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Policy Options and Their Potential Effects on Moroccan Small Farmers and the Poor Facing Increased World Food Prices

A General Equilibrium Model Analysis

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ABSTRACT

This study evaluates the potential impact of the recent rise in world food prices on the Moroccan economy and possible policy options to respond to it. The study focuses mainly on the poverty effects of such an external shock and the possible policy responses to it. A new social accounting matrix (SAM) and a computable general equilibrium (CGE) model have been developed for this study based on micro-level data in combination with sectoral and economywide data. The CGE model simulations show that while increased world food prices hurt poor consumers, the general equilibrium effect of welfare loss is modest. Agricultural producers gain, and benefits to small farmers are especially large. The simulation of import subsidies shows that while such policy options can temporarily stabilize domestic prices, the benefits to consumers are at the expense of producers. However, the model results indicate that there are win-win options for Morocco if policies are based on a longer-term objective. Direct transfers to poor consumers, combined with increased public investment in agriculture to improve agricultural productivity, is a win-win strategy that the government should consider. Low productivity in staple crop production is the dominant reason for poverty among Moroccan farmers. Improving this productivity can also benefit poor consumers by lowering domestic food prices.

Keywords: food price crisis, general equilibrium, Morocco

JEL Classification: C68, I32, O55, Q18

1. INTRODUCTION

The sharp increase in world food prices over recent years has raised serious concerns in many countries about the food and nutrition situation of their people and about inflation and macroeconomic stability in their economies. Since 2003, world maize and wheat prices have more than doubled, and the price of rice has jumped to unprecedented levels, doubling in the first four months of 2008 alone. Dairy products, meat, poultry, and vegetable oils, among other agricultural commodities, have also experienced price hikes. Moreover, these high global agricultural prices do not appear likely to return to their 2000–2003 levels, and fluctuations may become even more serious (von Braun et al. 2008).

With its heavy dependence on imports of wheat, maize, oilseeds, and, to some degree, livestock for domestic consumption, Morocco has been hit by rising world food prices. Most imported food products are raw materials used in the domestic food-processing industry to produce wheat flour, vegetable oil, and feed for domestic consumers and livestock producers. High material prices have put pressure on the domestic prices of food products, many of which are staples for urban and rural households. The government of Morocco has cut tariffs on wheat imports from 130 to 2.5 percent (Trostle 2008) in order to prevent the processing industry from passing price increases on to final consumers. However, as current world prices are already higher than the former protected domestic prices, and as some food-processing sectors have been heavily subsidized for many years, food price inflation is still possible even after tariffs on imported food materials are removed. Thus, under pressure from the domestic processing industry, the government is currently considering import subsidies to lower costs for the processing industry.

Against this background, we have developed a computable general equilibrium (CGE) model based on the newly constructed social accounting matrix (SAM) for Morocco to analyze the economywide impacts of rising food prices and a possible import subsidy policy on Morocco's economy. The model explicitly captures agricultural production technology at the level of the six agro-ecological regions, with details on the crop and livestock production system and farm structure. The model also aggregates consumers into 10 representative groups consistent with the income quintiles of rural and urban households. With this disaggregated structure, the model is able to analyze the impact of food prices and import subsidy policies on different income groups of rural and urban households at both the national and regional levels. The rest of the paper is organized as follows: in Section 2, we first address poverty distribution and the structure of smallholder agriculture in Morocco, as food prices usually affect the poor more, on both the consumption and the production sides. In Section 3, we introduce the SAM that has been newly developed for this study. Section 4 presents the new Moroccan CGE model, while Section 5 analyzes the impact of rising food prices and selected policies to deal with this situation based on the CGE model. Section 6 concludes the paper with a discussion of policy implications.

2. UNDERSTANDING POVERTY DISTRIBUTION AND SMALLHOLDER AGRICULTURE IN MOROCCO

According to the 1998/99 National Household Living Standard Survey (ENVI)1 and 1998 agricultural census, 33.6 percent of rural households in Morocco are landless, 44.2 percent are small farmers, and 15.7 and 6.5 percent are farmers with landholding between 5 and 20 hectares (medium farms) and more than 20 hectares (large farms), respectively. In total, 46 percent of the national population lives in rural areas, and almost half of the rural population is composed of the households of small farmers. While the national poverty rate was 19.7 percent according to the 1998/99 ENVI, 80 percent of the country's poor live in rural areas, and most of them are landless or small farmers (Table .1).

Table 1. Population and poverty distribution of rural households

	% of total rural households	% of national population	% of national poor population
Rural total	100.0	46.0	80.0
Landless	33.6	12.9	23.0
Small farms	44.2	21.0	44.0
Medium farms	15.7	8.4	11.0
Large farms	6.5	3.7	2.5
Urban total		54.0	20.0

Source: Authors' calculation using data from 1998/99 National Household Living Standard Survey
Note: Small farms are defined as having total land less than 5 hectares or irrigated land less than 2 hectares.
Medium farms have total land between 5 and 20 hectares or irrigated land between 2 and 5 hectares.
Large farms have total land more than 20 hectares or irrigated land more than 5 hectares.

In rural areas, poverty also generally relates to the size of landholdings and what type of land is farmed. Thus, we further disaggregated rural households according to the following indicators. For landless rural households, we consider three groups: (1) not engaging in agricultural activities, (2) engaging in agriculture as workers, and (3) engaging in livestock production. For the other three farm groups, we further disaggregate them into farms with irrigated land and with rainfed land only. As shown in Table .2, only 9.4 percent of the rural population does not engage in agricultural activities, and the other rural landless households either provide labor forces to agricultural production (accounting for 11.9 percent of the total rural population) or engage in livestock production (6.8 percent). While the poverty rate among landless rural households is generally higher than the poverty rate for total rural households, it is particularly high for those not engaging in agriculture or only in livestock production.

As shown in Table .2, a majority of small farmers are unable to obtain access to irrigation. Small farmers with rainfed land account for 34 percent of the rural population (Table 2). The poverty rate for this group of farmers is 45 percent, much higher than that for the other types of farmer groups. Table .2 also shows that a majority of farmers with large farms (i.e., 5.7 percent out off 8.1 percent of total rural population that belong to large farm households) have irrigated land, and a much lower poverty rate is observed for this group. Such statistics indicate that the distribution of rural poor is highly related to the distribution of land as well as accessibility to irrigation, a factor that will be considered in the modeling analysis.

1 1998/99 ENVI is the most recent national representative household living standard survey available in the country. The survey includes 5,129 sample households, of which 2,154 are rural households, including 710 rural households without land.

Table 2. Poverty distribution among different types of rural households

	% of rural population	Poverty rate
Rural landless	28.1	35.3
Not engaging in agriculture	9.4	42.4
Engaging in agriculture as workers	11.9	27.0
Engaging in livestock production	6.8	40.0
Small farms	45.6	42.0
With irrigated land	11.9	33.7
Rainfed land only	33.7	45.0
Medium farms	18.2	26.1
With irrigated land	5.4	26.5
Rainfed land only	12.8	25.9
Large farms	8.1	12.6
With irrigated land	5.7	15.3
Rainfed land only	2.4	6.6
Rural total	100.0	34.9

Source: Authors' calculation using data from 1998/99 National Household Living Standard Survey

Morocco has quite diverse agro-ecological conditions across the country, which determines the different crop patterns across regions. Given that world prices have increased primarily for a few grain and oilseed commodities, different crop patterns across regions indicate possible differential impacts of rising food prices at the regional level. Thus, it is necessary to examine the regional distribution patterns of rural households and poverty. Morocco is divided into six agro-ecological regions: (1) Favorable, (2) Intermediary, (3) Unfavorable South, (4) Unfavorable East, (5) Mountain, and (6) Sub-Saharan. About one-third of the country's cropland and a quarter of the irrigated areas are in the Favorable region, which, by definition, has the most favorable agro-ecological conditions in the country. Because of adequate rainfall and better intrayear distribution of rainfall, irrigation takes place on only 9 percent of the total land in this region. The Intermediary region is the smallest agricultural zone in the country in terms of total land and irrigated land areas. Compared to the other regions, this region also has the lowest share of irrigated land in the region's total land. Two regions, the Unfavorable South and Unfavorable East, together have more than 30 percent of the total land and 23 percent of irrigated land. The share of irrigated land in the two regions' total land is similar (13 percent) and slightly higher than the national average. The Mountain and Sub-Saharan regions have the worst agroclimatic conditions in the country. Though both regions have relatively high shares of irrigated areas in total land, unfavorable agro-ecological conditions constrain agricultural development in the vast majority of the land, which is rainfed.

We now look into the population and poverty distribution across the six agro-ecological regions. As shown in Table 3. , more than one-third of the rural population lives in the Favorable region. While the region has the most favorable agricultural conditions, the poverty rate is higher than the rural average. Among the regional rural population, 56.9 percent are small farmers, and the poverty rate for this group is even higher, at 42.7 percent, compared to 37.5 percent for the regional rural population as whole, and 40.3 percent for national small farmers as a group. What the table does not show is that about 38 percent of the rural landless population lives in this region, a share higher than in any other region.

Table 3. Poverty distribution across agro-ecological regions

	Share in total rural population	Share in total rural poor population	Rural poverty rate	Share of small farmers in regional population	Poverty rate among small farmer population
Favorable	33.7	36.2	37.5	56.9	42.7
Intermediary	11.3	7.9	24.5	57.6	31.4
Unfavorable South	17.5	20.1	40.0	66.5	47.8
Unfavorable East	9.8	7.6	27.0	38.9	27.1
Mountain	9.6	9.6	34.7	69.6	44.9
Sub-Saharan	18.2	18.7	35.9	58.6	36.2
Rural total	100	100	34.9	59.1	40.3

Source: Authors' calculation using data from 1998/99 National Household Living Standard Survey

In terms of size of rural population, the Unfavorable South is the third largest agro-ecological region. However, this region has the highest rural poverty rate (40 percent), primarily due to the high poverty rate among small farmers (47.8 percent), a group accounting for two-thirds of the region's total rural population. In contrast, the poverty rate is much lower in the Intermediary and Unfavorable East regions than in the other four regions, at 24.5 percent and 27.0 percent, respectively. For the Intermediary region, the low regionwide poverty rate is due primarily to a low poverty rate among small farmers (31.4 percent), while for the Unfavorable East, it is due to both the low poverty rate for small farmers (27.1 percent), who account for 38.9 percent of the regional population, and the low poverty rate (28.8 percent) for the landless, who account for 42.4 percent of the regional population (not shown in table).

In summary, the distribution of the poor is very different across regions and types of household groups. The national-level distribution of the poor by types of farm households, though important for understanding the big picture for the country, is unable to reveal such regional heterogeneity. For this reason, the construction of the SAM and the development of the CGE model that will be introduced in the following sections must take into account such regional heterogeneity in order to analyze the differential impact of agricultural policy on the poor.

3. THE NEW SAM FOR MOROCCO

A SAM is a data set that is necessary for CGE modeling analysis. The SAM itself can also be applied in certain economic analyses when the general equilibrium effect on both commodity and factor prices are ignored, such as a SAM multiplier analysis. Various SAMs have been constructed for the Moroccan economy, including the one presented in Doukkali (1997) and the one constructed by Doukkali and applied in a CGE model developed in Diao, Roe, and Doukkali (2005). The second SAM also included details of the agricultural production structure. However, the data used for those SAMs are out of date, and they generally do not take regional heterogeneity into account. While the SAM constructed by Doukkali in Diao, Roe, and Doukkali (2005) regionalizes irrigated agriculture according to the seven irrigation administrative authorities (ORMVAs), this SAM defines rainfed agriculture, which accounts for the lion's share of Moroccan agriculture, at the national level.

Given that the agro-ecological conditions are quite different across Morocco, it is important to capture regional heterogeneity in a general equilibrium analysis. It is also equally important to capture the heterogeneity among farmer groups because, as has been shown in the previous section, the size of farms and types of land matter in rural income distribution and poverty. Thus, we have constructed a new SAM for Morocco based on various data sets just recently made available. We present the structure of the new SAM in detail below.

The newly constructed SAM includes 64 commodities or subsectors, which cover the entire country's production, consumption, and trade. In Table 4, we first report the aggregate economic structure, in which relatively aggregated agricultural and nonagricultural sectors are reported in terms of their shares in the gross domestic product (GDP), national production value, returns to labor, export value, and import value. There are 47 SAM subsectors in the agricultural sector, which can be further grouped into cereals, pulses and oilseeds, vegetables, industrial crops, fruit trees, and other crops (Table 4). The agricultural sector accounts for 16.5 percent of GDP and a relatively smaller share (16.2 percent) of national production value. While rural population accounts for about 46 percent of the national population (Table 1), given that wage rates are low in the agricultural sector and a majority of family laborers are even not paid, the agricultural sector's share of national total labor returns is low, at 14.8 percent.

Table 4. Economic structure of Morocco

Share (%):	GDP	Production value	Value of return to labor	Export value	Import value
Agriculture	16.5	16.2	14.8	5.4	7.6
Cereals	4.2	3.0	3.0	0.0	3.5
Pulses and oilseeds	0.2	0.2	0.4	0.0	0.9
Vegetables	2.2	1.9	2.0	1.7	0.2
Industrial crops	0.4	0.3	0.7	0.0	0.7
Other crops	2.2	1.4	2.4	0.2	1.7
Fruit trees	3.5	2.0	2.8	1.8	0.1
Livestock	2.3	6.2	2.0	0.0	0.1
Forest and fishery	1.5	1.2	1.4	1.6	0.3
Nonagriculture	83.5	83.8	85.2	92.0	90.5
Industry	28.6	46.6	22.9	68.9	90.5
Agroprocessing	5.1	12.8	2.9	10.9	5.7
Services	54.9	37.2	62.3	23.1	0.0

Source: 2003 Social Accounting Matrix

Compared with its share of production or GDP, the agricultural sector accounts for much smaller shares of national exports and imports, 5.4 and 7.6 percent, respectively, than the nonagricultural sector. Keeping in mind that some agricultural products must be processed to export, and such exports are included in industrial exports, the contribution of agriculture to the country's total exports is higher than the share of direct exports of agricultural products.

The industrial sector accounts for 28.6 percent of GDP but a much larger share of national production value, due to the fact that the sector consumes proportionally more intermediate inputs than the other two economic sectors, agriculture and services. Some of these intermediate inputs include the output of the agricultural sector, which creates backward linkages from industry to the agricultural sector. The general equilibrium analysis discussed below will capture such intersectoral linkages. Within the industrial sector, the agricultural processing industry accounts for 5.1 percent of national GDP and 12.8 percent of national production value. Again, the intensive use of intermediate inputs, of which a large portion is from the primary agricultural sector, creates strong linkages between the agroprocessing and agricultural sectors.

While the majority of Morocco's exports and imports are industrial goods, the share of industrial import value (90.5 percent) in total national import value is much higher than the share for the sector's exports (68.9 percent), which indicates that the sector as a whole is a trade deficit sector. For the agroprocessing industry sector, however, the share of export value (10.9 percent) is almost double the share of import value (5.7 percent), implying a strong comparative trade advantage in the country's agroprocessing sector.

Services are the largest sector in the Moroccan economy, accounting for 54.9 percent of national GDP and 62.3 percent of returns to labor, indicating that services are more labor intensive but employ relatively fewer intermediate inputs than the industrial sector. Thus, the linkages of the service sector with the rest of the economy take place mainly through its output (services) as input in other sectors' production activities or as a necessary component in the market transaction activities of all commodity goods in both domestic markets and trade.

Cereals are the most important agricultural subsector in Morocco and account for 25.3 percent of agricultural GDP (AgGDP). Among cereal production, soft wheat is particular important, accounting for 17.6 percent of AgGDP. Wheat also dominates agricultural imports, as it alone accounts for 37.8 percent of agricultural import value. While maize is a small crop in terms of production, it counts for 13.7 percent of agricultural imports. Thus, cereal imports in total account for more than 50 percent of agricultural imports. Such statistics indicate that through imports, domestic consumers and farmers who grow wheat can potentially be affected by any change in the international wheat market, which is the focus of our modeling analysis. The second group of crops reported in Table 4 is pulses and oilseeds. Like maize, pulses and oilseeds are a small group of crops in terms of domestic production (accounting for only 1.3 percent of AgGDP), but they are important in terms of imports, accounting for 9.5 percent of agricultural imports.

The new SAM includes relatively detailed breakdowns of vegetable crops (15 types of vegetables). Vegetables are the second largest group of annual crops in the country (13.4 percent of AgGDP) after cereals. Moreover, Morocco has a strong comparative advantage in vegetable exports, as 21.9 percent of agricultural exports are vegetables. The new SAM includes eight fruit tree crops, which together account for 21.2 percent of AgGDP. Like vegetables, fruits are also important export commodities, accounting for 23.5 percent of national agricultural exports.

Seven livestock products are included in the new SAM, and together they account for 13.8 percent of AgGDP. Tariffs and other nontariff barriers have protected domestic livestock production, and hence the share of livestock trade in both agricultural exports and imports is small. After livestock, forest and fishery together account for 8.1 percent of AgGDP. A study by Diao et al. (2007) shows that fish have been the most important export commodity in the last four decades; consistent with this, fish account for 26.4 percent of agricultural exports in the new SAM. Detail on the agricultural structure at the national level is presented in Table A.1 in the appendix.

About 5 percent of national GDP is agricultural processing, and hence it is necessary to look into these subsectors in greater detail. Table A.2 in the appendix reports on the agroprocessing sectors included in the SAM and their shares in industrial GDP, production value, and trade. Ten agroprocessing sectors that have strong linkages with primary agriculture are included in the SAM. Generally speaking, most of these subsectors are relatively small in terms of their contribution to national GDP. However, most of them are important food import sectors, together accounting for 54 percent of imports of processed foods. Moreover, some agroprocessing sectors, such as raw sugar and vegetable oil mills, are highly protected from import competition, which indicates the possible impact of trade and agricultural policies on their performance.

As we mentioned above, agricultural activities (excluding forest and fishery) are further disaggregated into six agro-ecological regions in the new SAM. Consistent with their agro-ecological conditions, the distribution of crop and livestock production is quite different across the six regions. Regional shares of agricultural production can be found in Tables A3–A4 in the appendix. Moreover, regional crop production is further disaggregated by type of land (i.e., two types of irrigated land and rainfed land) and size of landholding (i.e., small, medium, and large farms) in the SAM. Tables A5–A6 first present the distribution patterns of crop production by type of land across regions, while Tables A7–A8 focus on distribution by size of landholding across the regions.

As shown in these tables, agricultural production patterns are quite different across regions, mainly due to different agro-ecological conditions. The Favorable region, accounting for 32 and 34 percent of agricultural land and rural population, respectively, produces more than 40 percent of national crops and 45 percent of national livestock and is the most important agricultural region in the country. At the individual crop level, this region is the country's most important producer of most crops except fruit trees, in which the Unfavorable South ranks first in the country. Crop production accounts for 60–87 percent of total agricultural revenue in four of the six regions, while in the Unfavorable East and Sub-Saharan regions livestock is more important than crops in terms of the regions' total agricultural revenue.

In crop production, almost 60 percent of crop value comes from irrigated land, though irrigated land accounts for less than 13 percent of national agricultural land. This is due to the fact that high-value crops, such as vegetables and fruit trees, are predominately produced in irrigated areas, while cereals are mainly produced in dryland areas (84 percent of cereals are produced in rainfed areas). Although the Favorable region is the most important producer for most crop subsectors in the country, when production is further disaggregated by type of land, some other regions become more important than the Favorable region. For example, vegetables are produced in large-scale irrigated areas, where the Unfavorable South has the highest national share. Again, fruit trees are mainly produced in other regions (not in the Favorable region) in irrigated areas.

Grouping crop production by the size of landholding, almost 60 percent of crop value comes from the large farm group. This is due not only to the fact that the amount of land held by the large farm group is more than 40 percent of the national total, but also to the quality of the land, as large farms contain more than 60 percent of irrigated land. Because of this, large farms produce more of the high-value crops that are predominantly produced on irrigated land, such as vegetables and fruit trees. This is one of the most important reasons explaining why 60 percent of crop revenues are generated by the large farm group. On the other hand, the small farm group produces only 12.2 percent of national crops from 22 percent of national crop land.

While we have not reported the difference in the yield levels for each crop between small and large farm groups, efficiency in land allocation—another reason to explain land productivity using agricultural production revenue data—seems to be more important. Small farmers must allocate more land to staple crop production. As a group, they count for 15.8 and 16.5 percent of national cereal and pulse/oilseed production, respectively, but only 9.8 and 11.4 percent of national vegetable and fruit tree production, respectively. Such land allocation patterns indicate that small farmers may be more sensitive to any staple-food-related trade and agricultural policies. Given that the country imports mainly staple food commodities and exports high-value commodities such as vegetables and fruits, rising world food prices would seem to be more relevant to small farmers, as their incomes depend more on the production of staple foods, while farmers with large landholdings generate more income from growing high-value export crops. This differential impact of world food price shocks will be analyzed in this paper.

In a general equilibrium framework, agriculture also affects consumers primarily through price changes. At different income levels, the share of food consumption in consumers' total consumption bundles is different, and poor consumers usually allocate more income proportionally to food consumption than do consumers whose income level is relatively high. Thus, facing similar changes in domestic food prices, poor consumers may be hurt more than rich consumers due to this difference in food budget share. Moreover, food demand is generally price inelastic, as food represents a certain basic need for consumers. When the price of food increases, consumers are unable to proportionally reduce their demand and substitute food with other nonfood consumption. Because of this inelastic demand for food, the poor, who spend a larger portion of their income on food, will again be hurt more than the rich when food prices rise.

To fully capture this differential general equilibrium effect on consumers, we further disaggregate consumers into 10 groups in the new SAM, five in urban and five in rural areas, according to their different income levels. These 10 consumer groups are consistent with the five income quintiles. Table 5 reports the share of food and cereal consumption in total expenditure for the national average and the poorest quintile, for rural, urban, and national consumers. Consistent with the prediction of the economic theory, rural households, which have much lower per capita incomes than urban households, on average, spend a larger portion of their income on food and on cereals than urban households do. As shown in Table 5, an average rural consumer spends 65.2 percent of total income on food, while an average urban consumer spends 46.0 percent. For rural households belonging to the poorest population quintile at the national level, the food expenditure share in their total budget rises to 72.1 percent. The difference in the food budget share between poor and average urban households is more significant: poor urban households spend 10 percent more of their income (i.e., 56.4 percent) on food than the average urban household. Shares of cereal consumption in households' total spending follow the same pattern as for food consumption in general. Compared with the national average, poor consumers, no matter whether they are in rural or urban areas, spend proportionally more of their income on cereals. Moreover, for the cereal spending share, the difference between rural and urban poor is much smaller than for the average household, indicating that cereals are indeed necessary staples for Moroccan households.

Table 5. Share of food and cereal consumption in total expenditure

		Average	Poorest quintile
Food in total	Rural	65.2	72.1
	Urban	46.0	56.4
	National	52.4	69.1
Cereals in total	Rural	10.8	13.7
	Urban	6.3	11.8
	National	7.8	13.4

Source: Authors' calculation using data from 1998/99 National Household Living Standard Survey

4. DEVELOPING A NEW CGE MODEL FOR MOROCCO

An Overview of the Model

The ability to capture the links between agriculture and other sectors of the economy makes CGE models a proper tool for assessing the impacts of world food price shocks on both producers and consumers as well as on the overall economy. Like any other CGE model, the Morocco CGE model captures, with its general equilibrium feature, economic activities on both the demand and supply sides. On the supply side, however, unlike traditional CGE models that focus on national economies with multiple production sectors, the new Morocco model considers subnational heterogeneity in agricultural production. Consistent with the new SAM discussed in Section 3, the CGE model explicitly captures agricultural production technology at the level of the six agro-ecological regions. Moreover, for crop production, the technology is further distinguished among the two types of irrigation (large-scale irrigation vs. small- and medium-scale irrigation) and rainfed land, and three types of farms according to landholding size. Specifically, for any livestock product (e.g., ruminants), there are six production functions defined at the regional level, which implies 42 (= 7 x 6) livestock production functions. On the crop side, there are 2,052 (= 38 x 6 x 3 x 3) production functions for 38 crops produced in 6 regions with 3 types of farming systems and 3 landholding sizes. Together with forestry and fishery, which are defined at the national level, the model includes, in total, 2,113 agricultural production functions. The production functions for the nonagricultural sectors are also defined at the national level.

As in any other quantitative economic analysis, certain assumptions must be applied before calibrating the Morocco model to the data. In a typical CGE model, a constant-return-to-scale technology with constant elasticity of substitution (CES) between primary inputs is a fundamentally necessary assumption in order for the model to have a general equilibrium solution. However, as both primary and intermediate inputs are considered in the production functions of a CGE model, a Leontief technology in which input-output coefficients are fixed is often assumed for the use of intermediate inputs—such as fertilizer and seeds in crop production, feed in animal production, and raw materials in the food-processing industry—as well as for the relationship between intermediate and primary inputs in aggregation.

The demand side of the CGE model is dominated by a series of consumer demand functions. In our model, the system of consumer demand functions is solved by maximizing a Stone-Geary utility function in which the income elasticity can departure from one (which is different from a Cobb-Douglas [CD] utility function in which income elasticity is always one), and hence the marginal budget share for each consumer good departs from the average budget share of consumption.2 With such a utility function assumed, information on income elasticity is required in order to calibrate the demand system to the data. We will discuss this in detail below, together with the discussion about the data and other parameters applied in the model. As in any other general equilibrium model, consumers' income that enters the demand system is an endogenous variable. Income generated from the primary factors employed in the production process is the dominant income source for consumers, while incomes coming from abroad (as remittances received) or the government (as direct transfers) are also considered. The links between demand and income are further considered for 10 representative consumer groups that are consistent with the 10 aggregated households (five in the rural and five in the urban areas) according to national population quintiles. Income distribution and sources of income are based on the National Household Living Standard Survey.

2 Marginal budget share (MBS) relates the allocation of incremental income among different consumption goods, while average budget share (ABS) is the current (total) budget allocation among different goods. For example, a consumer currently spends 2 percent of his or her income on vegetable consumption, indicating that the ABS for vegetables is 2 percent. When this consumer's income increases in the next year, for each increased dollar of income, he or she prefers to spend 3 cents on vegetables. In this case, the MBS for vegetables is 3 percent. When the MBS is greater than the ABS for a particular consumption good (in this case, vegetables), demand for this good is called income elastic. In contrast, if the MBS value is lower than the ABS for a particular good (e.g., wheat), demand for this good (wheat) is said to be income inelastic.

The relationship between supply and demand must be explicitly modeled in a CGE model, and this relationship determines the equilibrium prices in the domestic markets. Given that a CGE model also captures trade flows, both import and export, the relationship between domestic and international markets is also modeled explicitly. Generally speaking, any commodity produced or consumed in the domestic market can also be an exported or imported commodity. However, in a CGE model, the commodities produced or consumed in the domestic market are not perfectly substitutable for those going to or coming from international markets. Because of this assumption, the international price for any product, regardless of whether this product is exportable or importable, cannot be fully transmitted into domestic markets, and changes in domestic supply and demand will ultimately determine its price. That is to say, all the prices in the domestic market, either as producer prices or consumer prices, are endogenous variables, although the border prices (measured in U.S. dollars) are the exogenous variables.

The endogenous producer and consumer prices, however, are affected by international prices, and linkages with international markets are captured by price-sensitive substitution (imperfect substitution) between foreign goods and domestic products. With such assumptions, when the international price of wheat rises, import demand for wheat falls and domestic wheat begins to substitute for imports. This in turn puts pressure on the domestic price of wheat, and domestic producers respond to the increased world wheat price only when the domestic price of wheat starts to rise. As a result, the consumer price of wheat increases not only because of a higher import price but also because of a higher domestic price. With such imperfect substitution, while the international price can transmit into the domestic market, the magnitude of increases in the domestic wheat price is always smaller than the increased world price, and this magnitude is determined by the initial ratio of wheat imports to total wheat consumption and the elasticity of substitution between imported and domestically produced wheat.

While the linkages between demand and supply through changes in income (an endogenous variable) and world prices (exogenous variables) are the most important general equilibrium interactions in an economywide model, production linkages also occur across sectors through the intermediate demand and competition for primary factors employed in production sectors. Many primary agricultural products must be processed before reaching consumers. Consumers only indirectly consume wheat, as it is an intermediate input of flour. Moreover, other inputs, both intermediate and primary factors, are employed in both wheat and flour production, which creates a series of backward and forward linkages across many other sectors. In this complex linkage process, it is not only the prices of wheat and flour that are expected to change, but also the prices of many other products and factors. Obviously, without a general equilibrium framework with a detailed subsector structure for agricultural and nonagricultural activities, an analysis is unlikely to capture this economywide impact of world food price shocks.

The government is generally included in a CGE model as an institutional account. In our model, the government collects taxes (which include tax revenue from domestic households and producers, export taxes, and import tariffs), transfers part of this income to households, and spends the rest either as investments or recurrent spending. To support any intervention that involves increasing government spending, the additional sources of government revenue must be considered in the general equilibrium setup. This will create additional impact on the economy. We will further discuss this in the scenario analysis of the model in the next section. The mathematical presentation of the Morocco CGE model is available upon request from the authors.

The interactions and linkages discussed above are a complex process, and they work together in the CGE model to determine how the model solution moves from its initial equilibrium to a new equilibrium when any external shock is introduced in a simulation process. The discussion of such linkages in this paper will focus on their effects on small farmers and poor consumers. The potential shocks introduced in the model simulations include external changes in world food prices and possible government policy responses corresponding to these external shocks.

Parameters and Elasticities Applied in the CGE model

Any modeling analysis based on a model with a system of equations depends critically on the elasticities and parameters employed in the model. However, unlike most partial equilibrium models, in which supply and demand functions are constructed as elasticity-based functions, in a CGE model, well-behaved structural functions are solved by maximizing profits on the producer side and maximizing welfare on the consumer side. In this way, the parameters capturing the economic structure and factor intensity at the sector level (in our case, at sector, agro-ecological region, and type of farm group levels) play more important roles in determining the model results than elasticities do. All these parameters must calibrate to the data, together with the predetermined elasticities.

Specifically, the substitution elasticity between primary inputs in the CES production function must be assumed or chosen from the literature, as any country's data set used to construct a CGE model is generally unable to support an econometric estimation for obtaining this elasticity for the entire production system that will be included in the model. For example, if a CD technology is chosen as the production structure of a CGE model, it then implicitly assumes a unit elasticity of substitution between primary inputs (e.g., labor, land, and capital) in the production functions. In this way, other parameters in the CD production function of the model (e.g., the marginal product of each input, the key parameter in this type of function) can be directly calibrated using the country data of the SAM (i.e., the share of value added for each input employed in the total value added by this sector). In our Morocco CGE model, we chose a general CES function form (other than CD technology) to calibrate other parameters in the production function. The elasticity in the production function is predetermined and drawn from the CGE model previously developed for Morocco. The other parameters in the production functions of the model are then calibrated using the data composed in the new Morocco SAM. Also, we decide to use similar substitution elasticity in the production functions for each production sector across agro-ecological regions and types of farm groups. However, because of the difference in factor intensity between different types of farm groups and different sectoral structures across regions, heterogeneity in the technology for producing a similar product is captured by calibrating the other parameters of the production function to this disaggregated data.

In addition to primary inputs, intermediate inputs are also employed in production processes. With the assumption of Leontief technology in the use of intermediates, a set of fixed input-output coefficients is applied in the production function, and these coefficients are directly calibrated using the data from the Morocco SAM.

With a Stone-Geary type of utility function applied in the model, the marginal budget share (MBS) is the parameter applied in the demand system of the model. While the average budget share (ABS) for each individual commodity consumed by each individual household group can be directly calculated using the data from the Morocco SAM, to derive a series of MBSs, the income elasticity of demand must be obtained. For this study, the income elasticity is estimated from a semi-log inverse function suggested by King and Byerlee (1978) and based on the household survey data discussed in Section 2. The estimated results are the MBSs for different commodities and different groups of households.

Limitations of the CGE Model

Like any other economic model, the CGE model has its limitations. Of these, there are at least two limitations or caveats that are important when interpreting the results. The first caveat is on the demand side. While income elasticities of demand in the model are econometrically estimated and subsistence consumption is taken into account in the demand functions, the use of a linear expenditure system (LES) to specify household demand can only partially capture structural change in the demand system. Marginal budget shares, and hence the income elasticity in such a demand system, remain constant over time. While rapid demand shifts can be better captured by using an AIDADS demand system (Yu et al. 2003) or by applying latent separability (Gohin, 2005), the highly disaggregated demand structure in the model constrains our choice of methods. Second, as in most other CGE models, production technologies that are calibrated to the initial economic structure remain constant and will not change with changes in world food prices. Because of this, the supply response is more static, and the model cannot capture the longer-term potential response when new investments are added and new technology is adapted. Bearing these caveats in mind, the CGE model can still provide useful simulations to assess the effects of rising world food prices within the context of a broader economic system.

5. ASSESSING THE GENERAL EQUILIBRIUM EFFECT OF RISING WORLD FOOD PRICES

Technically speaking, a CGE model is a simulation tool by nature, and it is often applied to evaluate an external change that may possibly occur in the economy. For this paper, we apply the CGE model developed for Morocco to evaluate the effect of rising world food prices by exogenously introducing a shock on import prices for cereals and oilseeds.

As discussed in the introduction, world food prices have been rising in recent years, which is a reverse trend against the historical movement of world food prices over a much longer period, such as over the last three decades. For example, world prices for wheat and corn almost doubled after 2003 but did not increase and even declined before that. Such significant jumps in world food prices have started to affect many developing countries that depend on food imports to meet domestic demand. Morocco is such a country. As shown in Section 3, cereal and oilseed imports account for 63 percent of total agricultural imports. Imports account for 22 percent of cereals, 76 percent of corn, and 60 percent oilseeds in the country's total absorption of these three commodities. Most imported food products are raw materials used in the domestic food-processing industry that provides wheat flour, feed, and vegetable oil to domestic consumers and livestock producers. While Morocco usually imposes high import tariffs on raw material imports, some food-processing sectors are heavily subsidized. Two major food-processing industries, refined sugar and soft wheat flour, are the most heavily subsidized sectors. Subsidies account for 74 percent of the flour product value produced by the large subsidized manufacturers and are equivalent to 48 percent of the import value of soft wheat.

The general purpose of food-processing subsidies is to keep domestic prices low for commodities consumed as staples by a majority of Moroccans. However, even with the removal or reduction of import tariffs, increased world prices for imported food materials mean that domestic prices for food products that depend on these imports are expected to rise, given that the processing manufacturers have already been heavily subsidized. Concerned about the welfare impact of these increased food prices on poor consumers, the Moroccan government is considering a policy of temporary subsidies for imports of wheat, corn, and soybeans, to lower the production costs of domestic processing manufacturers. However, while large domestic food manufacturers depend heavily on material imports for their food production, wheat and oilseeds are also major products of many small farmers, for whom the poverty rate is very high and for whom higher prices mean higher incomes. Certain trade-offs exist. Balancing the welfare impact between consumers and small farmers is an important policy issue.

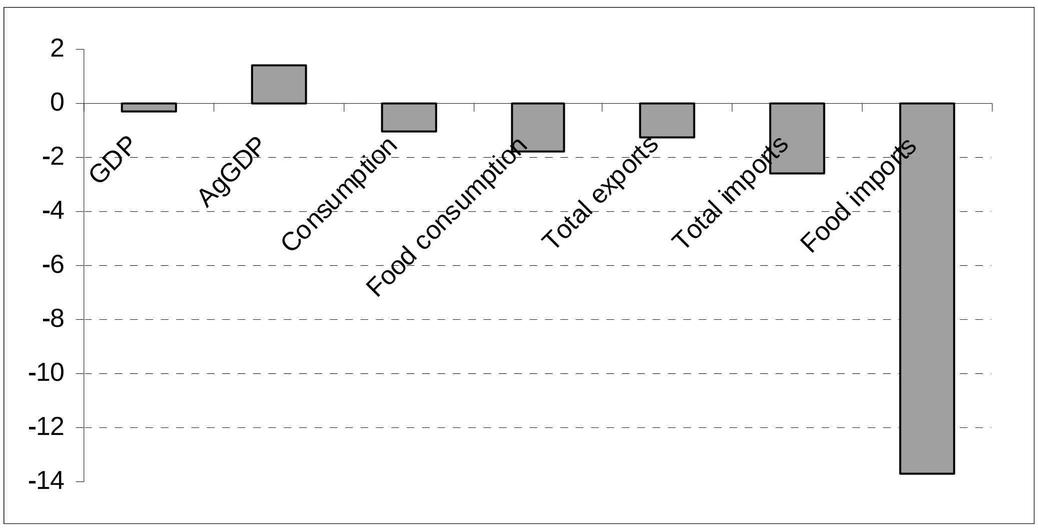
Against this background, we first use the newly developed CGE model to simulate a policy option in which, other than removing or reducing import tariffs, the government does not introduce any more interventions to lower food prices domestically. The net increases in wheat, corn, and oilseed prices are calculated according to the difference between current world prices and the previous protected prices with high tariff rates. These increases are equivalent to a 50 percent rise in the import price of wheat and corn and a 20 percent rise in the price of oilseed. In the second scenario of the CGE model simulation, we then assess the economywide impacts of import subsidies, with a special focus on poor consumers and small farmers. The subsidy rate for wheat, corn, and oilseed is chosen at a level such that there is no net increase in import prices for these three commodities, which implies that the import subsidy rate is about 50 percent for wheat and corn, and 20 percent for oilseed.

The last two scenarios are designed to evaluate whether there are alternative policies to minimize the negative effects of import subsidies, which in theory are a policy-distorting resource allocation and hence lower the efficiency of the country's overall economy. In the third scenario, instead of an import subsidy policy, we assume that the government can directly subsidize low-income consumers, and the total of this direct transfer is equivalent in value to the import subsidies. The last scenario is the combination of consumer subsidies with increased public investment in agriculture. The purpose of this scenario is to emphasize that increased import substitution of agricultural products should mainly come from improved agricultural productivity in these crops instead of land expansion, which will further damage the long-term growth of agriculture. In this scenario, the amount of subsidy value and increased agricultural investment together is the same as the total value of import subsidies assumed in scenario 2.

World Food Price Affects the Economy Modestly

We first discuss the aggregate effect of increased world prices for wheat, corn, and oilseed on the economy as a whole. With the removal or reduction of import tariffs and without other government intervention, the increased import prices are still higher than the previous tariff-protected prices. This affects the domestic economy directly by making imports of wheat, corn, and oilseed more expensive to domestic users, mainly manufacturers in the food-processing industry. The increased production costs for food manufacturing cause increases in the prices paid by domestic consumers and livestock producers for wheat flour, feed, and vegetable oil. For example, the domestic price of wheat flour rises by 8.5 percent and the price of vegetable oil by 4.0 percent. When world prices are high, import substitution occurs for wheat, corn, and oilseeds, as processing manufacturers prefer to use more domestic products than imports when import prices are high. This causes total food imports to fall by 14 percent in real terms (Figure 1), but fall less in the normal terms (4.7 percent). However, as imports of these food material products account for only 1.7 percent of total national imports, declining food imports cause total imports to fall by only 2.6 percent.

Figure 1. Aggregate effect of increased world food prices on the economy (% change from the base)



Source: New Morocco CGE model results

When high world food prices translate into high domestic prices, domestic supply response occurs. Resources move into wheat, corn, and oilseed production. Competition for resources causes land returns to rise by 14 percent on average (but varies across the six agro-ecological regions). Change in the returns to other factors and in the wage rate depends on the factor intensity of wheat, corn, and oilseed production relative to other production activities. The model results show that while the family labor wage rate increases by 4.1 percent on average, the wage rate for hired labor actually falls slightly, by 1.1 percent, due to the release of labor from sectors negatively affected by the increased import prices and from food-processing sectors. A similar change is also observed for returns to capital, especially for the capital employed in livestock production (which falls by 12.4 percent) as increased feed costs hurt domestic livestock production.

However, in total, the agricultural sector benefits from world food price increases, as real AgGDP increases by 1.4 percent, mainly due to an increased supply of wheat, corn, and oilseeds by domestic producers, as domestic production increases by 15.4 percent for wheat, 80 percent for corn (from a quite low base), and 15.7 percent for oilseeds.

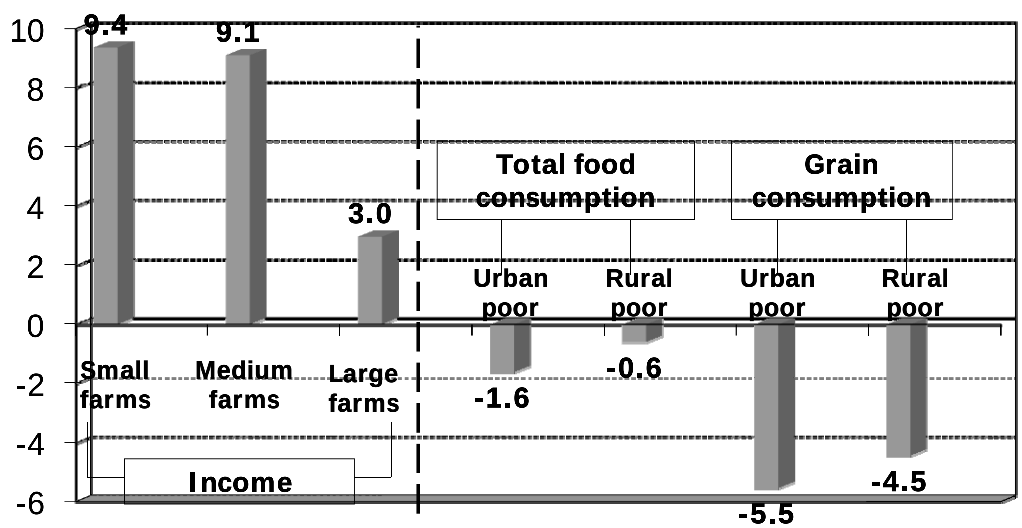
On the consumer side, because of high food prices, wheat flour consumption falls by 4.3 percent, though consumers must pay 3.2 percent more for this reduced consumption. Food consumption in total falls by 1.7 percent and total consumption by 1.1 percent, all in real terms. Combining the effects on the consumer and producer sides, the joint macroeconomic effect is negative but very modest, as national real GDP falls by 0.3 percent.

Poor Consumers Are Hurt While Small Farmers Gain

The main concern regarding increased world prices is their effect on low-income consumers. As shown in Table 5, poor consumers spend proportionally more of their income on food, and their food demand is more price inelastic than that of rich consumers. While food accounts for more than 50 percent of the total consumption expenditure average for the country, for the poorest consumers that share rises to almost 70 percent. Moreover, the poor consume proportionally more cereals than the nonpoor (second part of Table 5), and cereals have experienced the most significant price hikes in the world market.

Increased food prices, however, can benefit farmers for whom cereals and oilseeds are the major income-generating crops. Among these farmers we pay more attention to the small farmers, as small farmers account for 44 percent of the national poor.

Figure 2. Direct effect of rising world food prices on the poor (% change from the base)



Source: New Morocco CGE model results

The simulation supports the intuitive expectations in terms of consumer effect. As shown in Figure 2, facing increased food prices, both rural and urban poor consumers must reduce their total food and grain consumption. The urban poor are affected more; their grain consumption falls by 5.5 percent, compared to the 4.5 percent decline in rural poor consumers' grain consumption. When poor consumers spend more on grain consumption, they must reduce their consumption of other goods, given their budget constraints. Poor urban consumers reduce their total food consumption by 1.6 percent and poor rural consumers by 0.6 percent.

Table 6. General equilibrium welfare effect (EV) of model simulations

	Rising import price Sim 1	Import subsidy Sim 2		Direct transfer Sim 3		Transfer+TFP Sim 4	
	% change from base		% change from Sim 1	% change from base	% change from Sim 1	% change from base	% change from Sim 1
Poor rural consumers	0.02	0.07	0.05	4.86	4.83	5.38	5.36
Poor urban consumers	-0.62	-0.03	0.59	6.24	6.90	6.79	7.45

Source: New Morocco CGE model results
Note: *EV = equivalent variation; TFP = total factor productivity*

However, a general equilibrium welfare measure of increased world food prices is modest for poor consumers when the equivalent variation (EV) is calculated using the formula adapted from Blonigen, Flynn, and Reinert (1997). EV is an indicator used to measure welfare in monetary terms, as it shows the minimum payment that the consumer would require to forgo a change (in this case, the increase in food price). That is to say, if the consumer receives this payment, then his or her welfare would be the same as in the base scenario with the base prices and income. The EV thus considers both income and price effects in a general equilibrium setup. The calculated change in the EV is slightly positive (0.02 percent) for rural poor households and slightly negative (-0.62 percent) for urban poor households (Table 6, column 1). These results indicate that, taking into account both income and price effects, rural poor households are slightly better off, while urban poor households are worse off, when world food prices rise. However, these negative effects on the urban poor are very modest when measured in monetary terms.

The slightly positive welfare effect on the rural poor is due to the relatively large income effect on small farmers, of which many are net sellers of wheat. As shown in Figure 2, among the three farmer groups classified by landholding size, those with small farms benefit more from increased world prices, as their income rises by 9.4 percent. Next are those with medium farms, whose income rises by 9.1 percent, while the income for those with large farms rises by only 3.0 percent. Why do small farmers benefit more from increased food prices? As shown in the survey data (not presented here), small farmers allocate more land to staple crop production (89 percent of small farmers grow staple crops only, according to the survey) and a majority of them are involved in wheat production. The simulation results show that returns to land rise with increased world food prices. The second reason is that for small farmers, family labor is a dominant input (together with land), while the use of hired labor and capital is minimal. As discussed above, the wage rate for family labor increases in nominal terms. This benefits small farmers more than farmers with large landholdings, who depend on hired labor and use more capital in their production.

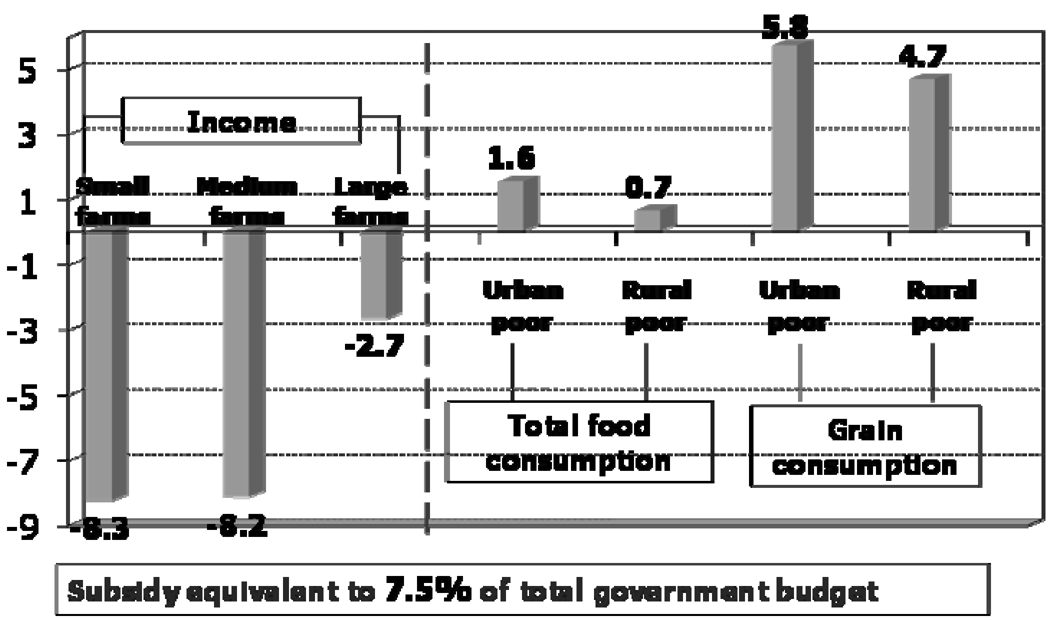
It must be noted that the rural poor are not only small farmers. The survey data show that while the majority of rural poor (55 percent) are small farmers, rural landless households account for 28 percent of the rural poor. These rural poor households cannot enjoy positive income effects, as they are involved in agricultural production either as workers or are participating in livestock production. Moreover, we know that wage rates for hired labor and returns to capital employed in livestock production actually fall in this scenario, indicating a negative income effect for rural landless households. Combined with a negative price effect for them as consumers, this is expected to lead to a decrease in the welfare of the rural landless poor. The model, however, cannot distinguish the rural landless poor from rural poor farmers on the consumer side; it can only distinguish them on the production side, which may underestimate the negative effect of increased world food prices on this group of rural poor.

Impact of Food Import Subsidy Policy

The above analysis shows that although the welfare effect on the poor is small in a general equilibrium measure, the direct effect of increased world food prices on poor consumers, especially on urban poor consumers, is significant if it is measured by the change in grain or food consumption. Such effects are easily observed and hence cause more concern than the general equilibrium effect, which is measured using a relatively complicated economic formula. Because of this, the pressure to increase government intervention is high and the direct response, which is the easiest one, is to subsidize imports of commodities whose prices have risen significantly. In the second scenario we simulate this policy option, and the subsidy rate is calculated to counter the effect of the increase in world prices. The required total subsidy is equivalent to 7.5 percent of the government budget.

The results shown in Figure 3 seem to indicate that the import subsidy does achieve its purpose of isolating the domestic market from the international shock and stabilizing domestic prices. If the increase in world food prices is a temporary phenomenon, this kind of policy seems to be necessary. However, we should point out that price interventions will always have a negative effect on the economy if the change in the world prices becomes a long-term trend. Morocco has for a long time applied high tariffs on many staple crops and livestock products to protect domestic producers. At the same time, there have been high subsidies for processors of wheat flour, vegetable oil, and refined sugar to protect domestic consumers. Such double-protection policies have been shown to significantly distort price signals, resource allocation, and competition in the processing industry, which lowers the competitiveness of Moroccan agriculture in the long term.

Figure 3. Direct effect of food import subsidy on the poor (% change from the first scenario)



Source: New Morocco CGE model results

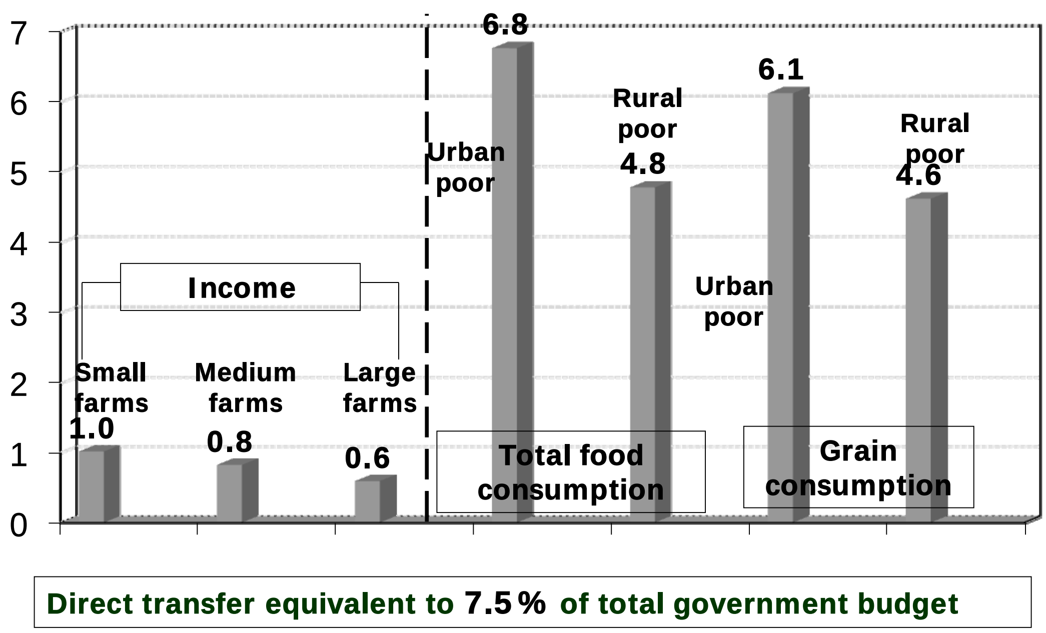
While the negative effects of current double-protection policies in agriculture and food processing have already been recognized, pressure from interest groups that have enjoyed these policies for a long time has resulted in continuous postponement of any possible reform. With increased world food prices for agricultural products that Morocco imports, it is possible for the first time for the country to liberalize its agricultural trade without too much concern about negative effects on the farm producers protected by the trade policy. In the meantime, Morocco is renegotiating with the European Union for bilateral trade liberalization in agriculture. Against such a background, while the imposition of import subsidies may temporarily isolate domestic markets from the international price shock, such a policy may prevent the country from benefiting from a unique opportunity to liberalize its agricultural trade and enjoy long-term gains from more efficient resource allocation and increased competitiveness. Based on these considerations, we have analyzed two additional scenarios using the CGE model to evaluate policy alternatives and their effect on the economy and the poor.

Alternative Policy 1: Targeting the Poor through Direct Transfer

The first alternative is a direct transfer policy to target the poor as consumers. While import subsidies benefit poor consumers, they lower domestic food prices for all consumers and, in absolute terms, the largest gains actually go to rich consumers who do not need to be protected. While staple food accounts for a smaller share of rich consumers' total budgets, in absolute terms, rich consumers consume more such products than the poor do. In terms of grain consumption, urban consumers in the richest national population quintile consume six times more than poor urban consumers, while in terms of share of total spending, the share of grain consumption in the richest urban consumers' total expenditure is only 15–25 percent of the grain share in the poorest urban consumers' total budget. Because of this, the simulation results show that the general equilibrium benefit (EV) of import subsidies received by the richest urban consumer group (which are not reported in Table 6) is 16 times that of the poorest urban consumers, compared with the results of scenario 1, in which there is no such subsidy when world food prices rise.

When the import subsidy is replaced by direct transfers to poor consumers, with a similar amount of government spending, the benefits of the policy intervention go primarily to poor consumers. As shown in Figure 4, in comparison to the first scenario, the total food consumption of the urban and rural poor increases by 6.8 and 4.8 percent, respectively, and grain consumption increases by 6.1 and 4.6 percent. The fact that the increase in total food consumption is more than the increase in grain consumption indicates that the income effect becomes a dominant factor. Although the poor now face higher food prices, because the direct transfer provides them more income, not only can they consume almost the same level of grain products as before the world price increase, but they can also allocate more income to increase their consumption of other food products.

Figure 4. Effect of the direct transfer on the poor (% change from the first scenario)



Source: New Morocco CGE model results

The general equilibrium measure of the welfare effect is more encouraging. Compared with the welfare level (EV) in the first scenario, the import subsidy policy increases rural and urban poor consumers' welfare by only 0.05 and 0.6 percent, respectively. When the import subsidy is replaced by direct transfers, the welfare gains increase to 4.8 percent for the rural poor and 6.9 percent for the urban poor (Table 6, columns 3 and 5). It should be noted that this increase in the welfare of the poor is at the expense of the welfare of the rich, as in a general equilibrium model the transfer must be financed through increased income taxes, and, in general, the rich pay most of these taxes. However, as the per capita income of the rich is 3.3 and 6.6 times the per capita income of the poor in rural and urban areas, respectively, the welfare loss for the rich is insignificant calculated as a percentage of their total income. For example, the welfare loss for the richest urban household group is only 0.22 percent compared with that in the first scenario and 1.7 percent compared with that in the base.

Another advantage of the direct transfer policy is its effect on producers, especially on small farmers. As shown in Table 7, compared with the results in the first scenario, not only do small farmers continue to enjoy the gains from increased world food prices, but these gains are further enhanced due to the demand-side effect in the domestic market. In total, the income of small farmers increases by 10.5 percent from the base: 9.4 percent due to increased world food prices and 1.1 percent due to the direct transfer policy. Thus, it is reasonable to conclude that the direct transfer policy can generate the benefits that the import subsidy policy attempts to achieve and, at the same time, can overcome the disadvantage of the import subsidy policy affecting small farmers negatively. It is true that moving from direct intervention via price supports to an income transfer policy needs an administrative infrastructure that may not exist in the current system. Our analysis shows the advantages of creating such an administrative infrastructure, and hence suggests that it should be considered as an important component of policy reform during the trade and market liberalization process.

Table 7. Income and consumption effect of the simulations

	Rising import price	Import subsidy		Direct transfer		Transfer+TFP	
	Sim 1	Sim 2		Sim 3		Sim 4	
	% change from base	% change from base	% change from Sim 1	% change from base	% change from Sim 1	% change from base	% change from Sim 1
Income							
Small farms	9.4	0.3	-8.3	10.5	1.0	9.8	0.4
Medium farms	9.1	0.2	-8.2	10.0	0.8	9.5	0.4
Large farms	3.0	0.2	-2.7	3.6	0.6	4.2	1.2
Food consumption							
Urban poor	-1.6	-0.1	1.6	5.0	6.8	6.8	8.6
Rural poor	-0.6	0.0	0.7	4.1	4.8	5.4	6.1
Grain consumption							
Urban poor	-5.5	-0.1	5.8	0.2	6.1	4.5	10.6
Rural poor	-4.5	0.0	4.7	0.0	4.6	3.5	8.3

Source: New Morocco CGE model results
Note: *TFP = total factor productivity*

Alternative Policy 2: Direct Transfer Combined with Increased Agricultural Investment

In the last scenario, we combine the direct transfer policy with increased public investment in agriculture. While rising agricultural prices benefit farmers through supply response, increased grain production requires more water, a scare resource in the country. Although irrigation potential still exists in Morocco (UNDP 2008), without additional public investment, this potential cannot be realized in the short term. Additional grain production is often a result of land expansion, which may have a long-term negative effect on the environment. Moreover, without improving productivity in grain production, Morocco will be unable to increase the competitiveness of its agricultural sector, and domestic grain-processing manufacturers will hesitate to substitute imports with domestic supply.

Table 8. Grain production effect in the simulations

	Rising import price Sim 1	Direct transfer to poor consumers Sim 3		Transfer+TFP increase in grain production Sim 4	
	% change from base	% change from base	% change from Sim 1	% change from base	% change from Sim 1
Grain output, total	15.4	15.9	0.4	23.0	6.5
Small farms	14.6	15.0	0.4	21.8	6.3
Medium farms	15.3	15.8	0.4	22.9	6.6
Large farms	15.8	16.3	0.4	23.4	6.6
Grain area, total	6.7	6.7	0.0	2.6	-3.8
Small farms	7.6	7.7	0.0	3.0	-4.3
Medium farms	6.3	6.3	0.0	2.3	-3.8
Large farms	6.7	6.8	0.1	2.8	-3.6

Source: New Morocco CGE model results
Note: *TFP = total factor productivity*

Against this background, we have designed a scenario in which 40 percent of the government spending assigned to the import subsidy in scenario 2 is assumed to be spent on direct transfers targeting the poor, while the remaining 60 percent is assumed to be used for promoting agricultural productivity in cereals through public investment in agriculture. Due to a lack of estimations of the impact of public investment on cereal productivity in Morocco, we applied the estimated elasticity in Thirtle et al. (2003, which sampled 22 African countries, including Morocco.3 With this elasticity, a 1 percent increase in a government's agricultural spending results in a 0.363 percent increase in agricultural total factor productivity (TFP). In this simulation, given that cereal production is about 34 percent of total agricultural output, the increased agricultural spending results in a 10 percent TFP increase for cereal production.

With a 10 percent productivity increase in grain production, more grain is produced by domestic farmers with less land allocated to the grain sector. As shown in Table 8, the pure supply response to the increased world grain prices is about 15.4 percent of the base level of total production (Table 8, column 1), and an additional 0.4 percent increase can be induced by a further response to the increased incomes of poor consumers (Table 8, column 3). With a 10 percent increase in TFP, an additional 6.5 percent increase in grain production (compared with that in scenario 1) is obtained. Farmers of all types enjoy these productivity gains equally. More encouraging is the fact that the amount of land allocated to grain production actually falls, while production increases. Compared with scenario 1, grain areas fall by 3.8 percent in total and fall more for small farmers (Table 8, column 5), though the grain areas still rise compared with those in the base scenario.

3 Similar elasticity is obtained in Fan (2008).

Increased grain production causes the domestic price of grain to fall. Compared with their base levels, domestic producer prices for wheat fall by 3.5–4.1 percent, which lowers the gain to farmers, measured by their nominal income (Table 7, column 7). However, consumers benefit from the lower food prices. As shown in Table 7, poor consumers significantly increase their grain consumption. Comparing the results in columns 5 and 7, additional 4.5 and 3.7 percent increases in grain consumption are observed for urban and rural poor consumers, respectively. This further benefits the poor by raising their total food consumption. The general equilibrium measure of welfare gain (EV) shown in Table 6 indicates an additional 0.53 and 0.55 percent increase, respectively, in urban and rural consumers' total welfare.

6. CONCLUSIONS

Against the background of the recent rise in world food prices, this study has evaluated the potential impact of the price increases on the Moroccan economy and of the policy options to deal with it. The study has paid more attention to the poverty effect of such an external shock and possible policy responses to it. In order to fully capture the poverty effect, we first address the patterns of poverty distribution and smallholder agriculture in Morocco using national representative household survey data. A new SAM and a CGE model were developed for this study based on micro-level data in combination with other sector-level and economywide data. Both the SAM and CGE model have been disaggregated to the six agro-ecological regions for agriculture with three types of land and three types of farms by landholding size. Households on the consumer side are further disaggregated into 10 groups according to their income level and rural or urban location. We developed four scenarios using the CGE model to simulate possible policy options to address the increased world food prices.

The CGE model simulations show that while increased world food prices would hurt poor consumers, the general equilibrium effect of welfare loss is modest. Agricultural producers gain, and benefits to small farmers are especially large. The simulation of import subsidy shows that while such a policy option can temporarily isolate the external shock coming from international markets and stabilize domestic prices, the benefits to consumers are at the expense of producers. The most important risk of such a policy is in the long term if world prices continue to rise. Any policy that directly works on the market price can distort market incentives and lower the efficiency and competitiveness of the economy.

This study has pointed out that it is possible for Morocco to turn the challenge of rising world food prices into an opportunity to move away from the market interventions that have existed in the country for a long time. The opportunity arises because it is the first time that agricultural trade liberalization can have less negative effect on the producer side. In this context, we applied our CGE model to simulate some alternative policy options. The model results indicate that there are win-win options for Morocco if policies are based on a longer-term objective. When direct transfers are provided to the poor as consumers, using the same government budget, the benefits received by poor consumers are much larger than those under the import subsidy policy. In addition, a direct transfer policy will benefit farmers—especially small farmers, who account for the majority of the nation's poor.

The study emphasizes the close relationship between poverty alleviation and agricultural policies. While certain policies, such as import subsidies, seem to benefit a group of the poor—the urban poor and rural landless consumers—these benefits can come at the expense of another group, poor farmers. A win-win policy often depends on balancing the interests of different types of poor and paying attention to the long-term effects of the policy on the poor. The model results show that combining direct transfers to poor consumers with increased public investment in agriculture to improve agricultural productivity is a win-win strategy that the government should consider. Our analysis indicates that now is a good time for the government to create an administrative infrastructure that can provide more poverty-targeted interventions instead of direct interventions to support prices—policies that provide little benefit to the poor while representing a huge cost in terms of economic efficiency. The analysis further points out that, because low productivity in staple crop production is the dominant reason for rural poverty among Moroccan farmers, improving productivity in staple food production as a poverty alleviation strategy can benefit the poor as producers. However, given that about one-third of rural households are landless and many of them are poor, creating more nonfarm opportunities is equally important for poverty alleviation. Thus, poverty reduction in rural areas also depends on factors outside agriculture. These linkages between rural areas and the rest of the economy deserve further study.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1. Structure of Moroccan agriculture

Share (%):	Agricultural GDP	Production value	Value of return to labor	Export value	Import value
Hard wheat	6.1	4.9	4.1	0.0	14.7
Soft wheat	11.5	8.6	6.8	0.0	23.1
Barley	6.7	4.3	8.1	0.0	2.1
Corn	0.5	0.4	1.4	0.0	13.7
Other cereals	0.6	0.3	0.3	0.0	0.1
Broad beans	0.3	0.4	0.7	0.1	0.0
Peas	0.1	0.1	0.2	0.0	0.2
Other pulses	0.5	0.5	1.4	0.5	0.4
Oilseed crops	0.5	0.6	0.7	0.0	9.5
Sugar beet	1.8	1.2	2.7	0.0	0.0
Sugarcane	0.2	0.2	0.7	0.0	0.0
Other industrial crops	0.4	0.4	1.4	0.0	8.4
Tomatoes	2.4	2.5	1.4	11.3	0.0
Potatoes	3.6	3.1	4.7	1.3	1.1
Onions	1.8	1.2	0.7	0.1	0.0
Green peppers	0.6	0.5	0.4	0.6	0.0
Melons	0.6	0.5	0.7	1.3	0.0
Watermelons	0.6	0.5	0.3	0.1	0.0
Green broad beans	0.3	0.2	0.4	0.0	0.0
Green peas	0.2	0.2	0.5	0.1	0.0
Green beans	0.4	0.2	0.4	2.5	0.0
Carrots and turnips	0.6	0.5	0.5	0.0	0.0
Zucchini	0.3	0.2	0.3	1.0	0.0
Strawberries	0.5	0.4	1.4	0.9	0.0
Other vegetables	1.2	1.2	1.4	2.5	0.2
Industrial tomatoes	0.1	0.1	0.3	0.0	0.0
Other industrial vegetables	0.2	0.1	0.2	0.2	0.0
Clover	2.4	1.2	2.7	0.0	0.0
Other fodders	1.8	1.2	2.0	0.0	0.0
Other crops and services	9.1	6.2	11.5	22.6	18.9
Olives	2.4	1.8	8.1	0.0	0.0
Clementines	1.2	0.6	1.4	10.0	0.0
Other citrus crops	1.8	1.2	1.4	10.0	0.0
Grapes and vineyards	1.2	0.6	1.4	0.5	0.2
Almonds	3.6	2.5	1.4	0.4	0.1
Apple trees	2.4	1.2	2.0	0.0	0.1
Dates	1.2	0.6	1.4	0.0	0.8
Other fruit trees	7.3	3.7	2.0	2.5	0.4
Cattle	4.9	9.9	6.1	0.0	0.0
Ruminants	2.4	4.9	2.7	0.0	0.0
Poultry and eggs	5.5	5.5	0.5	0.0	2.1
Other livestock activity	0.3	0.6	0.3	1.3	0.2
Beef	0.4	9.2	2.0	0.0	0.0
Mutton	0.1	4.3	0.7	0.0	0.0
Raw milk	0.3	3.7	1.4	0.0	0.0
Forest	1.8	1.2	0.5	3.8	3.2
Fisheries	7.3	6.2	8.8	26.4	0.4

Source: 2003 Social Accounting Matrix

Table A.2. Structure of Moroccan agricultural processing industry

Share (%):	Industrial GDP	Production value	Value of return to labor	Export value	Import value
Dairy industry	1.9	5.5	2.3	2.4	8.7
Raw sugar mills	1.9	2.3	6.9	0.0	24.6
Sugar refinery	5.8	4.7	10.3	0.2	0.1
Hard wheat flour	3.9	3.9	1.6	0.0	0.0
Soft wheat flour, regular	3.9	7.8	3.4	0.0	0.0
Soft wheat flour, subsidized	0.9	1.6	2.0	0.0	0.0
Vegetable oil mills	0.9	1.6	0.7	0.0	17.4
Refinery of vegetable oil	1.9	3.9	3.4	0.3	1.4
Olive oil, table	1.5	1.6	1.6	5.6	0.0
Olive oil	1.6	2.3	2.7	0.1	1.4
Other food industry	75.7	64.8	65.1	91.4	46.3

Source: 2003 Social Accounting Matrix

Table A.3. Distribution of agricultural production across agro-ecological regions (National total for each subsector is 100)

	All crops							Livestock
		Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees	
Favorable	40.5	43.4	85.2	42.8	47.4	33.0	33.8	44.7
Intermediary	19.0	20.8	5.4	16.3	25.1	46.6	1.9	13.1
Unfavorable South	26.1	21.8	6.2	31.3	14.4	13.3	39.7	6.7
Unfavorable East	5.5	4.7	1.3	5.0	9.2	1.9	9.1	17.5
Mountain	5.0	7.9	1.6	2.7	3.9	1.2	6.0	4.8
Sub-Saharan	3.9	1.4	0.2	1.9	0.0	4.0	9.6	13.2

Source: 2003 Social Accounting Matrix

Table A.4. Distribution of agricultural production within each agro-ecological region (Regional total agricultural production is 100)

	All crops							Livestock
		Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees	
Favorable	60.5	21.5	3.5	12.9	2.2	7.9	12.5	39.5
Intermediary	71.0	25.7	0.6	12.3	2.9	27.8	1.7	29.0
Unfavorable South	86.9	24.1	0.6	21.1	1.5	7.0	32.6	13.1
Unfavorable East	34.6	10.0	0.2	6.4	1.8	1.9	14.3	65.4
Mountain	63.7	33.5	0.6	6.9	1.5	2.5	18.8	36.3
Sub-Saharan	33.1	3.9	0.1	3.3	0.0	5.5	20.3	66.9

Source: 2003 Social Accounting Matrix

Table A.5. Distribution crop production across three types of land by region (National total agricultural production in each type of land by subsector is 100)

	All crops	Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees
Favorable							
Large irrigation	19.5	17.8	82.9	25.5	27.2	16.1	11.4
Other irrigation	37.3	25.5	98.9	43.4	75.8	31.0	33.8
Rainfed	52.8	47.9	81.7	65.0	78.8	75.6	51.5
Intermediary							
Large irrigation	14.4	24.9	2.3	11.6	41.7	16.1	0.3
Other irrigation	22.1	1.1	0.0	15.6	0.0	59.8	0.3
Rainfed	18.2	21.6	7.8	28.2	0.0	20.7	5.7
Unfavorable South							
Large irrigation	38.2	42.7	13.2	41.3	21.4	42.9	38.0
Other irrigation	31.6	43.6	1.1	33.0	13.1	6.2	53.1
Rainfed	15.7	17.6	6.1	5.9	0.0	3.0	18.7
Unfavorable East							
Large irrigation	12.3	6.4	0.0	14.9	9.7	6.7	19.2
Other irrigation	2.3	5.4	0.0	3.2	11.1	0.7	1.8
Rainfed	5.5	4.5	2.0	0.9	7.3	0.2	13.2
Mountain							
Large irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other irrigation	5.7	22.9	0.0	3.8	0.0	1.7	9.3
Rainfed	6.5	7.9	2.5	0.1	13.8	0.4	5.1
Sub-Saharan							
Large irrigation	15.7	8.1	1.6	6.7	0.0	18.2	31.1
Other irrigation	1.1	1.4	0.0	1.0	0.0	0.5	1.7
Rainfed	1.3	0.5	0.0	0.0	0.0	0.1	5.8
Rural total							
Large irrigation	18.2	10.7	15.4	17.5	60.3	20.1	22.8
Other irrigation	40.1	5.9	19.3	70.9	11.4	68.6	48.2
Rainfed	41.7	83.5	65.3	11.6	28.3	11.3	28.9

Source: 2003 Social Accounting Matrix

Table A.6. Distribution of crop production by three types of land within each agro-ecological region (Regional total agricultural production is 100)

	All crops						
		Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees
Favorable	100.0						
Large irrigation	8.8	1.6	0.9	2.2	1.3	1.3	1.6
Other irrigation	36.9	1.2	1.3	15.4	0.7	8.4	10.0
Rainfed	54.3	32.8	3.6	3.8	1.7	3.4	9.1
Intermediary	100.0						
Large irrigation	13.7	4.6	0.1	2.2	4.1	2.7	0.1
Other irrigation	46.5	0.1	0.0	11.7	0.0	34.5	0.2
Rainfed	39.7	31.5	0.7	3.5	0.0	2.0	2.1
Unfavorable South	100.0						
Large irrigation	26.6	5.8	0.2	5.6	1.5	5.3	8.2
Other irrigation	48.4	3.3	0.0	18.1	0.2	2.6	24.2
Rainfed	25.0	18.7	0.4	0.5	0.0	0.2	5.1
Unfavorable East	100.0						
Large irrigation	41.0	4.2	0.0	9.7	3.3	3.9	19.9
Other irrigation	16.6	1.9	0.0	8.4	0.7	1.5	4.0
Rainfed	42.4	22.7	0.7	0.4	1.2	0.1	17.3
Mountain	100.0						
Large irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other irrigation	45.7	9.0	0.0	10.8	0.0	3.7	22.2
Rainfed	54.3	43.5	0.9	0.0	2.4	0.1	7.3
Sub-Saharan	100.0						
Large irrigation	74.2	7.4	0.2	6.1	0.0	15.1	45.4
Other irrigation	11.2	0.7	0.0	3.8	0.0	1.5	5.2
Rainfed	14.5	3.7	0.0	0.0	0.0	0.0	10.8
Rural total	100.0	33.2	2.7	20.2	3.1	16.0	24.8
Large irrigation	18.2	3.5	0.4	3.5	1.9	3.2	5.7
Other irrigation	40.1	2.0	0.5	14.3	0.4	11.0	11.9
Rainfed	41.7	27.7	1.8	2.3	0.9	1.8	7.2

Source: 2003 Social Accounting Matrix

Table A.7. Distribution of crop production across three types of farms by region (National total agricultural production in each type of farm group by subsector is 100)

	All crops	Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees
Favorable							
Small farm	47.4	46.9	89.1	47.7	70.9	40.7	38.6
Medium farm	44.4	44.2	83.3	46.6	56.2	41.2	35.1
Large farm	37.3	41.3	85.3	40.9	32.5	30.6	32.5
Intermediary							
Small farm	15.7	18.7	3.9	16.2	12.9	37.3	4.4
Medium farm	18.9	22.6	7.0	16.4	21.1	39.0	3.9
Large farm	19.8	19.8	4.7	16.3	32.5	49.1	0.8
Unfavorable South							
Small farm	20.3	18.1	2.7	27.6	4.5	14.5	27.7
Medium farm	21.7	19.4	5.7	27.8	8.1	13.1	32.1
Large farm	29.4	25.5	8.0	33.0	22.1	13.2	44.3
Unfavorable East							
Small farm	4.8	3.2	1.6	4.7	7.4	1.8	9.0
Medium farm	6.0	4.7	1.7	5.0	10.3	1.6	12.2
Large farm	5.3	5.3	0.8	5.0	9.3	1.9	8.0
Mountain							
Small farm	6.8	10.6	2.4	2.0	4.3	1.5	6.2
Medium farm	6.0	8.0	2.1	2.7	4.2	1.6	6.7
Large farm	4.2	6.8	0.9	2.8	3.5	1.1	5.7
Sub-Saharan							
Small farm	5.0	2.4	0.3	1.7	0.0	4.3	14.1
Medium farm	3.1	1.1	0.2	1.6	0.0	3.5	9.9
Large farm	4.0	1.3	0.3	2.0	0.0	4.1	8.7
Rural total							
Small farm	12.2	15.8	16.5	9.8	20.4	6.5	11.4
Medium farm	28.1	40.5	38.6	21.9	29.6	17.1	22.4
Large farm	59.7	43.8	44.8	68.3	50.0	76.4	66.2

Source: 2003 Social Accounting Matrix

Table A.8. Distribution of crop production by three types of farms within each agro-ecological region (Regional total agricultural production is 100)

	All crops						
		Cereals	Pulses & oilseeds	Vegetables	Industrial crops	Other crops	Fruit trees
Favorable	100.0						
Small farm	14.2	6.1	1.0	2.3	1.1	1.0	2.7
Medium farm	30.8	14.7	2.2	5.1	1.3	2.8	4.8
Large farm	55.0	14.8	2.6	13.9	1.2	9.2	13.2
Intermediary	100.0						
Small farm	10.0	5.1	0.1	1.7	0.4	2.0	0.6
Medium farm	27.9	15.9	0.4	3.8	1.0	5.6	1.1
Large farm	62.1	15.1	0.3	11.8	2.6	31.5	0.7
Unfavorable South	100.0						
Small farm	9.4	3.6	0.0	2.1	0.1	0.6	3.0
Medium farm	23.3	9.9	0.2	4.7	0.3	1.4	6.8
Large farm	67.2	14.2	0.4	17.4	1.3	6.2	27.8
Unfavorable East	100.0						
Small farm	10.8	3.1	0.1	1.7	0.9	0.3	4.7
Medium farm	31.0	11.7	0.3	4.0	1.7	0.8	12.4
Large farm	58.2	14.1	0.2	12.8	2.6	4.3	24.2
Mountain	100.0						
Small farm	16.5	11.1	0.2	0.8	0.5	0.3	3.5
Medium farm	33.5	21.6	0.4	2.4	0.8	0.9	7.5
Large farm	50.0	19.8	0.2	7.6	1.1	2.7	18.6
Sub-Saharan	100.0						
Small farm	15.6	3.3	0.0	0.9	0.0	1.2	10.3
Medium farm	22.3	3.9	0.1	1.8	0.0	2.4	14.2
Large farm	62.0	4.7	0.1	7.2	0.0	13.1	37.0
Rural total	100.0						
Small farm	12.2	5.2	0.4	2.0	0.6	1.0	2.8
Medium farm	28.1	13.4	1.0	4.4	0.9	2.7	5.5
Large farm	59.7	14.5	1.2	13.8	1.6	12.2	16.4

Source: 2003 Social Accounting Matrix

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