Chapter – 10

Food Insecurity, Price Volatility and Trade: A Panel Data Analysis in Developing Countries

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10.1 Introduction

Low-income countries need access to international markets to supplement their inadequate domestic food supplies. It is believed that elimination of export and domestic subsidies and of barriers to market access is good for food security in developing countries. Thus, trade openness is one of the key tools to bring food security to people of lower income countries that remain chronically undernourished. The global financial crisis and the recent volatility in world markets for some cereals have revived interest in the analysis of trade issues and food security in developing countries. The crisis has posed additional challenges for the poor and their ability to access to sufficient and nutritious food (World Bank 2010). Market access, domestic support and export subsidies are the three major stipulations on agricultural trade in the context of food security in low-income developing countries. To improve food security by increasing food availability at the national level, countries may increase domestic agricultural production or increase imports. Food imports play a major role in improving a country's food security in a society where agricultural growth is limited.

Food security under trade liberalisation of agricultural goods is a critical issue. Agricultural trade and trade policies affect food security partly and unevenly across countries. The effect of differential treatment for developing countries in trade negotiations defined at the macroeconomic level on food insecurity and ultimately on poverty and hunger at the household level may be different for different households. Trade protection, for example, may help some small producers, but it adversely affects poor consumers. Thus, a complementary policy initiative may be to invest in the agricultural sector to support production and employment in agriculture. Investment in agriculture induces higher productivity that will help reduce food prices for consumers.

The Agreement on Agriculture (AoA) was aiming at the liberalisation of world trade in agricultural commodities by removing protection and subsidies in agriculture. The Uruguay Round of trade negotiations of 1986, perhaps, was the first serious attempt to address the issue of trade-distorting agricultural policies. But the negotiations failed to restrain subsidies or trade protection in industrialised advanced countries. The Doha Round was supposed to eliminate those disagreements, but it also collapsed around the time that food prices peaked in the late 2000s. It was expected that trade liberalisation by following WTO norms led to some gains to producers in food grains-exporting countries with a significant redistributive effect. The central goal of the Doha Round in 2001 was to reduce agricultural subsidies. Unfortunately, deep disagreements over agriculture and food security repeatedly blocked the progress of these objectives. Subsidies and trade barriers in rich countries have been driving international agricultural prices down since the early 2000s, leaving poor farmers in developing countries struggling to support their families.

Against this background, this study investigates the relationship between food insecurity, price volatility and trade openness with panel data from 36 low- and lower-middle income countries during 1990–2014. In our panel frame 21 countries are taken from Sub-Saharan Africa, 12 countries from Asia and 3 countries from Latin America. In Sub-Saharan Africa, agriculture has an important role for growth and poverty, while in South Asia and East Asia agriculture is relatively less significant for growth although poverty is mostly rural in nature (World Bank 2007). In Latin America and the Caribbean, agriculture is not a major contributor to GDP and employment. However, Latin America exports more agricultural products, and agriculture appears more productive as compared to other developing regions. Africa and Latin America have more available arable land per capita than Asian developing countries. Average holding size is larger and land is distributed more unequally in Latin America than in Asia. While Sub-Saharan Africa has land availability comparable to Latin America, its average holding size is significantly low (Diaz-Bonilla et al. 2010). In Sub-Saharan Africa, per capita calorie intake is only 2150 kcal per day. On the other hand, the average calorie consumption in South Asia is 2350 kcal per day. Food insecurity is a multidimensional concept. In this study, prevalence of undernourishment and prevalence of food inadequacy are taken as two major indicators of food insecurity.

Trade openness may facilitate food security by increasing income, reducing poverty, reducing price volatility, and making food cheaper and physically available. Using the production function approach, Martin and Mitra (2001) observed that trade openness increased productivity growth in agriculture. Using computable general equilibrium analysis, Anderson and Strutt (2012) predicted that the liberalisation of global agricultural trade has growth-enhancing effect in Southeast Asian countries. However, the impact of market integration for food staples varies across countries. Food imports, on the one hand, substitute or complement domestic production, but, on the other, trade openness makes a country more vulnerable to international shocks and coordination failure. In the present study, we have empirically re-examined how trade openness affected food security by taking food price volatility as a control variable in a panel data framework in low- and middle-income countries during 1990–2014.

We briefly discuss the theoretical relationship between trade openness, price volatility and food security in Section 10.2. The econometric methodology used in this study is described in Section 10.3. Section 10.4 analyses the performance of 36 countries in terms of prevalence of undernourishment and prevalence of food inadequacy. Section 10.5 interprets the empirical results of the relationship between food security, price volatility and trade openness. Section 10.6 concludes.

10.2 Food Security, Price and Trade: Theoretical Relationships

Food security exists when all people have affordable access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. As a means of assuring food security, closed markets have several limitations in general and some very specific limitations with respect to developing countries. Countries do not all enjoy favourable climatic conditions for producing the grains, oilseeds and rice that are the typical commodity staples that are relied on to fend off chronic hunger. These limitations can be made more constricting by a lack of arable land per capita, limited water availability or special pest problems.

10.2.1 Trade Openness and Food Security

International trade has potential impact on food security both through the import and export mechanisms. Trade opens access to additional sources that can supplement domestic production to meet demand. Trade expands the range of options for exchanging nonfood products for food, and commodities with different nutritional characteristics for each other. Trade can also enhance food security through its impact on prices. Imports may help lower food prices for the undernourished and can be critical in times of droughts, floods or other disruptions to domestic production. Import of food improves food security at least temporarily while increase in exports generates purchasing power by raising national income. Neoliberal reformers claim that trade openness lowers food prices through competitive mechanism and thus improves food security in the developing world. Opening markets to international trade promotes competition. As farmers integrate into higher value-added agricultural processing chains, competition can help to avert monopsonistic procurement practices by those higher up the chain, preserving higher value for poor farmers. Greater competition from expanded markets reduces rent-seeking opportunities and monopolistic practices, reinforcing the aims of competition policy (Brooks and Evenett 2005).

It is also believed that opening up of the domestic market offsets to some extent the adverse domestic supply shocks and helps to maintain stability in food prices. Trade liberalisation in a transitional developing food-importing economy would lower domestic food prices. However, a removal of export subsidies in food exporting countries could cause a rise in world food prices, offsetting partly the above-mentioned domestic price effect associated with tariff reduction by the importing country. The fall in food prices through import of food would exert a disincentive effect on domestic production and could adversely affect the food security of the poor depending mainly on agriculture.

Trade may have a variety of impacts on the determinants of food and nutrition security. Availability of food is one of the major components of food security. Trade influences both food availability as well as production and food imports at the national level. Trade openness also has an impact on decisions to invest in agriculture and to adopt new technology. External trade has some impact on output and employment growth affecting ultimately food security, poverty and inequality. Trade affects the cost of food through the impact of world food prices on domestic market, and determines the volume of domestic production, stocks and imports for a country. Economic access to food, another component of food security, depends on the cost of food, households' incomes and potential food subsidies. These factors have been affected directly or indirectly by trade openness. Positive productivity effects can follow from trade, raising agricultural output and food security levels. Closed markets, or trade protection may discourage firms from adopting productivity-enhancing technology because of the lack of market. Trade and trade policies are related to macroeconomic issues that are applicable at the national level.

Similar kinds of trade intervention may have very different effects on food security across different countries with heterogeneous characters.

10.2.3 Food Price Volatility and Food Security

Production and consumption of food are highly affected both by the level and variability of food prices. Volatility in prices generate uncertainty about the market price for producers and consumers. High food prices benefit food producers (other things equal), while low food prices help consumers, at least in the short run. High food prices normally lead to more food production, improving availability of food, but reduce economic access to food. Price volatility is more important than the price level in explaining agricultural supply, mainly because uncertainty tends to shift production towards low-risk and less productive technologies (Schultz 1954). Food price volatility enhances more speculative activities with further potential destabilising effects affecting badly more the poor and vulnerable households.

Both trends and volatility in prices have been heavily influenced by global macroeconomic and trade-related issues. For example, the low volatility in world prices, both nominal and real, until the early 1970s, was attributed to Bretton Woods system of stable exchange rates. After that the higher prices in the 1970s were influenced by strong growth in the global economy with expanding inflationary pressures and dollar depreciation. The deceleration of the world economy in the early 1980s expanded public support for agricultural production mostly in the industrialised nations, particularly the European Union. A further decline of food prices took place in the late 1990s and early 2000s after the financial crises of Mexico (1995), East Asia (1997), Russia (1998), Brazil (1999) and Argentina (2001). The acceleration in the world economy since the early 2000s pushed up the nominal and real prices of several commodities. These global macroeconomic developments affected not only agricultural products but commodities in general.

The movement of global food price is transmitted to the national economy through trade openness, but the final effect is determined largely by the level of integration between the local market and the national food markets. The World Bank (2009) estimated that, while prices of internationally traded commodity increased by 74% in US dollars, the real food price in majority of the countries increased by 12% or less during 2005–2007. The study also observed that while world price for rice increased at a monthly rate of 1.2%, this figure was at 1% in India and 0.2% in Thailand during this period.

10.3 Econometric Methodology

The relationship between food security, price volatility and trade openness is estimated by applying the Generalized Method of Moment (GMM) approach in a dynamic panel frame to control for endogeneity in our regression model. Use of panel data in estimating common relationships across regions is particularly appropriate because it allows the identification of region-specific effects that control for missing or unobserved variables. Panel models make more information available, hence, more degrees of freedom and more efficiency. They also allow controlling for individual heterogeneity and identifying effects that cannot be detected in simple time series or cross-section data.

10.3.1 Panel Unit Root Tests

Panel data unit root tests have become very popular recently for solving the problem of low power of the tests for a single time series. The panel unit root tests developed by Levin-Lin and Chu (2002) (LLC) and Im-Pesaran-Shin (2003) (IPS) are used to explore the panel time series properties of the variables. Panel unit root tests, although similar, are not identical to unit root tests carried out on a single series. In testing panel unit roots, the basic ADF specification is

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{j=1}^{p_i} \eta_{ij} \Delta y_{i,t-j} + X'_{it}\delta + \varepsilon_{it} \quad (10.1)$$

The LLC test allows the intercepts, the time trends, the residual variances and the order of autocorrelation to vary freely across the cross-section units. But it requires independently generated time series with a common sample size and all individual AR(1) series have a common autocorrelation coefficient. The lag order p_i is permitted to vary across individual states. The appropriate lag order is chosen by allowing the maximum lag order and then by using the *t*-statistics for η_{ij}. The estimate of the autocorrelation coefficient, ρ, is not obtained directly from the estimation of Eq. (10.1). By using proxies for Δy_{it} and y_{it} that are standardised and free of autocorrelations and deterministic components, the autocorrelation coefficient can be estimated in the following way:

At the first stage, the regression equation of Δy_{it} on $\Delta y_{i,t-j}$ and X_{it} is to be estimated. Similarly, the regression equation of $y_{i,t-1}$ on the same regressors is also estimated. Let the regression coefficients in these two equations be denoted by $(\hat{\eta}, \hat{\delta})$ and (η', δ') respectively.

Now define

$$\Delta\bar{y}_{it} = \Delta y_{it} - \sum_{j=1}^{p_i} \hat{\eta}_{ij} \Delta y_{i,t-j} - X'_{it}\hat{\delta} \tag{10.2}$$

and

$$\bar{y}_{i,t-1} = y_{i,t-1} - \sum_{j=1}^{p_i} \eta'_{ij} \Delta y_{i,t-j} - X'_{it}\delta' \tag{10.3}$$

The proxies for Δy_{it} and $y_{i,t-1}$ are obtained as

$$\Delta\tilde{y}_{it} = \frac{\Delta\bar{y}_{it}}{s_i}$$

$$\tilde{y}_{i,t-1} = \frac{\bar{y}_{i,t-1}}{s_i},$$

where s_i are the estimated standard errors in estimating Eq. (10.1).

An estimate of the coefficient ρ may be obtained by estimating the following proxy equation

$$\Delta\tilde{y}_{it} = \rho\tilde{y}_{i,t-1} + \omega_{it} \tag{10.4}$$

Under the null hypothesis y_{it} is supposed to have a unit root, while under the alternative it is trend stationary:

$$H_0 : \rho = 0$$
$$H_1 : \rho < 0.$$

Under H_0, the modified t statistic for $\hat{\rho}$ is asymptotically normally distributed:

$$\tilde{t}_\rho = \frac{t_\rho - \left(N\tilde{T}\right)S_N \hat{\sigma}^{-2} se(\hat{\rho})\mu^*}{\sigma^*} \sim N(0,1),$$

where t_ρ is the standard t-statistic for $\hat{\rho} = 0$,

$$\tilde{T} = T - \frac{\sum_i p_i}{N} - 1,$$

S_N is defined as the mean of the ratios of the long-run standard deviation to the innovation standard deviation for each cross-section unit and estimated by using kernel-based techniques, and $\hat{\sigma}^2$ is the estimated variance of the error term ω. The terms μ^* and σ^* represent adjustment factors for the mean and standard deviation, respectively, and are computed by the Monte Carlo simulation. The major weakness of the LLC test is its implicit assumption that all individual AR(1) series have a common autocorrelation coefficient. Consequently, under H_0, each series has a unit root while under H_1, each of them is stationary.

In the IPS test, on the other hand, autocorrelation coefficient ρ is considered to be different for each cross section unit even in the case of a heterogeneous panel. In this model, the null hypothesis is

$$H_0 : \rho_i = 0, \forall i$$

against the alternative hypothesis

$$H_1 : \begin{matrix} \rho_i = 0, \rightarrow i = 1,2,3 \ldots\ldots\ldots\ldots N_1 \\ \rho_i < 0, \rightarrow i = N_1 + 1, N_1 + 2 \ldots N \end{matrix}.$$

Separate unit root tests are performed on the N time series of the same length, T, by allowing each series to have its own short-run dynamics. After estimating the separate ADF regressions, the average of the *t*-statistics for $\hat{\rho}_i$, $\bar{t}$, is adjusted to arrive at the desired test statistics:

$$\bar{t} = \frac{\sum_{i=1}^{N} t_{\rho_i}}{N}$$

10.3.2 Generalised Method of Moment (GMM)

The most commonly used estimator for dynamic panels with fixed effects in the literature is the GMM estimator by Arellano and Bond (1991). In this approach, the fixed effects are first eliminated using first differences instead of the actual level of the variables and then an instrumental variable estimation of the differenced equation is performed. As instruments for the lagged difference of the endogenous variable—or other variables which are correlated with the differenced error term—all lagged levels of the variable in question are used, starting with lag two and potentially going back to the beginning of the sample. The overall validity of instruments can be checked by a Sargan test of over-identifying restrictions.

Simple dynamic panel data model, with one period lag can usually be expressed as:

$$y_{it} = \alpha_i + \theta_t + \beta y_{i,t-1} + x'_{it}\eta + \varepsilon_{it} \qquad (10.5)$$

αi represents fixed effect, θ_t is time dummy, x_{it} is a $(k-1) \times 1$ vector of exogenous regressors and $\varepsilon_{it} \sim N(0, \sigma^2)$ is a random disturbance.

The Hausman specification test compares fixed and random effect models under the null hypothesis that individual effects are uncorrelated with any regressor in the model. The Hausman test says that the covariance of an efficient estimator with its difference from an inefficient estimator is zero. If the null hypothesis of no correlation is not violated, LSDV and GLS are consistent, but LSDV is inefficient; otherwise, LSDV is consistent but GLS is inconsistent and biased. In this study, the Hausman test suggests that fixed effect model is more appropriate.

The presence of lagged dependent variable in Eq. (10.5) makes the dynamics nature of growth regression. This dynamic fixed panel growth model can account for the differences in the individual effects and explain a part in the differences in the initial levels of technology across the states.

In order to eliminate the unobservable state-specific effects, we difference Eq. (10.1) and then it becomes:

$$\Delta y_{it} = \Delta\theta_t + \beta\Delta y_{i,t-1} + \Delta x_{it}\eta + \Delta\varepsilon_{it} \tag{10.6}$$

The lagged difference of the logarithm of the dependent variable is correlated with the difference of error term. To remove this kind of endogeneity in Eq. (10.6), instrumental variables are to be used. The differenced components of endogenous explanatory variables should also be treated cautiously. We have also to use lagged values of the original regressors with at least two lagged periods as their instruments satisfying the following moment conditions:

$E\left[y_{i,t-s}\left(\varepsilon_{it} - \varepsilon_{i,t-1}\right)\right] = 0$, for $s \geq 2$, t = 3,4……..*T*

$E\left[x_{i,t-s}\left(\varepsilon_{it} - \varepsilon_{i,t-1}\right)\right] = 0$, for $s \geq 2$, t = 3,4……..*T,*

x is the exogenous explanatory variable.

The basic GMM panel estimators $\delta = \left(z'x\right)^{-1} z'y$ are based on moments of the form,

$$g(\delta) = \sum_{i=1}^{N} g_i(\delta) = \sum_{i=1}^{N} z_i'\varepsilon_i(\delta) \tag{10.7}$$

where z_i is a $T_i \times p$ matrix of instruments for cross-section, i, and,

$$\varepsilon_i(\delta) = \left(y_i - f\left(x_{it}, \delta\right)\right) \tag{10.8}$$

GMM estimation minimises the quadratic form:

$$S(\delta)=\left(\sum_{i=1}^{N} z_i'\varepsilon_i(\delta)\right)' H\left(\sum_{i=1}^{N} z_i'\varepsilon_i(\delta)\right) \tag{10.9}$$

with respect to δ for a suitable chosen weighting matrix H.

Thus, the basics of GMM estimation involve: (1) specifying the instruments Z, (2) choosing the weighting matrix H, and (3) determining an estimator.

10.4 Performance Indicators of Food Security

Food security appears to have improved during the past few decades, at least until the recent price hike and financial crisis. Total food availability in developing countries, measured in daily calories intake per capita, was about 29% higher in the mid-2000s than in the 1960s, and average consumption of protein per capita increased 37% over the same period, even though the world population almost doubled during that time (Diaz-Bonilla et al. 2010). The prevalence of undernourished people in developing countries has decreased from 33% in 1970 to 25% in 1980 and 20% at the beginning of the 1990s (FAO 2009). This downward trend in the proportion of undernourished people has continued during the subsequent years, although at lower rates, to reach at 16% in 2006 (Table 10.1). The rate of improvement of the prevalence of undernourishment has been highly uneven across different regions. The rate of improvement was very fast in Southeast Asia, while it was very slow in Sub-Saharan Africa and South Asia. In fact, in South Asia the percentage of undernourished population actually increased during the first half of the 2000s. Some regions and countries have become more food insecure. Prevalence of undernourishment was very high in Sub-Saharan Africa and South Asia as compared to the other parts of the developing world. Food availability is still low in Sub-Saharan Africa where 30% of the population was undernourished in 2006.

Table 10.1: Prevalence of undernourishment

Regions	Latin America	Sub-Saharan Africa	South Asia	Southeast Asia	East Asia	Developing countries
1990–1992	12	34	25	24	15	20
1995–1997	11	34	22	18	12	18
2000–2002	9	32	22	18	10	17
2004–2006	8	30	23	15	10	16

(Source: FAOSTAT)

In this study we have used the prevalence of undernourishment and prevalence of food inadequacy as two important indicators of food insecurity. Both indicators are based on the notion of an average individual in the reference population. The prevalence of undernourishment expresses the probability that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover that person's energy requirement for an active and healthy life. This indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with a threshold level called the minimum dietary energy requirement. Prevalence of food inadequacy is conceptually analogous to the prevalence of undernourishment but calculated by setting the caloric threshold to a higher level, by using a Physical Activity Level (PAL) coefficient of 1.75, as opposed to 1.55. It measures the percentage of the population that is at risk of not covering the food requirements associated with normal physical activity, and therefore including also those who, even though cannot be considered chronically undernourished, are likely being conditioned in their economic activity by insufficient food. The performances of the 36 lower- and middle-income countries in Sub-Saharan Africa, Asia and Latin America in terms of reduction in undernourishment and food inadequacy and in terms of per capita GDP are shown separately for 1990–2000 and 2001–2014 in Table 10.2a–10.2c. The incidence of food security improved in most of the countries taken in this study both in terms of prevalence of food inadequacy and prevalence of undernourishment.

In Sub-Saharan Africa, the prevalence of undernourishment declined at the highest rate in Ghana followed by Gambia and Cameroon, while it declined at the lowest rate in Congo during 2001–2014 (Table 10.2a). In most of the countries the prevalence of undernourishment declined at higher rates in 2000s and thereafter as compared to 1990s. In Uganda and Zambia, however, the undernourishment increased during this period. All countries in Sub-Saharan Africa excepting Uganda, Congo and Lesotho performed better in reducing food inadequacy during 2001–2014. In some countries such as Cabo Verde, Côte d'Ivoire, Madagascar and Rwanda food inadequacy increased in the 1990s but declined significantly in the next decades. In terms of per capita GDP also, all countries in this continent performed better during 2001–2014 compared to the growth performance in the 1990s.

Table 10.2a: Trend growth rates of undernourishment, food inadequacy and per capita GDP: Sub-Saharan Africa

Countries	Prevalence of undernourishment		Prevalence of food inadequacy		Per capita GDP	
	1990–2000	2001–2014	1990–2000	2001–2014	1990–2000	2001–2014
Ethiopia	−3.27	−3.78	−2.55	−3.09	0.59	6.73
Kenya	−0.97	−3.99	−0.55	−2.89	−0.73	2.06
Madagascar	2.52	−1.41	2.19	−0.95	−1.11	0.11
Malawi	−5.79	−2.71	−4.88	−2.29	1.98	2.55
Mozambique	−4.25	−3.81	−3.63	−3.33	2.85	4.23
Rwanda	1.02	−3.81	0.89	−3	−1.69	4.91
Uganda	2.23	3.9	1.51	0.47	3.55	3.85
Zambia	2.66	0.01	1.94	−0.13	−0.91	4.67
Cameroon	−1.8	−9.21	−1.4	−7.62	−0.95	0.68
Chad	−4.17	−0.08	−3.48	−0.89	−1.14	4.94
Congo	−2.33	−0.03	−1.82	0.31	−1.69	1.76
Sao Tome and Principe	−1.19	−6.67	−0.73	−5.19		2.51
Lesotho	−1.95	−0.18	−1.51	0.05	2.17	3.37
Benin	−2.25	−7.04	−1.84	−5.99	1.17	0.67
Cabo Verde	3.11	−5.38	2.89	−4.09	9.1	4.8
Côte d'Ivoire	3.7	−1.41	2.58	−1.25	0.3	0.11
Gambia	0.42	−9.29	0.47	−8.22	0.03	0.23
Ghana	−9.86	−10.68	−8.07	−11.02	1.67	4.41
Guinea	2.18	−3.66	1.92	−2.99	0.31	0.16
Mauritania	−2.67	−5.92	−2.13	−5	−0.02	1.47
Togo	−3.97	−6.63	−3.22	−5.6	0.95	0.58

Source: Authors' estimation with FAO data

In Asia, the better performers are Afghanistan, Nepal and Indonesia (Table 10.2b). Bangladesh has negative growth rate for the indicator in both the segments but it has severely worsened its situation in the relative sense. India's position has also deteriorated. But the most brightened position in terms of these variables is Southeast Asian countries relative to the rest of Asian countries and also in comparison to Sub-Saharan African countries. Though the situation is not that impressive in Latin America, among the three countries taken into consideration only one has shown some improvement, whereas in El Salvador the situation has even worsened, resulting in change in growth path from negative to positive. This reverse trend is observable in terms of both the variables only in case of El Salvador (Table 10.2c).

The movement of the growth rate of the variables can be related with the growth rate of per capita GDP. If we look at the African countries, there is a directly proportional positive relationship between growth rate of per capita GDP and improvement in terms of the growth rate of the food security variables in a country like Zambia. But in countries like Chad and Cabo Verde, this relationship is found to be negative. Ghana, on the other hand, has shown strikingly impressive performance in terms of the food security variables despite having comparatively low growth rate value and slow change in growth rate of per capita GDP. Taking account of the Asian countries we find that the relationship between growth rate of per capita GDP and improvement in terms of the growth rate of the food security variables is positive in countries like Nepal and Indonesia, and negative in case of India and Bangladesh. El Salvador, the only country showing reverse trend in terms of the food security variables, has also shown a drop in the per capita GDP growth rate.

Table 10.2b: Trend growth rates of undernourishment, food inadequacy and per capita GDP: Asia

Countries	Prevalence of undernourishment		Prevalence of food inadequacy		Per capita GDP	
	1990–2000	2001–2014	1990–2000	2001–2014	1990–2000	2001–2014
Republic of Korea	–	–	-1.12	-0.48	5.09	3.42
Afghanistan	3.27	−4.73	2.89	−3.68		6
Bangladesh	−4.49	−0.59	−2.83	−0.36	2.6	4.65
India	−3.53	−2.74	−2.63	−2.09	4.01	6.1
Nepal	−0.6	−8.77	−0.59	−6.9	2.28	2.72
Pakistan	−1.14	−1.35	−0.94	−0.93	1.09	2.34
Sri Lanka	−0.45	−2.44	−1.26	−2.19	3.92	5.33
Cambodia	0.9	−4.07	0.69	−2.9	4.03	5.99
Indonesia	−1.3	−8.28	−0.84	−6.5	2.52	4.13
Myanmar	−2.36	−1	−1.66	−7.85	–	–
Viet Nam	−5.31	−5.57	−3.7	−4.66	5.99	5.17
Yemen	0.6	−1.59	0.66	−1.03	1.44	−0.42

Source: As for Table 10.2a

Table 10.2c: Trend growth rates of undernourishment, food inadequacy and per capita GDP: Latin America

Countries	Prevalence of undernourishment		Prevalence of food inadequacy		Per capita GDP	
	1990–2000	2001–2014	1990–2000	2001–2014	1990–2000	2001–2014
El Salvador	−3.04	2.87	−2.32	2.75	3.55	1.38
Honduras	−2.22	−2.89	1.73	−2.25	0.74	2.05
Nicaragua	−5.27	−3.94	−4.24	−3.17	1.54	1.97

Source: As for Table 10.2a

10.5 Explaining Food Insecurity

We hypothesise that undernourishment and food inadequacy depend on GDP per capita, import dependency, incidence of trade openness and food price volatility in the domestic market. We have estimated the impacts of these macroeconomic factors on food insecurity in a dynamic panel framework. The econometric method of estimation is described in Section 10.2. The estimated results are shown in Table 10.3a and 10.3b. The coefficient of the lag dependent variable indicates the nature of dynamics. In our estimate, the coefficient of the lag dependent variable is positive and strongly statistically significant both for the prevalence of undernourishment and the prevalence of food inadequacy implying that the incidence of food insecurity transmits forward from its previous state. The explanation of this relationship can be given with respect to the poverty trap. According to the consumption efficiency hypothesis, the more a person consumes, more efficient the labour becomes. Thus, people who are suffering from food insecurity issues in the previous period are not efficient enough to apply high effort that leads them towards low levels of income and consumption in the current period.

The coefficient corresponding to per capita GDP implies the effect of economic growth on food insecurity. The coefficient is negative implying that economic growth reduces food insecurity but at a very slow rate. Thus, the growth in per capita GDP is necessary but not sufficient for providing food security. This result is not surprising. All of these countries are of lower- and lower-middle income group, which are characterised by high level of income inequality. Per capita GDP increases when overall GDP increases more than the increase in population. However, in the presence of high level of income inequality, the increase in per capita GDP actually results in increase in the income of the richer people, with the situation of the poor remaining the same. Also, the explanation can be given from the production side. The increase in the per capita GDP is mostly due to the expansion of the manufacturing and the service sector, which are relatively less labour intensive than the agricultural sector, and characterised by little or no participation of the poor population. Hence, the poor section of the population gets deprived of the increase in the per capita GDP. So, the poor farmers cannot afford enough to invest in the domestic agricultural production and consequently they fail to take the advantage of multiplier effect.

Table 10.3a: Dynamic panel estimation of the coefficients for determinants of undernourishment

Explanatory variables	Coefficient	z	$p > z$
y_{t-1}	0.78	66.03	0.00
x_{1t}	−0.001	−9.54	0.00
x_{2t}	0.02	3.08	0.00
x_{3t}	0.01	0.60	0.95
x_{4t}	−0.02	−4.65	0.00
c	8.27	9.05	0.00

Source: Authors' estimation with FAO data
Note: y_t denotes prevalence of undernourishment in period t
x_{1t} = per capita GDP in period t
x_{2t} = import dependency ratio
x_{3t} = domestic food price volatility
x_{4t} = trade openness
c = intercept

Table 10.3b: Dynamic panel estimation of the coefficients for determinants of food inadequacy

Explanatory variables	Coefficient	z	$p > z$
y_{t-1}	0.80	66.76	0.00
x_{1t}	−0.001	−6.85	0.00
x_{2t}	0.02	2.33	0.02
x_{3t}	0.00	2.24	0.03
x_{4t}	−0.02	−6.27	0.00
c	10.18	9.43	0.00

Source: Authors' estimation with FAO data
Note: y_t denotes prevalence of food inadequacy in period t
x_{1t} = per capita GDP in period t
x_{2t} = import dependency ratio
x_{3t} = domestic food price volatility
x_{4t} = trade openness
c = intercept

The coefficient of cereal import dependency ratio is positive and significant, though it has a very small value. This implies higher the import dependency ratio, food security situation of these countries will be worse. The cereal imports dependency ratio shows the net import of the available domestic food supply of cereals. As the ratio increases, the percentage composition of import increases within the domestic food basket. Though initially the increase in food imports is supposed to improve the food security of these countries by lowering the general food price level, it has a negative impact on the domestic food producers. As domestic farmers loose in competition with their international counterparts, the import dependency ratio further increases that gives foreign producers monopoly over the domestic food market. The nature of the imported food items became characterised by high prices and obviously out of reach of the poor population. So, the poor section of the population cannot afford to purchase a majority of the food items and as a result they get deprived of the necessary standard of nutrition.

There is no significant relation between food insecurity and domestic food price volatility. The explanation of the given phenomenon can be that the volatility is found to be in the price of those food items which are not consumed by the poor section of the population. The low- and the lower-middle income countries are characterised by public distribution systems with regard to the food items which act as a cushion for the deprived class. So, it is very well been observed that only after crossing a certain threshold level of income, food price volatility is going to affect this section of people. This clearly implies the presence of high level of inequality acts as a "blessing in disguise."

We find an inverse relationship between trade openness and food insecurity. This clearly implies that, as suggested by the advocates of the free trade, the excess demand present in the closed domestic market would be mitigated by the import of food items from the international market, lowering the domestic prices to the competitive price level and hence enhancing the welfare of the consumers. The gain that can be realised from the production side is found to be in this manner such that the domestic agricultural producers get to enjoy the scale effect of production in the form of market expansion. The producers get benefited from the international market prices in the form of arbitrage opportunities.

But we find a contrasting result in terms of the two indicators: cereal import dependency ratio and trade openness. Conventionally, the benefit that we are expecting out of trade openness is not getting reflected in terms of the import-dependency ratio. The observed contradictory results are due to the facts that if the domestic farmers cannot sustain the competition from the international market, they fail to get benefited from the scale effect promised by the proponents of the free trade argument. The ideal result can be achieved, which is going to favour the domestic farmers, and can be obtained if governments of the respective nations can provide certain kind of assistance to these poor farmers in terms of development of pro-poor institutional structures.

10.6 Conclusions

This study has looked into the incidence of food insecurity of 36 low- and lower-middle income countries from Sub-Saharan Africa, Asia and Latin America over 15 years (1990–2014). We observe that the prevalence of undernourishment was the highest in Ethiopia followed by Chad in Sub-Saharan Africa in the 1990s. The situation of Ethiopia improved significantly during the period 1990–2014. The index of undernourishment reduced dramatically from above 74% to 32% during this period. The situation, however, deteriorated in Zambia during this period and the index of undernourishment became the largest in 2014. The prevalence of undernourishment was the least in Gambia throughout the period. In Asia, the prevalence of undernourishment was the highest in Myanmar in 1990 but improved drastically in 2014. The degree of undernourishment was the lowest in Nepal followed by India in 1990. The prevalence of undernourishment reduced significantly during this period.

In Sub-Saharan Africa, the prevalence of undernourishment declined at the highest rate in Ghana followed by Gambia and Cameroon, while it declined at the lowest rate in Congo during 2001–2014. In Asia, the better performers are Afghanistan, Nepal and Indonesia. We hypothesise that undernourishment and food inadequacy depend on GDP per capita, import dependency, incidence of trade openness and food price volatility in the domestic market. The estimated results suggest that the growth in per capita GDP is necessary but not sufficient for providing food security. Higher the import dependency ratio, higher is the incidence of food insecurity. In this study we find an inverse relationship between trade openness and food insecurity.

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