2
AHealth	38.6	61.4		48.4	0.6
AEdu	86.2	13.8		29.7	0.1
APubAdm	80.7	19.3		31.5	0.2
AFinS	20.4	79.6		42.0	2.0
AOthS	92.7	7.3		9.8	0.1
AHotel	71.5	28.5		69.6	0.1
AComm	48.3	51.7		17.8	0.8
Ag average	41.8		58.2		
Non-ag average	44.1	55.9			
Total average	43.6	43.5	12.9		

Source: Authors' calculations from Fontana and Wobst (2001)

Appendix A.5: Labor value-added structure by activity

	Share of each labor type in total labor VA									
	No-ed male	Low-ed male	Med-ed male	High-ed male	No-ed female	Low-ed female	Med-ed female	High-ed female	Gender intensity (f/m)	Labor share in tot VA
Aman	42.0	23.3	14.7	6.5	7.2	4.0	1.9	0.4	15.6	57.4
Boro	42.1	23.3	14.7	6.5	7.1	3.9	1.8	0.4	15.3	51.8
Wheat&oth.grains	45.3	25.2	15.8	7.1	3.4	2.1	1.0	0.2	7.1	63.7
Jute	45.5	25.3	15.9	7.1	3.2	1.9	0.9	0.2	6.7	69.0
Comm.crops	46.6	25.9	16.3	7.3	2.0	1.2	0.6	0.1	4.0	27.4
Other crops	32.2	17.9	11.3	5.0	17.9	10.1	4.7	1.0	50.7	23.5
Livestock	30.8	17.1	10.8	4.8	19.3	11.0	5.1	1.1	57.5	68.5
Poultry	14.3	8.0	5.0	2.2	36.5	21.8	10.1	2.1	238.5	59.9
Other fish	9.8	12.9	30.2	28.3	12.7	2.7	2.1	1.2	23.1	6.3
Forestry	47.8	30.9	13.7	7.1	0.1	0.3	0.0	0.0	0.4	28.0
Rice milling	19.6	16.4	20.6	15.8	18.6	6.8	1.2	1.0	38.2	12.5
Ata&flour	26.5	22.5	28.2	21.9	0.9	0.0	0.0	0.0	0.9	6.9
Other food	25.7	21.7	28.4	21.2	1.9	0.8	0.1	0.1	3.0	14.4
Leather	20.6	27.2	24.1	26.8	0.5	0.5	0.2	0.0	1.2	18.8
Jute textile	20.8	27.4	24.4	27.0	0.1	0.1	0.1	0.0	0.3	66.6
Yarn	19.7	26.0	23.1	25.6	2.0	2.2	1.1	0.4	5.9	71.8
Mill cloth	20.7	27.2	24.1	26.8	0.4	0.4	0.2	0.1	1.2	45.1
Other cloth	19.7	25.8	22.9	25.4	1.8	2.7	1.3	0.4	6.6	84.1
RM garments	3.6	7.2	4.2	7.1	24.8	28.8	14.3	10.0	352.6	84.9
Other textiles	13.8	18.1	16.1	17.9	12.0	13.2	6.5	2.5	51.9	93.1
Tobacco products	21.5	18.2	22.9	17.7	12.8	5.5	0.8	0.6	24.6	14.2
Wood&paper	22.3	21.8	21.9	19.1	7.9	4.5	2.1	0.3	17.5	80.3
Chemicals	3.6	23.4	18.2	43.9	2.1	0.5	0.4	7.8	12.1	49.5
Fertilizers	3.9	25.2	19.1	47.1	0.9	0.2	0.2	3.4	4.9	41.8
Petroleum	36.8	32.3	16.2	14.6	0.0	0.0	0.0	0.0	0.0	0.2
Clay&pottery	41.1	25.3	14.9	8.7	7.9	1.7	0.5	0.0	11.2	54.3
Steel	6.7	33.9	32.9	26.0	0.3	0.2	0.0	0.0	0.5	41.9
Machinery	7.2	32.8	31.7	25.2	1.9	1.2	0.0	0.0	3.2	43.3
Misc. industries	7.7	24.5	22.5	35.1	5.6	3.6	1.0	0.0	11.4	28.9
Urban building	33.5	32.5	16.1	17.2	0.3	0.3	0.0	0.0	0.6	47.2
Rural building	33.2	32.3	16.0	17.1	0.8	0.6	0.0	0.0	1.4	3.7
Construction	43.2	17.7	9.5	24.6	5.0	0.0	0.0	0.0	5.3	84.0
Utilities	4.4	11.2	12.4	66.7	0.2	0.0	0.0	5.2	5.7	20.5
Trade	21.5	26.2	26.0	23.9	1.7	0.3	0.3	0.1	2.4	76.8
Transport	47.8	25.3	13.1	12.8	0.4	0.3	0.0	0.3	0.9	34.8
Housing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	0.7	3.8	8.6	64.6	1.4	0.6	1.3	19.0	28.8	38.6
Education	0.7	3.9	8.8	64.7	0.6	0.6	1.3	19.3	28.0	86.2
Pub. Administr.	2.4	6.4	15.2	67.3	0.5	0.1	1.3	6.7	9.5	80.7
Financial services	1.1	4.4	7.4	81.6	0.0	0.2	0.6	4.8	6.0	20.4
Other services	17.7	21.6	18.4	20.8	13.2	4.0	2.5	1.8	27.4	92.7
Hotels	23.3	32.7	19.2	20.4	3.3	0.3	0.4	0.3	4.5	71.5
Communications	16.4	13.8	16.3	48.3	0.0	1.0	0.0	4.1	5.4	48.3
Total	24.8	21.4	17.9	24.1	5.2	2.9	1.5	2.1	13.4	43.6

Source: Authors'calculations from Fontana and Wobst (2001)

Appendix A.6: SAM households and their sources of income

	Share in working population	Share in total income	Income from factors (% of total) No-ed male	Low-ed male	Med-ed male	High-ed male	No-ed female	Low-ed female	Med-ed female	High-ed female	Capital/ Land
Landless and marginal	17.7	5.6	55.6	22.3	7.3	1.3	10.1	2.6	0.5	0.2	0.0
Small farmers	19.8	11.2	18.1	15.4	9.5	5.2	4.0	2.4	0.9	0.6	43.8
Large farmers	11.5	13.2	6.2	6.6	7.9	6.5	1.5	1.3	0.9	0.6	68.5
Non-ag rural female poor	1.0	0.8	5.9	4.5	2.1	1.7	13.4	2.3	0.8	1.9	67.4
Non- ag rural male poor	14.6	9.0	20.1	17.5	9.6	6.9	3.6	1.9	0.8	0.3	39.3
Non- ag rural rich	8.5	7.9	5.2	10.5	10.5	19.7	1.5	1.9	1.4	1.6	47.7
Urban low educated	15.2	11.1	26.8	31.7	7.5	4.1	4.2	2.6	0.7	0.5	22.0
Urban medium educated	4.9	13.3	0.1	0.9	21.7	3.5	0.3	0.4	0.8	0.3	72.0
Urban highly educated	6.9	27.9	0.1	0.2	0.7	21.9	0.3	0.2	0.3	1.8	74.6

Source: Fontana and Wobst (2001)

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