AGROALIMENTARIA. Nº 8. Junio 1999

A FRAMEWORK FOR ASSESSING FOOD SECUTIRY IN FACE OF GLOBALIZATION:
The case of Morocco

Jenny Aker
Institut Agronomique et Vétérinaire Hassan II, Morocco
Aicha Lemtouni
Institut Agronomique et Vétérinaire Hassan II, Morocco

INTRODUCTION

As defined by the FAO, the goal of food security is to assure to all human beings, at all times, physical and economic access to adequate food. At the national level, food security is therefore a situation whereby a country is able to cover the food requirements of its population on a continuous and stable basis. These requirements can be met either through domestic production, through access to food beyond domestic production, or through a combination of both factors. Few, if any, countries are able to meet their food requirements through domestic production alone, and thus the most common model is an open economy that depends upon the world market to meet the caloric needs of its population. As a result, a country's level of food security is dependent upon a complex interaction of domestic and global forces, and any assessment of food security at the national level must take this into account.

This paper presents a framework for assessing food security at the national level in an effort to better understand how food security reacts to and is affected by the integration of domestic and global markets. To achieve this objective, a conceptual model is first presented to provide a stylized framework for the supply, demand and market-based factors that affect the domestic food economy. From this point, an empirical model will be presented in order to provide a more quantitative means of assessing food security, and in particular to pinpoint specific variables that explain food security at the national level. Both of these models will then be used to analyze the domestic food economy and food security situation of Morocco.

DEFINING FOOD SECURITY

Before undertaking an analysis of food security, it is important to present a workable definition on which to base the discussion. This study adopts the definition provided by the FAO (and further refined by the Committee on World Food Security), which defines food security as assuring to all human beings, at all times, physical and economic access to the adequate foods they need (FAO, 1996b: 4). Food security is thus a situation in which both food supply and effective demand are sufficient to cover food requirements on a continuous and stable basis. Food insecurity prevails if, at any time, either the volume of food supply, effective food demand, or both, fall short of food requirements. This definition applies to the individual, household, or country, although methods of measurement and assessment differ for each.

Based upon the above definitions, it is generally recognized that food security has three principal components: availability, access and stability. The first component, food availability, refers to the total amount of food available for human consumption. At the national level, food availability is determined by annual domestic food production, aggregate food stocks, the food trade balance (imports minus exports), and food aid transfers. From this total is subtracted all food assigned to non-food uses in order to determine the domestic food supply available for human consumption.

The second component of food security is access. In the food security framework, the concept of access refers to the ability to express food needs as effective demand. Access is included in the food security definition in order to account for the fact that food availability does not necessarily imply access; in other words, food can be available at the aggregate level (either the country or the household), but there can be certain units (the household or the individual) that do not have access to these supplies.

the household), but there can be certain units (the household or the individual) that do not have access to these supplies.

The third component of food security, stability, refers to variations and shortfalls in food production, supplies and/or effective demand over time. In particular, the component of stability addresses the issue of transitory food insecurity, meaning that cyclical or seasonal patterns of food deficits can result in a temporary decline in access to food. Repeated cycles of transitory food insecurity can result in a permanent shift in a country's or household's entitlements, and thus result in a state of chronic food insecurity (FAO, 1996b: 6).

A fourth component that will be included in our definition of food security is food utilization. Food utilization refers to the nutrition and health aspects of food security, and can be further disaggregated into two components: the nutritional status of individuals, and the health environment (Chung et al., 1997). Food utilization offers important information not only about the quality of the diet consumed, but also helps to distinguish food insecurity from problems related to health and sanitation.

The components of availability, access, stability and utilization all interact to determine a country's or household's state of food security. Yet taken by itself, each component is an insufficient indicator of food security. For example, sufficient food availability at the national level does not necessarily ensure that all households or individuals have the physical or economic means to access this food. Similarly, sufficient caloric consumption in one year does not guarantee the same level in future years, and thus the existence of assets, stocks, and market integration must also be analyzed in order to determine a country's ability to withstand supply and demand shocks. Furthermore, availability, access, stability and utilization are not determined in a vacuum, but are influenced by domestic and global markets. As a result, any analysis of food security must take into account the interaction between these components, as well as the domestic and international policies that affect them.

A CONCEPTUAL FRAMEWORK FOR FOOD SECURITY ANALYSIS

While the above definition of food security seems to be a relatively simple concept, the actual determinants of food security are far more difficult to measure. For this reason, it is important to establish a framework for food security analysis. In order to assess food security at the country level, and in particular, to better understand how food security reacts to and is affected by economic globalization, a model is a useful tool. This paper will first present a conceptual model of food security and its economic determinants. Following this model, an empirical model will be presented as a tool for quantitatively assessing a country's food security status. Both models will then applied to analyze food security in Morocco during the past two decades, a time during which the Moroccan economy has become increasingly open to international markets.

THE COMPONENTS OF THE CONCEPTUAL MODEL

The conceptual model for food security presented in this paper is based upon the framework presented by Anne Thompson and Manfred Metz in the FAO's 1996 publication, *Implications of Economic Policy for Food Security - A Training Manual* (FAO, 1996b: 263-285). In that publication, the FAO provides a stylized framework for understanding how certain economic parameters affect food security at the national level. The model has four components:

1. A *domestic food supply curve.* The first component is a domestic food supply curve. The domestic supply curve is an upward-sloping supply curve that shows total food supplies at varying market prices. This curve corresponds to the concept of availability in our definition of food security, and is a measure of total food supplies available at the national level. In a closed economy, the domestic supply curve is simply the country's food production curve, and domestic food prices are determined by the intersection of supply and demand in the economy. In an open economy, however, the domestic food supply curve incorporates domestic food production, stock changes, the food trade balance (food exports and imports), and food aid transfers. The domestic food supply curve in the open economy is identical to domestic production up until the point where domestic prices reach world prices; assuming that the country is a price-taker, the supply curve then becomes elastic. The domestic food supply curve, in its simplest form, is thus a function of quantity of food supplied and prices:

$$S = ds(Q^S, P) \quad (1)$$

where Q^S is the volume of domestic food supplies available for human consumption, and P is average market prices. Any exogenous changes in parameters that affect production or supplies (such as technology, capital, or labor) will result in shifts in the food supply curve.

2. A *food demand curve*. The second component of the conceptual model is a food demand curve. The demand curve is a typical downward-sloping demand curve expressing aggregate food demand at varying market prices. The food demand curve shows the relationship between the quantity of food demanded and prices:

$$D = d(Q^D, P) \quad (2)$$

where Q^D is volume of aggregate food demand, and P is average market prices. This curve corresponds closely to the component of access in our definition of food security, for it measures the ability to express food needs through effective demand.

The demand curve in this model is a function of two parameters: prices and aggregate income (GDP). Whereas price changes will result in movements along the demand curve, changes in GDP will shift the food demand curve, and thus result in a change in a country's ability to purchase food. However, GDP itself is not necessarily representative of the purchasing power of

households or individuals *within* a country. Neither aggregate GDP nor GDP/per capita reveal patterns of income distribution or disparities that exist between different social and economic groups. Any model of demand, therefore, should also take into account income distribution, as measured by the Gini coefficient for income distribution (Gillis et al., 1992: 72-77). The Gini coefficient (or income distribution) is captured in the slope of the demand curve, reflecting the price elasticities of demand for different income groups.

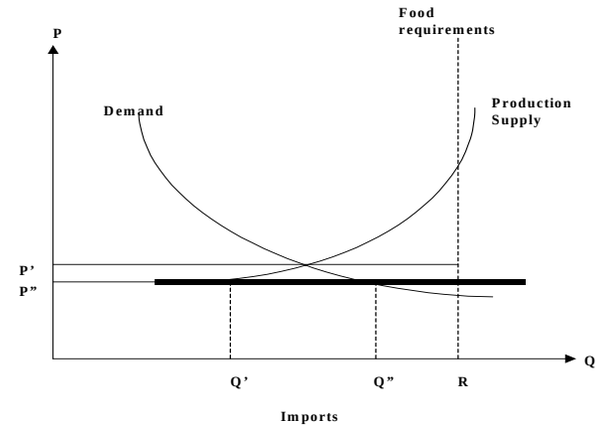
3. *Food requirements.* The third component of the conceptual model is the food requirements line. The food requirements line is a vertical line marking the aggregate staple food requirements of a country, calculated from a country's food balance sheet. This element of the model serves as a benchmark for determining whether the basic caloric requirements of the population are being met by the supply and demand mechanisms of the domestic and international markets[1].

4. *Market prices.* The final component of the conceptual framework is market prices. Whereas the above components serve as tools for analyzing the mechanisms by which supply and demand meet aggregate food requirements, market prices interact with both supply and demand forces. Market prices, both at the domestic and international level, are an important determinant of food production and consumption patterns within an economy. In a closed economy without regulations, domestic prices tend toward the equilibrium price, which is determined by the intersection of domestic supply and demand. In an open economy without market regulations or imperfections (such as imperfect information or a lack of market integration), domestic prices are determined by world prices.[2]. The most typical case, however, is an open economy with some degree of market regulations or imperfections, such as restrictive exchange rate policies, import quotas, pricing subsidies, imperfect information or poor infrastructure. These regulations distort the domestic market's determination of food prices, and thus can result in a gap between domestic and world prices. Such price distortions affect the food production and consumption patterns within an economy, and therefore have an impact upon the domestic food economy and food security. Thus, market prices are included in the model in order to account for their impact on food security through supply and demand.

THE MODEL AS A TOOL FOR ANALYSIS

The above components - a food supply curve, an effective demand curve, a food requirements line, and market prices - provide a stylized framework for analyzing the domestic food economy. Within this framework, food security can be defined as a state in which supply and effective demand fulfill aggregate food requirements, whereas food insecurity is a situation whereby supply and/or demand fail to meet these needs. With specific information on the supply and demand structure of an economy,

Figure No. 1
Model of the Food situation in an Open Economy[3]



as well as an estimate of its total food requirements, the conceptual model can be used to evaluate a country's state of food security, and in particular its ability to meet the caloric needs of its population in the face of certain shocks and deficits in the food economy. Four types of deficits are outlined below.

1. PRODUCTION DEFICITS

A production deficit emerges if a country's domestic food production is insufficient to meet its food requirements.[4] In particular, production deficits are linked to external or internal shocks that affect the domestic food production function, such as a drought or a sudden drop in the agricultural labor force. In an agricultural economy dependent upon rainfed or unmechanized agriculture, such shocks would cause domestic food production to fall, possibly resulting in a production deficit. In the case of a closed economy (without access to imports or to

[1] A common method of calculating the caloric requirements of a population (or estimated average requirement for energy, EAR) is the following: EAR = BMR*PAL, where BMR is the basal metabolic rate of the individual, adjusted for body weight, and PAL is the level of physical activity. This can be calculated if one knows the average weight of the population under consideration, by age group.

[2] Domestic prices are determined by world prices for tradable goods only. In this model, we are assuming that food is a tradable commodity.

[3] FAO, 1996b: 264. PI is internal (domestic) food prices, and Pw is world food prices; Q^D is the quantity of food demanded, and Q^P is the quantity of food supplied by domestic production alone. Imports are Q^D-Q^P.

[4] Domestic food production is determined by a country's food production function: Y = f (L, T), where L= total agricultural labor force, T = total arable land. A movement along the production curve occurs if there is a fall in the agricultural labor force or a decline in available arable land. A shift of the curve would occur given an outside shock, such as technological change or growth, or a climatic shock, such as drought.

food aid transfers), a production deficit would result in a state of food insecurity, as total food supplies would be insufficient to meet aggregate requirements. In an open economy, however, a production deficit would not automatically lead to food insecurity; in this case, the shortfall between domestic production and food requirements could be met by imports or food aid.

2. SUPPLY DEFICITS

A food supply deficit refers to a situation in which *total* food supplies (comprising production, imports, stocks, and aid) fall short of food requirements. In particular, a food supply deficit can be caused by several interrelated factors: a drop in production and/or a drop in stocks, combined with the inability to supplement food supplies through imports or food aid. Thus, although a food supply deficit can be precipitated by a production deficit, it differs from a production deficit in that, even with imports or food aid, aggregate food supplies are insufficient to cover requirements. As a result, this type of deficit automatically results in a state of food insecurity.

3. DEMAND DEFICITS

A demand deficit emerges when the country is unable to express its food requirements as effective demand. With this type of deficit, total food supplies can be sufficient to meet food requirements, but the country lacks the entitlements to access these supplies. At the aggregate level, a demand deficit is most closely related to income level or income growth. In the case of a fall in GDP growth, the demand curve would shift to the left; if growth fell far enough such that the curve shifted to the left of the food requirements line, the entire country would be faced with a situation of food insecurity.

At a more disaggregated (and practical) level, however, a demand deficit refers to a situation where there are households or individuals who are unable to access sufficient food. This type of deficit is thus related to poverty and the pattern of income distribution within the country, as measured by the Gini coefficient of income distribution. As mentioned above, the pattern of income distribution is captured by the slope of the demand curve; thus, any changes in income distribution would result in a shift in the slope of the demand curve[5]. A large enough change in a country's income distribution could result in insufficient effective demand for the country at the aggregate level, and thus lead to a food deficit and food insecurity.

4. MARKET DEFICITS

The final category of food deficits are those resulting from market imbalances. Up until this point, we have referred to the model of the open economy without market restrictions, and thus assumed that domestic prices are equal to world prices. However, in the face of market regulations or imperfections, domestic prices will deviate from equilibrium prices, thereby resulting in food deficits or surpluses. Although there are numerous examples of the mechanisms by which market regulations can lead to imbalances in the food economy, only two examples will be discussed here: price-setting policies and restrictive exchange rate policies.

Price-setting policies, such as food subsidies that lower prices for the poor, fix food prices below the world price. A consumer subsidy leads to an increase in the quantity of food demanded, as consumers demand more goods at the lower prices. However, the lower prices also lead to a decrease in food supply, as domestic producers lower their production. This situation can lead to a food deficit and possible food insecurity, as total food supply falls short of demand.

Exchange rate policies can lead to similar distortions in the domestic food economy. The exchange rate can affect the market in two ways: through its value, and through the type of policy pursued. In the first case, the exchange rate's value (overvalued or undervalued) has an impact upon the food economy through prices: for example, an overvalued exchange rate lower the domestic prices of imports, thereby increasing demand for imported goods and decreasing demand for domestic goods. This price distortion can also lead to a drop in food supplies, as domestic producers lower production in the face of a shift away from domestic goods (FAO, 1996b: 305). If production drops far enough, a food deficit can emerge.

The four types of food deficits described above - production-based, supply-based, demand-based and market-based - are examples of the ways in which external and internal shocks can precipitate food imbalances in a domestic economy. With specific information on the supply and demand aspects of a national economy, as well as on its market structure, the conceptual model can be used a tool for understanding how particular shocks will affect food used as a tool security at the national level. But how can these tools be used to quantitatively measure the state of food security or insecurity? What factors are the most important in determining a country's food security? And how can economic globalization and the integration of markets affect food security? In order to pursue this analysis, we will now to turn to an empirical model for the assessment of food security.

AN EMPIRICAL MODEL OF FOOD SECURITY

EMPIRICAL INDICATORS OF FOOD SECURITY: AVAILABILITY, ACCESS, STABILITY AND UTILIZATION

If the goal of food security at the national level is to meet the food requirements of a population, how can a country's success in meeting this goal be measured? What factors are the most important in determining a country's food security situation, and thus should be the focus of policy measures? How do policies linked to the globalization of the food economy affect domestic food security?

[5] For example, a reduction in equity (an increase in the Gini coefficient) would make the slope of the demand curve more vertical, thereby reducing aggregate demand and lowering average prices.

In order to address the above questions, the first step is to return to the components of food security - availability, access, stability and utilization - for a possible solution. As discussed above, food availability refers to the total food available for human consumption, supplied either by production, stocks, imports, or food aid. Food availability is central to any model of food security (and for a long time was the only indicator of food security) for a fundamental reason: if food is unavailable, food requirements cannot be met. The second component, access, refers to physical and economic access to food supplies; this can either imply access to subsistence production, or economic access to purchase food beyond subsistence production. The component of stability in food security refers to the ability to cover food requirements on a continuous basis, rather than cyclical or transitory food insecurity. Finally, food utilization encompasses the nutritional aspect of food security, going beyond simple caloric requirements to take into account the quality of the diet consumed.

At first glance, the elements of availability, access, stability, and utilization do not lend themselves to a quantifiable analysis of food security. Nevertheless, it is possible to use approximate indicators of these components at the national level in order to construct a food security scale, and then to incorporate this scale into an empirical model. Three principal indicators are proposed: food availability per capita (FA), food consumption per capita (FC), and nutritional status[6].

1. *Food Availability per capita (FA).* Food availability per capita is a proxy for the availability and stability components of food security. It is expressed on a per capita basis in calories/day, and indicates the amount of calories available for each person in an economy. Food availability is determined by domestic food production, food imports, stocks and food aid. At the aggregate level, it is a measure of food supplies available to a population, from both domestic and international markets.

2. *Food Consumption (Caloric Consumption) per capita. (FC).* Food consumption per capita is a proxy for the access component of food security. It is expressed on a per capita basis in calories/day, and measures average caloric consumption in a country. Food consumption differs from food availability in that it measures actual access to food supplies, meaning either access to own production or to food purchases. This is an important distinction, for while there may be adequate food supplies, certain individuals or households within a country may have insufficient entitlements to express their food needs. Although food consumption per capita is an average, it serves as an aggregate indicator of the internal market's ability to distribute food among the population. Nevertheless, it must be remembered that this indicator often hides gross disparities in food consumption.

3. *Nutritional Status (NS).* Nutritional status is a proxy for food utilization. At the aggregate level, nutritional status can be measured by the prevalence of malnutrition in children under-5. Because children under-5 are the most vulnerable segment of the population, their nutritional status changes more quickly in response to changes in food consumption or inadequacies in the diet. As a result, the prevalence of malnutrition in children under-5 is often used a proxy for the general nutritional status of a population. Although there are different methods for measuring child malnutrition, weight-for-age (WfA) is proposed as an indicator, which measures the presence of moderate and severe malnutrition.

Nutritional status is a two-pronged indicator, for it can provide important information on the quality of food being consumed beyond total calories, as well as on the distribution of food consumption. This latter information is important, given that the food consumption per capita indicator hides such variation.

MEASURING FOOD SECURITY: THE GUTTMAN SCALE

Based upon the above indicators of food security, an empirical scale of food security can be constructed. This can be done using a Guttman scale, which is a matrix scale for hierarchical variables (Lemtouni, 1998). In the case of food security, the hierarchy is the following:

Food availability per capita

****

Food consumption per capita

****

Nutritional status

As can be seen in the above hierarchy, food availability is necessary (but not sufficient) for food consumption, and food consumption is necessary (but not sufficient) for adequate nutritional status. In order to construct an empirical scale, the indicators are arranged in a matrix form to compute a value for food security. Each indicator takes on a value of 0 or 1, with 1 implying that a particular criterion has been met, and 0 implying that the criterion has not been met. For food availability per capita, the FAO's guidelines of 2,200 calories/day are proposed as a criterion. Thus, FA = 1 if food availability per capita > 2,200 cal/day, and FA = 0 if food availability per capita < 2,200 cal/day. This same criterion (average caloric requirements/day) can also be used for the food consumption indicator, whereby FC = 1 if food consumption per capita > 2,200 cal/day, and FC = 0 if food consumption per capita < 2,200 cal/day. The same criterion can be used for both indicators because of their hierarchical (and conditional) nature: given that food consumption cannot exceed food availability, food availability must first satisfy a basic level of requirements before food consumption can be considered.

As for nutritional status, there is currently no international standard for determining an "acceptable" malnutrition rate for a population. The criterion for nutritional status will therefore be an arbitrary one, but it is possible to use the Center for Disease

[6] While a separate indicator is not included to capture the element of stability in food security, it is assumed that stability is subsumed in the other indicators. Highly variable figures for food availability and consumption suggest instability at the national level.

Control's classifications of "low" anthropometric values (below two standard deviations) as a guideline. In this classification, the CDC establishes the categories of low, medium, high, and very high, to compare a country's malnutrition rates with those of other countries. If a country's WfA falls into the medium, high or very high categories (WfA ≥ 10%), then NS = 0. If its WfA is less than 10%, then NS = 1.

Now that the indicators and relative values of the scale have been established, a food security matrix can be constructed. The matrix appears below.

Table No. 1

Guttman Scale of Food Security

FA	FC	NS	FOOD SECURITY[7]
0	0	0	0 (Severe Food Insecurity)
1	0	0	1 (Moderate Food Insecurity
1	1	0	2 (Mild Food Insecurity)
1	1	1	3 (Food Security)

As can be seen from the above matrix, food security is a variable whose value ranges between 0 and 3. A value of 0 is classified as a state of severe food insecurity, where sufficient food is not even available to cover requirements (FA = 0); since food is not available, neither food consumption nor nutritional needs can be fulfilled. A value of 1 can be classified as a state of moderate food insecurity. In this case, food availability meets caloric requirements (FA=1), but it has not led to adequate consumption (0) nor adequate nutritional status (0). A value of 2 is classified as mild food insecurity. In this case, food availability and food consumption have met caloric requirements, but this has not resulted in adequate nutritional status. This may be due to the poor quality of the diet, the inequitable distribution of consumption among the population, or a poor health environment. This latter aspect is not necessarily a problem of food security, but is related to other factors that affect nutritional status. Finally, a value of 3 is classified as complete food security, where the criteria for food availability, food consumption and nutritional status have all been met.

AN ECONOMETRIC MODEL OF FOOD SECURITY

The above scale is a simple tool for measuring food security at the national level, and in particular for understanding how the indicators of food availability, consumption and nutritional status interact. Nevertheless, although the Guttman Scale compresses food security into an empirical scale, it does little to pinpoint the determinants of food security. In other words, what economic and social variables contribute to and explain food security, and thus should be the focus of policies designed to meet food security objectives? How will domestic and international shocks affect a country's state of food security? In order to respond to these questions, an econometric model of food security is needed. An empirical model will be briefly presented here, although its use in practice is a subject of continued research.

The empirical model outlined in this paper proposes food security as the dependent variable. Using the Guttman scale of food security, food security is a variable whose value ranges between 0 (severe food insecurity) and 3 (total food security).[8] Based upon the discussion of food security and its components presented throughout this paper, food security is a function of the following variables:

(3) FS = f (Y, R, P, GDP, Gini, TDS/XGS, FI, H)

where:
Y = domestic food production;
R = average annual rainfall;
P = world food prices;
GDP = Gross Domestic Product;
Gini = Gini coefficient of income distribution;
TDS/XGS = total debt service obligations/exports of goods and services;
FI = female illiteracy rate;
H = local health environment

The independent variables proposed above are consistent with the conceptual model and the Guttman scale of food security. The first six variables - Y, R, P, GDP, Gini and TDS/XGS C capture the domestic and global supply and demand mechanisms that affect the food economy, and thus serve to "explain" food security at the country level. The variable Y is included to measure the impact of domestic food production on food security, and thus can offer information about the importance of an economy's self-sufficiency in meeting its total food requirements. Similarly, the variable R is closely linked to domestic production, but is also included to capture the effects of frequent or periodic droughts (stability) on food security. The variables of P, GDP, Gini and TDS/XGS are included in the model order to capture the effective demand, or access, aspect of food security. As was evident in the conceptual model, changes in GDP shift the demand curve, and thus affect the quantity of food demanded. However, it is also important to measure GDP along with prices, which can then be used to assess a country's real purchasing power. TDS/XGS is included as a proxy for the availability of foreign exchange, which is needed to purchase food imports. Given that exports are the source of foreign exchange earnings, the TDS/XGS ratio offers an approximate idea of how much foreign exchange is actually available for food purchases, after debt service obligations are covered.

The last two variables - the female illiteracy rate (FI) and the health environment (H) - are included in the model in order to

[7] The Food Security value es the sum of the values in the row.

[8] In this case, the dependent variable (FS) would be a quadrochotomous variable. It is also possible to dichotomize the FS variable to ease regression analysis, whereby FS = 0 if the FS value < 3, and FS = 1 if the FS value = 3.

capture the effect of confounding variables on food security, but particularly on the indicator of nutritional status. As was mentioned above, there are determinants of nutritional status that are unrelated to caloric consumption or the quality of the diet consumed. Among these determinants are a child's health endowments, the household income level, the health knowledge of the mother, and the health environment. Given these variables, it is possible that a country's NS indicator may be equal to zero, yet that this value is unrelated to food security. As a result, it is important to capture some of these variables in the model; this paper suggests using the female illiteracy rate and the health environment. As for the former variable, the female illiteracy rate is important given the link between mothers' health knowledge and child health. A recent World Bank LSMS Working Paper found that health knowledge of the mother was significant in determining the nutritional status of children in Morocco (Glewwe, 1997)[9]. In the absence of specific information on maternal health knowledge, the female illiteracy rate can be used as a proxy.

The health environment (H) variable is included in the empirical model for similar reasons, namely, to capture the effects of access to potable water and to medical services on nutritional status. In the model, it is possible to break down the H variable into two separate dummy variables, one measuring the percentage of the population with access to potable water, and the other measuring access to medical services.

The econometric model outlined above is suggested as a means to assess food security at the national level, and in particular to measure how certain domestic and international market forces affect it. With information on food availability, consumption and the nutritional status of a particular country, a Guttman Scale can first be constructed; the above variables can then be regressed on food security in order to pinpoint the independent variables that are significant in explaining food security at the country level.

In conducting a food security assessment for a particular country, however, the conceptual and empirical models should be used as complements, in order to accurately capture the multiple dimensions of food security. In an effort to better understand how these models can be used, the models will be applied to the case study of Morocco. First, the conceptual model will be used to analyze the supply and demand structure of the Moroccan food economy. Given this characterization, we will look at the evolution of food security in Morocco from 1970-95, a time period during which structural adjustment and stabilization programs have significantly integrated Morocco's markets with the global economy. The evolution of food security in Morocco will then be measured using the Guttman scale, based upon indicators of food availability, food consumption and nutritional status. From this point, a simplified version of the empirical model will be applied in an effort to evaluate the effects of particular economic and social policies upon food security in Morocco.

AN ANALYSIS OF THE MOROCCAN FOOD ECONOMY AND FOOD SECURITY: MOROCCO IN FACE OF GLOBALIZATION

THE STRUCTURE OF THE MOROCCAN FOOD ECONOMY

Morocco is a particularly interesting case study for analyzing food security in the face of globalization. Throughout the previous two decades, the country's unstable macroeconomic performance and susceptibility to exogenous climatic shocks, coupled with high population growth, limited land resources, and an out-migration of rural (primarily agricultural) labor, have put pressure on Moroccan agriculture to meet the food requirements of its population. At the same time, structural adjustment and trade liberalization programs in the past decade have improved its macroeconomic indicators, lowering budget and current account deficits, increasing manufacturing exports, and opening its markets to foreign investment (World Bank, 1994). Nevertheless, the macroeconomic situation of Morocco remains fragile, and this fragility directly impacts the Moroccan food economy and its national food security.

In order to understand how supply and demand parameters affect food security in Morocco, it is first necessary to understand the structure of the Moroccan food economy. As outlined in the conceptual model, one of the first elements to consider is the domestic food supply curve. Because Morocco falls into the category of an open economy, its domestic food supply curve is determined by domestic production, stocks, imports and food aid.[10] In looking at the production component of domestic supply, it is important to note that Morocco is subject to highly variable food production from year to year, as droughts result in shortfalls in domestic food production (production deficits). This variability is evident when looking at domestic cereal production from the previous decade, as shown in Table 2. Cereal production coincides closely with drought years, as much of cereal production is still dependent on rainfed agriculture.

[9] The female illiteracy rate is included in the model to capture the link between maternal health knowledge and child health. If nutritional status is inadequate (NS=0), malnutrition may partially be explained by a lack of maternal health knowledge, rather than inadequate consumption due to food insecurity. The conditions of the health environment are also important to consider when evaluating food security. If the rate of malnutrition is high, it may be due to a poor health environment rather than a result of food insecurity.

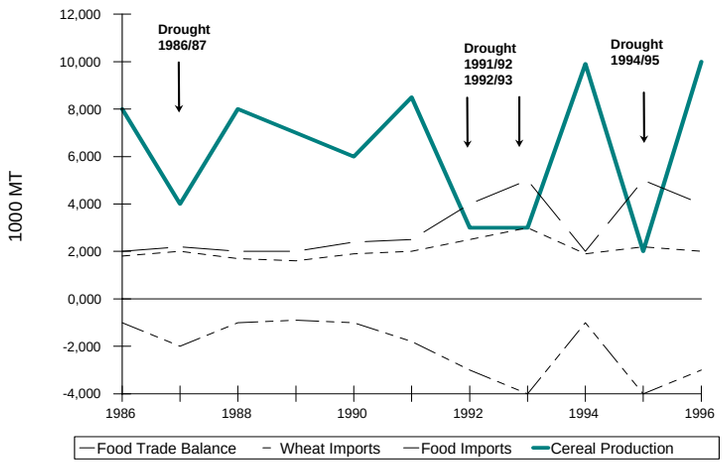
[10] For the purposes of the present analysis, we will only consider domestic production and imports as determinants of total domestic food supply, although in reality food aid is not a negligible factor. See Lemtouni, 1995.

Table No. 2

Cereal Production and the Food Trade Balance, 1986-96 (1000 Metric Tons)[11]

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Cereals, Total Production	7,824	4,337	7,959	7,429	6,276	8,668	2,952	2,82	9,641	1,823	10,100
Total Food Imports	2,087	2,666	2,041	1,768	2,006	2,412	3,96	4,747	2,444	4,917	3,903
Wheat Imports	1,355	1,944	1,368	1,255	1,357	1,534	2,418	2,695	1,191	2,549	2,24
Total Food Exports	973	872	1,271	1,08	953	1,229	961	976	1,11	996	1,125
Food Trade Balance (X-M)	-1,114	-1,794	-770	-688	-1,053	-1,183	-2,999	-3,771	-1,334	-3,921	-2,778

Figure No. 2
Cereal Production and the Food Trade Balance, 1986-96



The Moroccan food demand curve is somewhat more difficult to characterize, although we can analyze it in terms of income and income distribution. As discussed above, the demand curve essentially measures the country's aggregate level of food demand, and is determined by prices and income. Whereas changes in food prices will result in movements along the demand curve, changes in income or income growth will result in shifts in the demand curve, and thus affect the country's ability to access food. In the case of Morocco, changes in GDP and GDP growth is an especially important consideration. Given the economy's continued dependence on agriculture, which accounts for approximately 19% of GDP, GDP growth closely follows agricultural production. Between 1986-96, annual growth fluctuated rather wildly, with a low of -6.29 percent in 1995 and a high of 11.51 percent in 1996. Such changes in national income result in annual shifts in Morocco's food demand curve, and thus impact its ability to express its food needs.

A second aspect of effective demand is income distribution. The equality or inequality of income distribution within a country can be measured by the Gini coefficient, which ranges in value from 0 (perfect equality) to 1 (perfect inequality) (Gillis et al., 1992). If income is less equally distributed, aggregate food demand is lower, given the fact that there are individuals or households who are not able to express their food needs. According to the most recent household budget survey, the Gini coefficient for Morocco is .392, implying a fairly inequitable distribution of national income (Direction de la Statistique, 1990/91). On an empirical level, it is difficult to determine whether this income distribution has resulted in demand deficits; however, household food consumption data suggests that there are low-income subgroups of the population whose food requirements are not being met.[12]

The final element to consider is market prices. In the model, Morocco falls into the category of an open economy with market regulations. Although structural adjustment programs in the past decade have significantly reduced trade barriers and foreign exchange constraints, the Moroccan economy still has substantial market regulations. These include a complex system of targeted food subsidies, import tariffs in the agricultural and non-agricultural sectors, and an exchange rate pegged to a basket of currencies. In general terms, all of these market regulations suggest a distortion of internal market prices from world prices. An in-depth analysis of the above policies on the internal price level is beyond the scope of this paper, although it is possible to suggest the impact of these policies on the Moroccan food economy. We will restrict our analysis to two elements of market regulation: food subsidies and the exchange rate.

Food subsidies, often targeted toward the urban poor, keep internal prices lower than equilibrium prices. The lower price for food goods leads to higher effective demand and lower domestic food production (market deficit), unless matching policies serve to raise prices and hence increase production. If this is not the case, it is possible that the market deficit (demand > supply) can be closed by further increasing food imports. In Morocco, food subsidies for staple foods have traditionally been

[11] FAO, 1998.

[12] For example, while the 1984/85 household budget survey calculated the average food consumption/capita as 2,6055 calories/day, disaggregated data revealed that food consumption/per capita was highly dependent on income level, ranging from 2,642 calories/day in the lowest income decile to 3,1397 calories/day in the highest income decile. The variation was even greater in 1970/71, when caloric consumption ranged from 1,337 cal/day in the lowest income decile to 4,455 cal/day in the highest income decile. Direction de la Statistique, 1970/71; Direction de la Statistique, 1984/85.

targeted towards the urban poor, with direct protection rates of -15 and total protection rates of -32.4 between 1963-84. Attempts have been made during the past decade to remove subsidies for staple foods, but have often met with resistance in urban areas.

As for the exchange rate, there are two main considerations: the level of the exchange rate, and whether the exchange rate is fixed or floating. As for the level, an overvalued currency favors the non-tradables sector (the domestic sector) and taxes the tradables sector, which is often agricultural products. This is often called a negative indirect rate of protection, meaning that the overvalued exchange rate functions in the same manner as an import subsidy. As for the exchange rate policy, fixed exchange rates (whether overvalued or undervalued) often divert precious foreign exchange reserves to support the exchange rate's value. These foreign reserves are necessary to purchase food imports. Morocco's currency (the dirham) is pegged to a basket of currencies, suggesting that foreign reserves earned from exports need to be used in maintaining the exchange rate policy.[13]

The market regulations described above imply that there are several avenues through which prices are distorted in the Moroccan food economy. These distortions not only affect food supply and demand patterns within the economy, but also have an impact on Morocco's ability to access food products on the international market.

The food supply structure of the Moroccan economy suggests that Morocco is capable of fulfilling its total food requirements, but that this food security is heavily dependent on access to global markets. On the supply side, the Moroccan government responds to production/structural deficits through imports and food aid. However, when looking at aggregate demand, it is evident that annual variation in GDP, limited foreign exchange resources, and market regulations could inhibit the country from accessing food to cover the requirements of its population. Furthermore, even if Morocco is capable of responding to such shocks, a repeated pattern of food deficits and surpluses has hidden effects on households that cannot be measured at the aggregate level. Although we did not definitively determine whether the Moroccan food economy has failed to meet its total food requirements in the past, the seasonal production deficits, income fluctuations, and market distortions suggest that, faced with exogenous shocks, the economy is not particularly well-equipped to meet its energy needs. We could therefore characterize Morocco as a food secure country, but not necessarily secure in its food security status.

MEASURING MOROCCAN FOOD SECURITY: AN EMPIRICAL APPROACH

Now that we have characterized the basic structure of the Moroccan food economy, it is important to understand whether and how this economy has succeeded in meeting the food requirements of its population. To meet this end, food security in Morocco will be analyzed for the past 25 years in order to determine how economic globalization has affected food security. In order to measure food security, it is first necessary to break down food security into its separate indicators, and then to use the Guttman Scale to assign food security a value.

FOOD AVAILABILITY

Since 1971, food availability in Morocco has shown a steady average increase in both caloric availability and in the amounts of staple foods. The evolution of food availability per capita during the time period 1971-1994 is shown below.

Table No. 3

Food availability in Morocco, 1970/71, 1984/85, and 1994 (cal/person/day)[14]

	1970/71	1984/85	1994
FA/cap (Calories/day)	2,472	2,952	3,171

Table No. 4

Food availability per capita in Morocco, 1970/1, 1984/85, and 1994 (kg/person/year)[15]

	1970/1	1984/85	1994
Cereals (kg/year)	215.7	249.5	254.2
Meats	12.9	13.4	18.9
Eggs	2.5	3.9	6.2
Fish and seafood	3.2	7.7	7.9
Pulses	3.8	9.8	9.1
Milk	28.6	31.3	31.1
Fruits	45.8	68.7	80
Vegetables	26.6	50.6	71.4
Oils and fats	9.7	14.2	13

During this period, domestic production covered between 64 to 84 percent of food supplies, whereas food imports ranged from 16 to 34 percent of total food supplies. The ratio of food imports to domestic supply (dependency ratio) was .18 in 1971, .21 in 1984/85, and .187 between 1992-94 (FAO, 1993). This suggests that, in order to keep food availability relatively constant, Morocco has consistently relied upon food imports to make up for shortfalls in domestic production. This data also suggests that Morocco's food economy is relatively dependent upon global markets, and that any sudden increases in international prices or a fall in international supplies could have negative effect on Morocco's state of food security.

Nevertheless, despite annual fluctuations in production, food availability in Morocco has improved over the past 25 years. If food availability per capita is compared to the food requeriments criteria of 2,200 cal/day, we find that the food availability has met the requirements in all time periods ($FA_{1970/1}$=1, $FA_{1984/85}$ = 1, and FA_{1994} = 1), although the margin of coverage has steadily increased.

[13] Morocco must also use its foreign exchange earnings to pay off its external debt; on average, the ratio of the debt service obligations to export earnings (TDS/XGS) has been 30% for the 1990s.

[14] FAO, 1996a.

[15] CHEAM, 1997.

FOOD CONSUMPTION (CALORIC CONSUMPTION)

Following food availability, the next indicator in our scale is food consumption. Unlike food availability, which can be computed annually given food production and import data, food consumption per capita must be collected from household budget surveys, which can be infrequent. In Morocco, two such surveys were completed in 1970/71 and 1984/85, although a consumption survey for the 1990s is pending. Nevertheless, it is possible to calculate expected consumption in 1994 given the trend of past consumption patterns. This was done given information on cereal calories as a percentage of total calories (noting that cereals comprise over half of total caloric consumption), as well as on the amount of cereals (kg) consumed per capita per year. The consumption patterns in Morocco between 1971 and 1994 are as follows:

Table No. 5

Food consumption in Morocco, 1970/1, 1984/85, and 1994 (calories/per cap/day)

	1970/1[16]	1984/85[17]	1994 [18]
Total calories/day	2,466	2,605.5	2,842.6
Cereal calories/total calories (%)	62.3	55.5	50.5
Proteins (g)	71	65.2	61.3

Table No. 6

Food consumption in Morocco, 1970/71, 1984/85, and 1994 (kg/per cap/year)

	1970/71[19]	1984/85[20]	1994 [21]
Cereals	216.4	210.44	206.69
Pulses	4.97	5.76	-
Legumes	83.67	107.39	-
Fruits	46.47	32.17	-
Meat	17.85	15.95	-
Fish/seafood	3.56	6.24	-
Milk (excl. Butter)	28.34	30.26	-
Oisl/fats	13.11	14.52	-
Sugar/sugar products	30.14	27.78	-
Eggs (units)	11	21	-

[16] Direction de la Statistique, 1970/71.

[17] Direction de la Statistique, 1984/85.

[18] Calculations for food consumption per capita in 1994 were based upon trends in cereal consumption (kg/person/year) and trends in cereals as a percentage of total calories. The trend in cereal consumption between 1971-85 was r = -.0019928. This rate was then applied to the 1985-94 period (t=9) to estimate cereal consumption in 1994. The same technique was applied to calculate the trend of cereal calories as a percentage of total calories consumed. Estimated food consumption per capita (FC) in 1994 is therefore:

$$\text{cereal cal/totalcal}^{1994} * FC^{1994} = \text{cereal cal/day}^{1994}$$

$$505 * FC^{1994} = 1{,}435.5 \text{ cereal cal/day}$$

$$FC^{1994} = 1{,}435.5/.505 = 2{,}842.6 \text{ cal/day}$$

[19] Direction de la Statistique, 1970/71.

[20] Direction de la Statistique, 1984/85.

[21] Trend consumption tterns for foods outside of cereals was not computed, given the considerable variation of these foods in the Moroccan diet.

The data shows improvement in caloric consumption per capita over the past two decades. From 2466 cal/day in 1970/71 to 2,605.5 cal/day in 1984/85, caloric consumption is estimated at 2,842.6 cal/day in 1994. If we are to compare food consumption per capita to the food requirements criterion established above, food consumption has met caloric requirements in all time periods ($FC_{1970/71}$ = 1, $FC^{1984/85}$ = 1 and FC_{1994} = 1).

Nevertheless, as we have discussed at several points throughout this paper, food consumption per capita figures are only averages, and can therefore hide vast discrepancies in consumption patterns within a country. Given the stated relationship between income level and food consumption, we suggest that food consumption per capita can be assessed along with the Gini coefficient in order to give a more accurate picture of consumption above and below the average. In 1970/71, the Gini coefficient for Morocco was .45; by 1984/85, the Gini coefficient had fallen to .397, suggesting a slight improvement in income distribution. Between 1984/85 and 1990/91, the Gini coefficient changed slightly, falling to .392 (World Bank, 1992). This unequal distribution of income suggests that the average food consumption per capita hides a wide range in consumption patterns.

While the Gini coefficient gives us an idea of the patterns of income distribution in Morocco, a more telling indicator of consumption disparities can be found in the actual food consumption data from the 1970/71 and 1984/85 household budget surveys. Although these surveys estimated that food consumption per capita was 2,466 cal/day and 2,605.5 cal/day respectively, individual caloric consumption fluctuated widely around these averages. The average calories/per capita/day according to income decile is shown below:

Table No. 7

Income Level and Food Consumption in Morocco, 1970/71 and 1984/85[22]

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10[23]
FC (1970/71)	1,337	2,033	2,236	2,582	2,790	2,952	3,050	3,960	3,300	4,455
FC (1984/85)	2,164	2,237	2,254	2,353	2,452	2,513	2,627	2,708	2,181	3,139

Because the above table shows caloric consumption according to household expenditures without offering information about the proportion of each class in the population, it is not possible to calculate a reweighted average of food consumption per capita. Nevertheless, a 1992 World Bank study suggested that the food consumption per capita figure in 1984/85 was probably closer

[22] Direction de la Statistique, 1970/71.

[23] D1 through D10 are income classes divided into deciles, with D1 being the lowest income group and D10 being the highest income group. Although the values of these income expenditures are different for 1970/71 and 1984/85, the divisions clearly show the relationship between caloric consumption and income level.

to 2,287 cal/day, as compared to 2,605.5 cal/day reported in the survey (World Bank, 1992). While it is difficult to assess the validity of these figures, the disaggregation of consumption into income groups shows how income distribution affects food consumption, and also emphasizes the need for caution when using aggregated data. It is for this reason that we rely on the third indicator of our scale, nutritional status, in order to capture some of the consumption disparities mentioned above.

NUTRITIONAL STATUS IN MOROCCO

As discussed above, a proxy for the nutritional status of the population as a whole is the malnutrition rate of children under-5, who exhibit symptoms of chronic and acute malnutrition that are easier to measure than those found in the adult population. The nutritional status of under-5 year-olds in Morocco has made marked improvements in the last 25 years, although, in comparison with countries at a similar economic level, the prevalence of malnutrition is still high. The prevalence of malnutrition in Morocco, measured by weight-for-height (wasting), height-for-age (stunting), and weight-for-age, are provided below.

Table No .8

Prevalence of Child Malnutrition in Morocco

	1970 [24]	1987 [25]	1992 [26]
Weight-for-height (WfH)	-	2.9	2.3
Height-for-age (HfA)	-	28.2	22.6
Weight-for-age (WfA)	46.24	11.8	9

The above anthropometric scores show the changes in malnutrition rates in Morocco according to index. Weight-for-height, available only for the past decade, measures present bouts of malnutrition and illness, and can be highly sensitive to recent illnesses such as diarrhea. The low WfH scores in 1987 and 1992 suggest that wasting is not a problem in Morocco, as compared to other less developed countries. As for height-for-age, this indicator measures chronic malnutrition over the child=s lifetime. Although the HfA scores dropped by 25% between 1987 and 1992, 23% of children under-5 still suffer from chronic malnutrition (stunting), a figure that is moderately high in comparison with low HfA scores for other countries. Finally, the weight-for-age index measures the general level of malnutrition in the target population, including both moderate and severe malnutrition. WfA scores, in contrast with the other two indicators, are available from 1970/71, and can therefore be used to assess the evolution of general malnutrition in the past 25 years. The improvement is marked, with WfA scores of 46.24 in 1970/71, to 11.8 in the mid-1980s and 9 in the 1990s.

Given the above data, how can the nutritional status of the population in Morocco be evaluated? As suggested above, the WfA data will be used to measure nutritional status. The criterion for WfA, in comparing Morocco to the categories established by the CDC, is 10%. In 1970/71, the WfA the score of 46% is far above the criterion, and thus $NS_{1970/71}$ =0. $NS_{1984/85}$ is also equal to 0, as the WfA score of 11.8% is greater than the criterion. The most recent data, however, suggests that the prevalence of moderate and severe malnutrition has fallen to 9%; therefore, NS_{1994} = 1.

THE GUTTMAN SCALE

Given the above ratings for food availability, consumption and nutritional status, the Guttman scale can be applied in order to assign a value for food security in Morocco. The scale is as follows:

Table No. 9

Guttman Scale of Food Security for Morocco, 1970/1 1984/85, 1994

	FA	FC	NS	Food Security Value
1970/71	1	1	0	2 (Mild food insecurity)
1984/85	1	1	0	2 (Mild food insecurity)
1994	1	1	1	3 (Food security)

According to the above table, Morocco has evolved from a state of moderate food insecurity in 1970/71 to a state of "total" food security in 1994. In order to better understand how the globalization of the Moroccan economy has affected food security, we will now turn to the empirical model. For the purposes of this study, the empirical analysis will not be pursued very far, yet it will be used to speculate about the proposed effects of globalization on the Moroccan food economy.

MOROCCO IN FACE OF GLOBALIZATION

In order to understand the effects of certain policies on food security, and to measure their magnitude and direction, we outlined an econometric model for food security as a point of departure for further research. In the model, food security is the dependent variable, ranging in value from 0 to 3, and suggested independent variables include: domestic food production (Y), income (GDP), international food prices (P), the total debt service to export ratio (TDS/XGS), the Gini coefficient (Gini), rainfall (R), the female illiteracy rate (FI), and the health environment (H). For the purposes of this study, the above logit regression will not be pursued. Nevertheless, it is possible to estimate the impacts of certain variables on food security by looking at one of its indicators, food availability per capita.[27]

[24] Ministére de la Sante Publique, 1973. WfA data only available for the under-4 population.

[25] Ministére de la Sante Publique et Macro International, 1989.

[26] Ministére de la Sante Publique et Macro International, 1993.

[27] Although this paper has repeatedly emphasized that food security is not a function of one component, it is reasonable to look at food availability as a proxy for food security given its top position in the food security hierarchy. If the criterion for food availability are not met, or if food availability is negatively effected, it can be assumed that food consumption and nutritional status will also be affected, although the magnitude of the impact cannot be measured.

It is admitted that there is a high likelihood of inter-variable correlation between certain variables, specifically between rainfall and domestic food production, as well as between income and domestic production. This would be expected, given Morocco's dependence on rainfed agriculture and agriculture's share of GDP in the Moroccan economy. The correlation coefficients of these variables are presented below.

Table No. 10

Correlation Coefficients between Food Availability (FA), Cereal Production (1000 MT), GDP (constant 1987 USS) and Annual Rainfall (mm), 1976-96

	FA	Cereal Production	GDP	Rainfall
FA	1.000	.4632	.7622	.7400
Cereal Production	.4632	1.000	.2743	.8441
GDP	.7622	.2743	1.000	.8771
Rainfall	.7400	.8441	.8771	1.000

Source: World Bank, 1998.

As was expected, the correlation between rainfall and cereal production is quite strong, with a value of .8441. Some of the other findings, however, are more unexpected. Food availability shows a positive, yet weak, correlation with cereal production; this is surprising, given a 1980 World Bank study's finding that the correlation coefficient between food production and consumption in Morocco was .98 between 1961-76 (World Bank, 1980). Furthermore, the correlation coefficient between GDP and cereal production is quite low, while the correlation between GDP and food availability is .7622. Thus, inter-variable correlation appears to be limited to rainfall and cereal production, as well as to GDP and food availability.

Preliminary regressions between per capita food availability, GDP and food (cereal) production have been calculated in order to offer some insight into the extent that GDP and Y "explain" variations in food availability in Morocco. As can be seen below, the coefficient for cereal production is .0085, meaning that a 1000 MT change in cereal production per year would lead to an increase of .0085 calories/day in food availability per capita. Nevertheless, it should be noted that this coefficient is not statistically significant, which seems somewhat surprising. GDP, however, is statistically significant at the 95% confidence level, and thus appears to explain some of the variation in per capita food availability.

Table No. 11

OLS Regression of Anual Per Capita Food Availability on Cereal Production and Income, 1976-96

Regression Statistics[a]

Constant	GDP	Cereal Production	R^2	Adjusted
	(constant 1987 US)	(1000 MT)		R^2
2,375.7*	.0281*	.0085	.6508	.5636
-12,408	(-3,161)	(-1,265)		

[a] Number in ( ) are t-statistics.
* Indicates significance at the 95% level.

Although the above model is underestimated, the regression results can be used to draw some limited conclusions about the relationship between food availability, cereal production and income. Given that the coefficient for cereal production is insignificant, we cannot draw any concrete conclusions. Nevertheless, the regression coefficient suggests that, despite large fluctuations in cereal production, these production deficits do not explain variability in food availability. This finding suggests that Morocco has been able to access food from other sources, either through imports, food stocks, or food aid. This is consistent with our conclusions drawn from the conceptual model, as well as annual production and import data from the past two decades.

At the same time, the regression results show that income is statistically significant in explaining variation in food availability per capita. This is a reasonable finding, given that income is needed to access food beyond subsistence production. This is particularly important during times of lower food production, when imports are needed to keep food supplies stable. The above regression coefficient suggests that, when income falls, Morocco cannot access food beyond its own production, and food availability also falls.

What about the other variables proposed in the food security model? Even without regression analysis, it is possible to speculate about the direction of change between these variables and food security in Morocco. Given that we are concerned with the impact of economic globalization on the Moroccan food economy and food security, in particular the integration of the domestic economy through trade, we will restrict our assumptions to two independent variables: (1) world food prices and (2) the availability of foreign exchange, measured by TDS/XGS.

In looking at the above regression, it is possible to predict how prices and the availability of foreign exchange would affect food availability, and extend this analysis to their effect on food security. Before this is undertaken, however, it is admitted that regression coefficients estimated by OLS are biased when the model is underspecified and when the missing variables are correlated with included variables.[28] Nevertheless, the following positive and negative effects on food security can be postulated, when looking primarily at the food availability aspect of food security.

The effect of world cereal prices on food availability and food security is listed as ambiguous, although in reality it depends upon a country's status as a net food exporter or importer, and the market regulations in an economy. Nevertheless, given that Morocco is a net food importer, it is reasonable to assume that an increase in cereal prices would lower imports. If the fall in imports is not replace by an increase in domestic production, the increase in cereal prices would have a negative impact on food

[28] If the effect of the missing variable and its correlation with the included variables are both positive or negative, the estimated coefficient has an upward bias. If the effect and correlation are in opposite directions, the result is a downward bias.

Table No. 12

Missing Variables and Their Effects upon Food Security

Missing Variable	Effect on FA	Effect of FS	Correlation with Y	Correlation with GDP
World cereal prices	+/-	+/-	+	-
Foreign exchange availability	+/-	+/-	-	-

availability. It could also be assumed that this increase in prices would have a negative impact on food security, given that food availability affects the other two indicators (food consumption and nutritional status) in the food security scale.

Although the availability of foreign exchange is determined by a complex series of economic parameters, we will restrict our analysis to two: the exchange rate policy and the TDS/XGS ratio. In the table above, the effect of foreign exchange on food availability and food security is listed as ambiguous for both variables. The reasoning is as follows: if access to foreign currencies increases, the exchange rate will appreciate, thus making food imports relatively cheaper compared to domestic goods. While an increased level of food imports would raise food availability (+), the shift away from domestic products could also result in reduced production (-). Thus, in the case of Morocco, it is difficult to tell which way the exchange rate level affects food security. However, foreign exchange availability is also important for the role it plays in providing access to imports. This is particularly important for countries with high dependency ratios, who turn to the global market to close production deficits. As a result, any policy or macroeconomic constraint that limits foreign exchange can also inhibit a country's ability to purchase needed imports. In Morocco, the availability of foreign exchange is limited in two ways: through the present policy of the pegged exchange rate, as well as a high TDS/XGS (on average 30%). These policies, both of which limit access to foreign exchange, could inhibit the purchase of imports, and thus have a negative impact on food availability and food security.

The above empirical analysis is a brief look at past trends in order to lead to a better understanding of the effects of certain policies on the Moroccan food security at the national level. The explanatory variables chosen for further analysis - international cereal prices, the availability of foreign exchange, GDP and cereal production - are important in the context of economic globalization, given Morocco's increased dependence on international markets and its experience with structural adjustment in the past decade.

SUMMARY AND CONCLUSIONS

What does economic globalization mean for the state of food security in Morocco? It is hoped that the above analyses, both in a conceptual and empirical manner, have given further insight into the complex factors that affect the domestic food economy and food security at the national level.

From the above analyses, five major conclusions can be drawn. First, Morocco is a country with structural production deficits due to natural and agricultural constraints, thereby resulting in periodic food deficits. Although it appears as if Morocco has been able to maintain a sufficient level of domestic food supplies during times of drought, either through imports or stocks, it is difficult to ascertain if this is a sustainable policy. Second, Morocco is a net food importer, even during years of normal cereal production. Although this conclusion is based on data from the past decade, Morocco's current status as a food importer is important to consider when looking at international market fluctuations in the world market. Third, GDP appears to be a significant determinant of food availability in Morocco, given its role in providing access to food imports. Thus, any fluctuations in GDP have an impact on Morocco's ability to access its food needs. Given that GDP is largely dependent on agriculture (19%), such fluctuations are a real concern. Fourth, despite structural adjustment and trade liberalization programs in the past decade, market regulations still play an important role in the determining food prices, and thus food production and consumption patterns. Targeted food subsidies, import tariffs, and pegged exchange rate regime all cause distortions between domestic and world prices, and thus impact the market's ability to respond to supply and demand shocks. Finally, it should be noted that, despite Morocco's rating of "total" food security at the national level (FS=3), the aggregate indicators mask great disparities in income and consumption distribution, and thus the state of food security at the individual and household level. This should be a topic for further research.

The above conclusions can be used to better understand the future of the Moroccan food economy in the face of economic globalization. If the evolution of Moroccan food security in the past two decades is any indication, it appears as if the increased openness and liberalization of Morocco's markets could provide continued improvements in food security. These results and their policy implications may well apply to other developing countries following similar paths. Morocco is certainly not the only country with production deficits, and thus it is hoped that the above models can be a useful tool in assessing food security for other small economies.

REFERENCES

Chung, Kimberly, Lawrence Haddad, Jayashree Ramakrishna and Frank Riely. 1997. *Alternate Approaches to Locating the Food Insecure: Qualitative and Quantitative Evidence from South India.* FCND Discussion Paper No. 22. Washington, D.C.: International Food Policy Research Institute.

CIHEAM. 1997. *Med Agri: Yearbook of Agricultural and Food Economies in the Mediterranean and Arab Countries.* Montpelier, France.

Direction de la Statistique, Ministère du Plan. 1970/71. "Alimentation et Nutrition". *La Consommation et les Dépenses des Menages au Maroc, 1970/71.* Vol. IV. Rabat, Maroc.

Direction de la Statistique, Ministère du Plan. 1984/5. "La Consommation Alimentaire", *Enquête Nationale sur la Consommation et les Dépenses des Menages, 1984/85.* Vol. X. Rabat, Maroc.

Direction de la Statistique, Ministère du Plan. 1990/91. "Rapport de Synthèse", *Niveaux de Vie des Menages, 1990-91.* Rabat, Maroc.

FAO. 1993a. *Food Supply Indicators for African Countries, 1961-1990.* Statistical Analysis Service, Statistics Division, Rome.

FAO. 1993b. *Progress Report on the Development of a Household Food Security Index,* Document CFS: 93/2, FAO, Rome.

FAO. 1996a. *Food Balance Sheets.* Rome.

FAO. 1996b. *Implications of Economic Policy for Food Security - A Training Manual.* Training Materials for Agricultural Planning 40, Rome.

FAO, Committee on World Food Security. 1996c. *Rome Declaration on World Food Security and World Food Summit Plan of Action,* Rome.

Gillis, Perkins, Roemer and Snodgrass. 1992. *Economics of Development.* New York: W.W. Norton & Co.

Glewwe, Paul. 1997. *How Does Schooling of Mothers Improve Child Health? Evidence from Morocco.* LSMS Working Paper No. 128, Washington, D.C.: World Bank.

Lemtouni, Aicha. 1995. "Food Programs as a Food Security Measure: The Case of Morocco". *Options Méditerranéennes* (1995). Ser A/no 26.

Lemtouni, Aicha. 1998. "Evolution de la Sécurité Alimentaire au Maroc pendant la Deuxième Moitié du 20ème Siècle." Unpublished paper presented for the Seminar on "L'Agriculture marocaine face à la globalisation". Rabat, Maroc.

Ministére de la Sante Publique. 1973. *Enquête National sur l'Etat de Nutrition des Enfants de moins de 4 ans.* Bulletin de la Santé Publique, Volume 3, No. 54. Rabat, Maroc

Ministére de la Sante Publique et Macro International. 1989. *Enquête Nationale sur la Planification Familiale, la Fécondité et la Santé de la Population au Maroc (ENPS-I), 1987.* Rabat, Maroc.

Ministére de la Sante Publique et Macro International. 1993. *Enquête nationale sur la Population et la Santé (ENPS-II), 1992.* Rabat, Maroc.

Sen, Amartya. 1981. "Ingredients of Famine Analysis: Availability and Entitlements". *Quarterly Journal of Economics* 96, no. 3.

World Bank. 1980. *Food Security in Food Deficit Countries.* World Bank Staff Working Paper No. 393. Washington, D.C.: The World Bank.

World Bank. 1992. *Maroc: Nutrition et Développement National: Problèmes et Options.* Division Population et Ressources Humaines, Département Géographie, Region Moyen-Orient et Afrique du Nord. Washington, D.C.: World Bank.

World Bank. 1994. *Growing Faster, Finding Jobs: Choices for Morocco.* World Bank Middle East and North Africa Economic Studies. Washington, DC: The World Bank.

World Bank. 1997. *World Development Report: The State in a Changing World.* Washington, D.C.: The World Bank.

World Bank. 1998. *World Development Indicators.* Washington, D.C.: The World Bank.