International Transmission of Food Prices and Volatilities: A Panel Analysis [+]

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1. Introduction

Global food prices and their volatilities increased sharply in recent years.[1] High and increasing food prices pose a significant policy challenge particularly in developing countries where the share of food in household income is relatively high. Volatility is an added concern. The world witnesses large swings in food prices more often (perhaps owing to the effects of climate change and the volatility of oil prices). High volatility of food prices and the associated uncertainty may impede production and investment decisions of food producers, and lead to inefficient resource allocation in agriculture. Noting the importance of food price volatility in policy responses, Kharas (2011) argues "the crux of the food price challenge is about price volatility, rather than high prices *per se*." Roache (2010) also observes that “volatility has made the policy response to changes in food prices more challenging and complicated the investment and consumption decisions of many businesses and consumers.”

Understanding the dynamics of both food price inflation and its volatility is essential in designing appropriate policy responses. Byerlee et al. (2006) note that the country context matters for food price shock and instability. Food price shock and instability would be a serious concern for the poor in countries where there is only one major staple—for example, rice in much of Asia and in Madagascar, wheat in Pakistan and the Middle East to North Africa, white maize in Eastern and Southern Africa, and sorghum and millet in West Africa’s Sahel. The vulnerability of the poor can be further increased if these countries are net importer of such staple food and exposed to world food price shocks. Given the increased frequency and severity of food price shocks in global markets, the transmission of global food prices and their volatilities to local food price inflation and volatility is of particular interest to the policy makers in developing countries.

Earlier literature revealed an incomplete pass-through of global food price shocks to domestic prices of advanced and emerging economies, with estimated average coefficient of pass-through of about 0.30 (or 30%) for most countries (Ianchovichina, et al., 2012; IMF, 2011;

[1] Gilbert and Morgan (2010), however, find that the recent increase in food price volatility is not out of line compared with the historical volatility, which generally came down in the last two decades.

and Sharma 2003). Considerable difference exists, however, between advanced and emerging economies. The findings indicate that pass-through tends to be larger in emerging and developing economies than in advanced economies (IMF, 2011). There are also differences even among emerging and developing countries. Some studies show that the African markets tend to have rather incomplete transmission compared to other regions. On the other hand, transmission appears relatively more complete among Asian countries. The picture in Latin America is more mixed (P. Conforti, 2004). But Headey and Fan (2008) argue that the interventions of local governments in developing countries often hamper full transmission of international prices.

There is also significant heterogeneity across commodity types. For instance, rice has on average weaker price pass-through in developing Asia, compared to wheat (Dawe, 2008). Using the data spanning from 2003 to 2007, Dawe (2008) examines the extent to which increases in international cereal prices have been transmitted to domestic prices in Asian countries. He finds that the international food transmission was generally incomplete in these Asian countries as the real appreciation of their currencies against the US dollar during the sample period neutralized a considerable portion of the global price increases when these cereals were imported into domestic markets. Local policies on specific agricultural commodities, particularly rice for these Asian countries, seemed to have further stabilized and shielded domestic prices from the change in world prices. Having investigated the transmission of global price shocks to domestic prices in eleven Sub-Sahara African countries for eight food items during 2007-2008, Minot (2011) finds that there is a transmission of global food prices to domestic prices for rice and (to a lesser extent) maize. By studying the price transmission of global agricultural commodities to domestic food prices in India and the People’s Republic of China (PRC), Imai et al (2008) also find that domestic prices for wheat, maize and rice tend to adjust faster to the international prices than those of fruits and vegetables.

Many studies highlight the importance of domestic factors and policies in limiting the pass-through of food prices. These include movements in foreign exchange rate, transaction costs, and subsidies for agricultural commodities among others (Quiroz and Soto, 1995; Rapsomanikis et al., 2004; Timmer, 2008; Baffes and Gardner, 2003; Imai et al. 2008; Keats et al. 2010; Ianchovichina, et al., 2012; and IMF, 2011).

Recently, some studies also focus on food price volatility and its determinants. For example, Roache (2010) investigates a number of different potential determinants for the price volatility of different commodities such as corn, rice, sugar, palm oil, soybeans, and wheat. He finds that the variation in U.S. inflation and the U.S. dollar exchange explain a relative large part of the rise in volatility since the mid-1990s. Balcombe (2010) also examines the determinants of volatility in 19 agricultural commodity prices and finds that the volatilities of oil prices and exchange rates exert significant influence on the price volatility in the majority of the selected food commodities. However, he fails to find evidence for a systemic increase across agricultural commodity price volatilities, meaning that some commodities experience increasing volatilities, while others don't. On the other hand, he provides convincing evidence for some degree of transmission of volatility across commodities in the monthly data.

There are other studies which investigated volatility spillovers across different agricultural commodities. For example, Onour and Sergi (2011) find evidence for the transmission of price volatility from corn to wheat. Similarly, some studies examined the transmission of price volatility between different commodity future markets (von Ledebru and Schmitz, 2009; and Hernandez, Ibarra-Ramirez, and Trupkin, 2011). However, the transmission of food price volatility between countries has been less explored. Limited studies include Rapsomanikis and Mugera (2011), which examine the transmission of price signals from selected global food markets to developing countries. Specifically, they introduced a Generalized Conditional Autoregressive Heteroscedasticity (GARCH) effect for the market shock in a bivariate Vector Error Correction model in order to assess volatility spillover between the global and domestic food markets of Ethiopia, India and Malawi. Their findings suggest that volatility spillovers are significant only during periods of extreme world market volatility.

This paper aims to make a comprehensive assessment for the transmission of global food prices and their volatilities to national food prices and their volatilities during the period 2000-2011. While earlier studies failed to prove a meaningful international transmission of food prices and their volatilities, the global food crisis of 2007-08—with its wide coverage and considerable effect on national food price inflation—seems to suggest there may have been a change in the speed and magnitude of international transmission in food prices and their volatilities in more recent years. It also seems that some fundamental structural changes are underway with regard to global food supply and demand, which could exert enduring effects on domestic food prices. However, many of the past studies have not been extended to cover the recent episode of global food price hikes. Using various econometric tools, this paper aims to capture more recent dynamics and interactions of international food price inflation and volatility, reflecting the ongoing structural changes. No doubt that there are various factors that influence domestic food price inflation and volatility. This paper will also focus on identifying global, regional, and national sources for the domestic food price inflation and volatility. By providing regional comparison, this paper will be able to help Asian policymakers to craft more effective policy responses to high and volatile food prices.

The remainder of this paper is organized as follows. Section 2 offers a brief overview of the global food price development by measuring the food price inflation and volatilities of 82 different individual countries for the period of 2000 – 2011. Section 3 presents the empirical results utilizing the vector autoregression (VAR) model for the global transmission of food price inflation in each country. In section 4, a panel data analysis is utilized to assess the global transmission of food price inflation and volatilities to all individual countries. Section 5 concludes with a summary of empirical findings and discussions on policy implications.

2. Trend of global and national food prices

Figure 1a illustrates the annual growth rates of domestic food prices across Asia vis-à-vis the FAO’s world food price index during the period 2000-2011. Overall, domestic food price inflation rates appear to be more stable compared to the global food price inflation. Despite significant national variations in domestic food price inflation rates, there seem to be growing co-movements in recent years among domestic food price inflation rates in Asia except India. Figure 1b, which is Figure 1a excluding the global food price inflation, demonstrates this point more clearly. On the other hand, these domestic food inflation rates continue to move quite differently from the movement of global food prices represented by the FAO's world food price index. Nevertheless, the global food price inflation seems to lead the domestic food price inflation rates by roughly one year.

Table 1 reports the average of the annual growth rates of food prices for different countries/regions during the period 2000-2011. Domestic food price inflation in Asian countries averaged 4.29 percent per annum, lower than the regional average of Latin America (8.63 percent) and Sub Saharan African countries (5.70 percent). Among the Asian countries, Indonesia, the Republic of Korea (Korea), India, and PRC have relatively high food price inflation rates during the period, while Japan and Nepal report very low inflation in domestic food prices. By comparison, the average inflation of the European countries is much lower at 3.74 percent. For the world price inflation, two measures are presented. First, the annual growth rate of the FAO world food price index (World_1), which stood at 7.30 percent during the period 2000-2011. Second, a simple average of domestic food price inflation of all countries included in this study (World_2), which is lower at 5.73. It is important to note that a significant difference may exist in terms of the nature and composition of the index between World_1 and World_2 as World_1 is based on the food commodity prices while World_2 is based on consumer prices for food.

Table 2 reports the simple correlation coefficients between national food price inflation rates and the two different contemporaneous measures of world-wide food price inflation rates - World_1 and World_2. Also reported is the correlation between national food price inflation and the one-year lagged values of FAO's world food price growth rate (L.World_1). The correlation analysis suggests that national food price inflation rates closely track the growth rates of the FAO's world food price index with one-year lag.

Volatility of food prices can be measured in different ways. Many papers including the ones cited earlier in this paper use the GARCH or spline-GARCH model to obtain estimates of the volatilities of different commodities. However, long-term series of food price indexes are not readily available in many developing countries, forbidding the use of GARCH or spline-GARCH. We follow an approach used by Balcombe (2010) and use the volatility measured by the square root of the sum of the squared percentage changes in the quarterly series.

$$(1)\quad V_{it} = 100X\sqrt{\frac{\sqrt{\sum_{j=1}^{12}\left(\Delta \ln\left(p_{i,j,t}\right)\right)^2}}{11}}$$

Where $P_{i,j,t}$ is the food price of country i in the jth month in year t.

This measure is calculated using the quarterly data in a three year moving window. That is, the volatility for year 2001 is calculated using the quarterly data for the three years of 2000, 2001, and 2002. Figure 2a shows the trend of short-term volatility of food prices for the same set of countries in Asia. Three observations can be made. First, the volatility of global food prices (using FAO's world food price index) is far greater than those of national food prices. Second, there exists significant heterogeneity in national level volatilities. That is, some countries experience greater price volatility than others throughout the entire sample period. Third, volatility seems to be persistent regardless of periodic fluctuations: it also shows an increase in 2007-2008 followed by a decrease in 2009 before rising again in 2010 for many countries in Asia. Figure 2b, without the world price volatility, illustrates the latter two points more clearly. The volatilities of national food prices also exhibit growing co-movements in recent years.

Table 3 reports the food price volatilities for individual countries of different regional groups during the period of 2000-2011. Volatilities of food prices for Asian countries are on average smaller than those of Latin American countries and Sub-Saharan African countries. By comparison, however, industrialized countries in Europe and North America (Canada and the United States) show generally lower food price volatilities than developing countries including the ones in Asia. In Asia, PRC, India, Indonesia, Korea, and Taipei,China report relatively high volatilities of food prices, while Hong Kong, China; Japan; Lao PDR; Nepal; and Pakistan show relatively low volatilities of food prices during the last decade.

The volatility is reported for two different measures of the world food prices. One is the volatility of FAO's world food price index (World_1) and the other is a simple average of national food price volatilities of all countries included in this study (World_2). The volatility of FAO's world food price index more than doubles the simple average of national food prices volatilities (6.19 vs. 2.67).

Table 4 reports correlation coefficients between national and global food price volatilities during 2000-2011. The results show that national food price volatilities are highly correlated with the contemporaneous volatilities of the FAO's world food price index and with the average of national food price volatilities. In contrast to the correlations between national and global inflation rates of FAO's world food price index, the correlation between the national and global food price volatilities are rather contemporaneous. Among Asian countries, national food price volatilities in PRC; Hong Kong, China; India, Malaysia, Pakistan, and Thailand show relatively strong correlations with global food price volatility.

Figure 4 show average food price inflation rates for different regions. Food price inflation rates across different regions also seem to show increasing co-movements in recent years. The average volatilities of regional food prices are also reported in Figure 5 for different regions. There seem to be growing co-movements in the average volatilities of regional food prices across different regions.

The trend of food price inflation and volatility show that there may be spillovers from global food price inflation and volatility to national food price inflations and volatilities in recent years particularly since late 2000s. In the following sections, we will formally test if and, if so, to what extent the international transmission of food price inflation and volatility takes place. First, we employ the vector autoregression (VAR) analysis, using the quarterly data for the period of 1995-2011, in order to assess the transmission of the global food prices to "each" national food market. Second, we also employ the panel data analysis, using the yearly data for the period of 2000-2011, in order to assess the transmission of the global food price inflation and volatility to the national food price inflations and volatilities. We will also explore if there exist regional differences in terms of global food price transmission, by focusing on the Asian region and examining how it is different from other regions such as Latin America, Sub-Saharan Africa and Europe.

3. VAR analysis for food price inflation

3.1. Model Specifications

Several econometric techniques have been employed to assess the extent to which world prices are transmitted to domestic prices. Early studies of price transmission relied on simple correlation coefficient: a high correlation of prices is interpreted as a sign of strong integration between markets. As is well known, the approaches based on correlation coefficients suffer from several shortcomings. Mundlak and Larson (1992) apply a regression technique for modeling the transmission of world agricultural commodity prices. However, this was also criticized by later studies because the relationship between domestic and world prices was analyzed in a static framework. It is suggested that the inclusion of some dynamics is necessary since price adjustments usually do not complete instantaneously but take time. Quiroz and Soto (1995), Baffes and Gardner (2003), and Imai *et al*. (2008) propose error correction models to take price dynamics into account, and test the short/long-run adjustments. A vector error correction model is also postulated to better capture the dynamics among prices. Conforti (2004) and Minot (2010) employ a two-variable vector error correction model to test the international transmission of food prices to domestic prices.

While the use of (vector) error correction models is certainly rewarding, most of these studies are based on single-equation approaches or small-scale systems typically consisting of two to three variables. This may only allow for limited dynamic interactions, which can be undesirable for studies investigating the transmission mechanisms. Further, they focus mainly on food prices themselves and do not go further to identify the underlying factors responsible for fluctuations in food prices. When it comes to policy analysis, it is equally important to know the sources of price movements since policy should respond differently depending on those sources responsible.

We try to resolve these difficulties by modeling the determination of food prices in a block vector autoregression (VAR) framework. The block VAR model can accommodate a list of world, regional, and country-specific factors and examine how and to what extent these factors affect food prices. This approach is especially advantageous when the span of time series data is rather short as ours. Another feature is that each country is subject to identical world and regional factors and hence, it is possible to compare the responses across the countries at the same statistical footing. For more details on the block VAR model, see Cushman and Zha (1995), Zha (1999), Peersman (2004), and Lastrapes (2005).

For the application at hand, three blocks are assumed: world, Asian region, and country. The variables in the world block are oil prices, world GDP, world food price, and food price futures. They control for changes in world demand and supply for food. While it is natural to include the world food price, we provide some explanations for the other three variables. Oil prices have a considerable impact on production and transportation costs of agricultural commodities, which can affect the supply side of food. On the demand side, world GDP reflects the general conditions of the world economy. The food price futures variable is included on the basis of previous studies suggesting that speculative trading in agricultural commodities has played some role in recent food price surges. While there is a causality argument, the model can help address the issue on whether futures markets have contributed to stabilizing/destabilizing food prices. The regional block represents the Asian economy, containing Asian GDP and Asian food prices. The country block comprises of four domestic variables that can affect its food prices. The variables are the exchange rate against the US dollar, M1 money supply, real GDP per capita, and the domestic food price. Changes in the exchange rate can affect local food prices by altering import prices, and the inclusion of money supply is to reflect inflationary pressures on the general price level. More details of the data are provided in the next section.

The underlying shocks in the block VAR model are identified using the following restrictions.

(1) None of the shocks in the regional and country blocks affects variables in the world block throughout the whole period. On the other hand, the shocks in the world block can have an impact on variables in the regional and country blocks. That is, the world block is assumed to be exogenous to the regional and country blocks.
(2) The shocks in the regional block are allowed to influence variables in the country block, while the shocks in the country block cannot affect any variable in the regional block over the entire sample period. The regional block is assumed to be exogenous to the country block.
(3) In each block, the individual shocks are identified by assuming the Choleski-type recursive ordering of the variables.

The model is a near-VAR and is estimated by seemingly unrelated regression (SUR) developed by Zellner (1962). It is estimated in levels and we do not perform an explicit analysis of the long-run behavior of the economy due to the short span of data. Yet, by doing the analysis in levels, we allow for implicit co-integrating relationships in the data and still have consistent estimates of the parameters (Sims, et al., 1990; and Peersman, 2004).

3.2. Empirical Results

Empirical analysis is undertaken for 11 Asian countries: PRC [CN], Hong Kong, China [HK], India [ID], Indonesia [IN], Korea [KR], Malaysia [MY], the Philippines [PH], Singapore [SG], Taipei,China [TA], Thailand [TH], and Viet Nam [VT], where the two letters in squared brackets are country identifiers that will be used in defining country variables. The sample period begins at 1995:Q1, the earliest quarter where all data are available, and end at 2011:Q3. Definitions of the data series are as follows. Starting from the variables in the world block, the oil price (POILUS) is the average price of UK Brent, Dubai, and West Texas Intermediate, downloaded from Commodity Research Bureau (http://www.crbtrader.com). World GDP (WR_GDP) is obtained by summing up real GDP of US and EU from Bloomberg, and it accounts for about 50 percent of world GDP according to the 2010 IMF statistics. For the world food price (WR_FDP), the FAO's world food price index discussed in Section 2 is used. The Dow Jones-UBS Agriculture Sub-index (http://www.djindexes.com/commodity) is employed as a representative for food price futures (FUTURE).

Moving to the regional block, Asian GDP (AS_GDP) is calculated by summing up the real GDP of Asian 11 countries. The Asian food price (AS_FDP) is calculated by applying the principal component analysis to the food price indexes of 11 Asian countries. Following convention, it corresponds with the first principal component that has the largest eigenvalue. This first principal component accounts for 92 percent of the total variation and over 87 percent of the variation in the individual food prices of all countries except Hong Kong, China (72 percent). Finally, the individual food prices in the country block are obtained from various sources: OECD for PRC, Indonesia, and Korea; CEIC for Hong Kong, China; India; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam; Bloomberg for Malaysia. These variables are named XX_FDP, where XX is the country identifier listed above (e.g. CN_FDP, HK_FDP, and so on). The same naming applies to the other three country variables of US exchange rates (XX_USR), M1 money supply (XX_MON), and real GDP (XX_GDP).

The data are all available from Bloomberg. For each country, real GDP is divided by population to arrive at per-capita values. Quarterly data on population is obtained by interpolating the annual series from World Population Prospects, the 2010 Revision (United Nations) through the procedure INTERPOL in RATS. All variables are expressed in logarithms and seasonally adjusted by the X11 method when necessary. The models include three lag terms in addition to a constant and a linear trend.

Table 5 reports the percentage contribution of the shocks to the forecast error variance in food prices at various horizons. Beginning with the Asian food price in the top panel, its own shock is found to be most influential and accounts for over 89 percent of the total variation across the horizons. The world food price shock contributes less than 2 percent of the variation in the price. An implication is that the Asian food price as a whole is little affected by changes in the world food price. The contributions of shocks to oil prices and food price futures are also minimal. This is in contrast to some studies that point to oil prices and food price futures as potential causes of the food price surges. Among the four world shocks, the world GDP shock is the only one exhibiting some significance in explaining the Asian food price. By construction, none of the country shocks is allowed to have an impact on the Asian food price at all horizons.

The panels from second to bottom report the forecast error variance decompositions for the domestic food prices of 11 countries. By construction, every country is subject to identical world and regional shocks, and this feature allows us to compare the results across the countries at the same base. It appears that the findings with the Asian food price are repeated. The world food price shock contributes virtually none to explaining the variation in domestic food prices across the countries. The same is true for the shocks to oil prices and food price futures. The key finding is that the Asian food price shock plays an important role in determining domestic food prices. The evidence is particularly strong at medium to long horizons. Countries such as India, Indonesia, Malaysia, the Philippines, and Taipei,China, and Thailand show that the Asian food price shock is the most or equally most important in explaining the long-run variability of their food prices. A shock to world GDP also accounts for a significant fraction of the forecast error variance in the food prices of PRC, India, Indonesia, Korea, Taipei,China, and Thailand.

The short-run movement of domestic food prices is accounted for largely by its own shock across the countries. While there are several possible reasons, one is associated with the policies that local governments have implemented in order to dampen the impact of world food price changes on the domestic markets. For example, PRC, Indonesia, and Viet Nam have been imposing restrictions on rice export or have been raising export taxes. PRC and Indonesia have also reduced import barriers on food and have cut domestic food taxes. PRC and Thailand are holding considerable amounts of rice stocks in order to stabilize the market condition (Brahambhatt and Christiaensen, 2008). The strong influence of domestic food price shocks weakens as the horizon increases.

The other domestic shocks do not make a meaningful contribution in explaining the food prices. Two notable exceptions are Hong Kong, China and PRC. The exchange rate shock is shown to be most important in accounting for the variation of their food prices, while its importance is minimal in all the other countries. This difference may be partly due to the exchange rate system. Unlike the other countries adopting floating exchange rates, Hong Kong, China operates a fixed exchange rate regime by pegging its currency to the US dollar. From 1995 to 2005, the PRC currency, the yuan, was also pegged to the US dollar. The PRC announced a shift of its exchange rate regime to a managed float, tying the value of the yuan to a broad basket of foreign currencies, in July 2005. However, the yuan's movements have been relatively stable compared to other regional currencies. The cases of Hong Kong, China and PRC suggest that under the fixed or managed exchange rate regimes, local food prices may be affected more directly by changes in the exchange rate.

All in all, the VAR analysis does not seem to lend support to the transmission of global food prices to each national food market. While the result is generally consistent with the previous studies investigating the international transmission of food prices, this empirical methodology may suffer from similar shortcomings shared by the past studies, not being able to capture the effect of the most recent changes in global food markets. The international food price transmission appears to be a rather recent phenomenon since late 2000s. The following section, we will employ the panel data analysis to assess the global food price transmission, which allows for a relatively limited time span from 2000 to 2011.

4. Panel analysis for food price inflation and volatilities

4.1. The model for national food price inflation

We construct a panel data set using the inflation and volatility measures obtained in the previous section as two different dependent variables, respectively. Explanatory variables are grouped in two categories: external variables and internal (domestic) variables. The equation to be estimated is

$$\mathbf{C}_{it} = \beta_0 + \mathbf{EV}_{it}\boldsymbol{\beta}_1 + \mathbf{IV}_{it}\boldsymbol{\beta}_2 + \varepsilon_{it}.$$

where $\mathbf{C}_{it}$ is the annual food price inflation rates, EV is a vector of external variables, IV is a vector of internal variables, and ε_{it} is an error term.

<u>External variables:</u>

To assess the effects of transmission of global and regional food price inflations and volatilities to individual countries, we construct three separate types of external variables.

a. Global food price inflation rates

World_C1: Global food price inflation using FAO's world food price index.

L.World_C1: One year lag of global food price inflation using FAO's world food price index. This is to account for the lagging influence of global food commodity prices on individual countries' food prices, as described in the previous section.

World_C2: Average of national food price inflations rates of all countries included in this study.

b. Intra-regional food price inflation rates

Intra-regional food price inflation rates for different regions are constructed as the simple average of food price inflation rates of the neighboring countries in the same region.

Asia_Intra_C: Simple average of food price inflation rates of other neighboring countries in Asia (i.e. its own inflation rate is excluded).

Latin_America_Intra_C: Simple average of food price inflation rates of other neighboring countries in Latin America.

Sub_Sahara_Intra_C: Simple average of food price inflation rates of other neighboring countries in Sub-Saharan Africa.

Europe_Intra_C: Simple average of food price inflation rates of other neighboring countries in Europe.

Other_Intra_C: Simple average of food price inflation rates of other neighboring countries in other regions.

c. Extra-regional food price inflation rates

Extra-regional food price inflation rates for different regions are constructed as the simple average of food price inflation rates of all countries located outside the region.

Asia_Extra_C: Simple average of food price inflation rates of other countries outside Asia.

Latin_America_Extra_C: Simple average of food price inflation rates of other countries outside Latin America.

Sub_Sahara_Extra_C: Simple average of food price inflation rates of other countries outside Sub-Saharan Africa.

Europe_Extra_C: Simple average of food price inflation rates of other countries outside Europe.

Other_Extra_C: Simple average of food price inflation rates of other countries located in Asia, Latin America, Sub-Saharan Africa or Europe.

Internal variables:

a. Domestic demand factors

GDPPC_C: Difference in log of GDP per capita in US dollars. This is to capture the economic conditions of the country in terms of business cycle and hence to capture the income-driven increase in demand for food. Source: World Bank's World Development Indicators.

POP_C: Difference in log of population. This is to capture the population-driven increase in demand for food. Source: World Bank's World Development Indicators.

b. Domestic supply factors

FPI_C: Difference in log of food production index. This is to capture the general food production condition of the country. Source: World Bank's World Development Indicators.

FOOD_IMPORT: Share of food in merchandise imports. This is to assess whether countries with greater dependence on food imports experience higher food price inflation rates. Source: World Bank's World Development Indicators.

FOOD_IMPORT_C: Difference in log of share of food in merchandise imports. This is to assess how high food inflation is associated with a change in food imports as a share of merchandise imports. The causality here may be two ways, as domestic food price increase will induce more imports of foreign food products and more imports of foreign food products may result in lower prices of domestic food products. Thus, the positive sign for this variable will indicate that the first causality is stronger and the negative sign will indicate the second causality is stronger.

XRate_C: Difference in log of exchange rates (LOC/US$). As depreciation of local currency (LOC) against the US$ will result in higher domestic prices of imported food products in local currency, this variable is expected to carry a positive sign. Source: IMF's International Financial Statistics.

c. Domestic market's overall condition

M1_C: Money growth rates measured as the difference in log of M1. This is to capture the overall inflation pressure due to the expansion of money supply in the market. Source: IMF's International Financial Indicators.

L.M1_C: One year lag of M1_C. This is to capture the lagged effect of money supply on prices.

POL_STABILITY: This is a measure of political stability to capture the institutional quality of the market. This measure is also expected to capture the efficiency and consistency of public policies aiming at reducing the impact of various external and internal sources contributing to food price inflation. Source: World Bank's World Development Indicators.

GDPPC: Log of GDP per capita in US dollars. This is to capture the quality of the market. Thus, high income countries are in general expected to reveal lower growth rates in money supply and higher political stability, this variable is included here as a control variable. Source: World Bank's World Development Indicators.

4.2. Model specification for food price volatility

The model for food price volatility is similar. The dependant variable is replaced with the food price volatility measured as described in the previous section. Explanatory variables are also grouped in two categories: external variables and internal (domestic) variables. The equation to be estimated is

$$\mathbf{V}_{it} = \beta_0 + \mathbf{EV}_{it}\boldsymbol{\beta}_1 + \mathbf{IV}_{it}\boldsymbol{\beta}_2 + \varepsilon_{it}.$$

where $\mathbf{V}_{it}$ is the annual food price volatilities, EV is a vector of external variables, IV is a vector of internal variables, and ε_{it} is an error term.

External variables:

To assess the effects of transmission of global and regional food price inflations and volatilities to individual countries, we construct three separate types of external variables.

a. Global food price volatilities

World_V1: Global food price volatilities measured as the square root of the sum of the squared percentage changes in the quarterly series of every three-year moving window, using the FAO's world food price index.

L.World_V1: One year lag of World_V1. This is to account for the lagged influence of global food commodity price volatilities on individual countries' food price volatilities, as described in the previous section.

World_V2: Average of national food price volatilities of all countries included in this study.

b. Intra-regional food price volatilities

Intra-regional food price volatilities for different regions are constructed as the simple average of food price inflation rates of the neighboring countries in the same region.

Asia_Intra_V: Simple average of food price volatilities of other neighboring countries in Asia (i.e. its own inflation rate is excluded).

Latin_America_Intra_V: Simple average of food price volatilities of other neighboring countries in Latin America.

Sub_Sahara_Intra_V: Simple average of food price volatilities of other neighboring countries in Sub-Saharan Africa.

Europe_Intra_V: Simple average of food price volatilities of other neighboring countries in Europe.

Other_Intra_V: Simple average of food price volatilities of other neighboring countries in other regions.

c. Extra-regional food price volatilities

Extra-regional food price volatilities for different regions are constructed as the simple average of food price volatilities of all countries located outside the region.

Asia_Extra_V: Simple average of food price inflation rates of other countries outside Asia.

Latin_America_Extra_V: Simple average of food price volatilities of other countries outside Latin America.

Sub_Sahara_Extra_V: Simple average of food price volatilities of other countries outside Sub-Saharan Africa.

Europe_Extra_V: Simple average of food price volatilities of other countries outside Europe.

Other_Extra_V: Simple average of food price volatilities of other countries located in Asia, Latin America, Sub-Saharan Africa or Europe.

<u>Internal variables:</u>

d. Domestic demand factors

GDPPC_C: Difference in log of GDP per capita in US dollars. This is to capture the economic conditions of the country in terms of business cycle.

POP_C: Difference in log of population. This is to capture the population income-driven increase in demand for food.

e. Domestic supply factors

FPI_C: Difference in log of food production index. This is to capture the general food production condition of the country.

FOOD_IMPORT: Share of food in merchandise imports. This is to assess whether countries with greater dependence on food imports experience higher food price volatilities.

FOOD_IMPORT_C: Difference in log of share of food in merchandise imports. This is to assess how high food price volatilities are associated with a change in food imports as a share of merchandise imports.

XRate_V: Volatilities of quarterly series of exchange rates (LOC/US$) in three-year moving window. Volatile exchange rates increase the riskiness of returns, and hence there may be a positive transmission of exchange rate volatility to the volatility of food prices.

f. Domestic market's overall condition

M1_C: Money growth rates measured as the difference in log of M1. This is to capture not only the overall inflation pressure but also the laxity of monetary policy.

L.M1_C: One year lag of M1_C. This is to capture the lagged effect of money supply on price volatilities.

POL_STABILITY: This is a measure of political stability to capture the institutional quality of the market. This measure is also expected to capture the efficiency and consistency of public policies aiming at reducing the impact of various external and internal sources contributing to food price volatilities.

GDPPC: Log of GDP per capita in US dollars. This is to capture the quality of the market driven by factors other than monetary policy and political stability. Thus, high income countries are in general expected to reveal lower growth rates in money supply and higher political stability, this variable is included here as a control variable.

4.3. Results for food price inflation

Table 6 reports the estimated results for changes in national food price indices using the fixed effects model. Column (1) presents the results with both year dummies and country dummies included. Global food price changes are not included here because year dummies account for world-wide fluctuations of business cycles, food prices, etc. Thus, Column (1) presents the estimated results for the internal factors only in the most comprehensive empirical framework.

Among the demand-side factors, GDP per capita growth rate is found to carry a significant negative coefficient. That is, domestic food price inflation seems to be negatively associated with fast growing income. This finding is intriguing as growing income in poor countries will likely increase food consumption and hence contributes to food price inflation. However, given the low income elasticity of food consumption, growing income in rich countries would not necessarily increase food consumption and hence leads to food price inflation. As the panel data includes both developing and industrialized countries, the result seems to suggest that many countries in the sample already reached the income threshold for an additional increase in income not necessarily leading to food price inflation.

Among the supply-side factors, a country’s import reliance seems to be negatively associated with food price inflation. That is, countries with relatively high share of food imports seem to experience less food price inflation. However, countries with greater "increases" in share of food in their merchandise imports experience high food price inflation. The results suggest that countries that are more open to global food trade may control food price inflation better. However, a sudden increase in food imports in share of total imports (perhaps associated with any disruption in domestic food supply) could stoke food price inflation by exposing the country to the highly-priced global food markets.

Depreciation of local currency against the US dollar (i.e. increase in the local currency value of one US dollar) is positively associated with domestic food price inflation. It is also found that greater political stability and higher GDP per capita are strongly associated with lower food price inflation. High money growth rates also lead to high food price inflation rates.

Columns (2)-(4) report the regression results when global food price inflation rates are included instead of yearly dummies. Specifically, Column (2) reports the results estimated by including the contemporaneous annual global food price inflation rates using FAO's world food price index, while Column (3) reports the estimation results including the lagged value of the global food inflation rates. While the contemporaneous global food price inflation does not affect national food price inflation rates, its lagged value does at the one percent level. Specifically, a 10 percent increase in world food prices incurs an increase of 1 percent in national food prices after one year. When we included both in Column (4), the coefficients for both contemporaneous global food price inflation and its one-year lagged value become significant. However, the coefficient for the lagged value remains much higher (more than two times larger in size) than the one for contemporaneous global inflation.

On the other hand, Column (5) presents the results using the average value of all national food price inflation rates as the global food price inflation. The results generally confirm that there is an emerging tendency that national food price inflation rates move together.

Table 7 reports the results incorporating regional dummies for interactions among the countries in the same region. Columns (1)-(2) are again estimation results using contemporaneous and one-year lagged values of global food price inflation based on FAO's world food price index respectively. Column (3) employs both. Column (4) shows the results using the average of national food price inflation rates as the global food price inflation. In Column (1), regional interactions seem to be insignificant. However, Column (2) shows that one-year lagged values of global food price inflation are significantly and positively associated with national food price inflation rates in all regions. This positive relationship seems to be the strongest among Latin American and Sub-Saharan African countries. For example, a 10 percent increase in world food prices incurs an increase of 1.6 percent in food prices in Latin American countries and 1.3 percent in Sub-Saharan African countries, while the same increase induces only 0.8 percent increase in Asian countries. Column (4) also shows that regional food price inflations are significantly and positively associated with the average food price inflation rates for all countries.

In order to further assess if there are any specific regional factors versus factors that are external to the region, we investigated intra- versus extra-regional co-movements in national food price inflation rates. Table 8 reports these results, specifically those including the simple average of food price inflation rates for the countries in the same region (Column 1) and those including the simple average of food price inflation rates for the countries outside each regions (Column 2), respectively. The results suggest that national food price inflation rates move together not only with the counties in the same region but also with the countries located outside the region. Indeed, for Sub-Saharan African countries, national food price inflations show stronger co-movements with extra-regional food price inflation rates than with intra-regional food price inflation rates.

4.4. Results for food price volatilities

Table 9a reports the results when the dependant variable is the volatility of national food prices. The volatility is constructed using a three-year moving window, and therefore is highly auto-correlated by construction, causing in a regression analysis, the error term to be serially correlated. Indeed, Figure 2 presented that the volatilities for most countries appear to exhibit persistency. In order to overcome this drawback, we employ the system GMM estimator for dynamic panel data following the model of Blundell and Bond (1998).

Column (1) reports the regression results without external food price volatilities but with year dummies included. The consistency of the dynamic GMM estimator requires the presence of first-order correlation and a lack of second order correlation in the residuals of the differenced specification. Test results for the first-order and second-order correlations, as reported in the bottom of the Column, show the consistency of the dynamic GMM estimator. The overall appropriateness of the instruments is also successfully verified by the Sargan test of over-identifying restrictions. Volatilities of national food price indices in the previous year appear to persist very strongly. Among the internal factors, growth rate of GDP per capita is the only variable that carries a statistically significant coefficient. That is, fast growing countries appear to have smaller volatilities of national food prices. Thus, fast growing countries appear to be associated not only with smaller size of food price inflation rates (Table 6) but also with smaller volatilities.

Columns (2)-(4) report the results when volatility of FAO's world food price index is included in place of year dummies. Lagged value of the dependant variable continues to reveal a strong positive coefficient, but its size is smaller than that in Column (1) when year dummies are included without the world-wide food price volatility measure. Volatility of the global food commodity price index also appears to influence very strongly that of the national food prices, but in terms of size of the coefficients, the influence of global volatility is only about 20 percent (=0.078/0.358) of the influence of its own volatilities in the previous year. In Columns (2)-(4), unlike the case of food price changes, there is a strong contemporaneous association between volatilities of global food prices and national food prices.

Column (5) shows the result when the average of national food price volatilities is included instead of the global volatilities constructed with FAO's world food price index. It is interesting to note that it has a very large and significant coefficient. This suggests that national food price volatilities fluctuate together. Indeed the size of the coefficient for the average volatility of national food prices is greater than that for the lagged value of its own food price volatilities.

It is noted that in columns (2)-(3), Arellano-Bond test reveals a lack of both first-order and second-order correlations, and in Column (3) Sargan test does not pass the overall appropriateness of the instruments. Different lags of instruments and dependant variables were applied but a consistent estimator was not obtained and therefore as an alternative, Table 9b presents the results obtained from the fixed effects model. The size of estimated coefficients is slightly different but the basic results remain qualitatively the same.

Table 10 reports the results when the equation is re-estimated with the inclusion of interaction terms of global food price volatility measure and regional dummies. Columns (1)-(2) are those with FAO's world food price index and Columns (3)-(4) is the results with the inclusion of the average of national food price inflation rates. Looking on Column (1), all of the regions except for Sub-Saharan Africa reveal a positive and significant co-movement of food price volatilities with the global food commodity prices compiled as FAO's world food price index. However, the Arellano-Bond test reveals a lack of both first-order and second-order correlations, even though the overall appropriateness of the instruments is successfully verified by the Sargan test of over-identifying restrictions. Therefore, as an alternative, the results from the fixed effects model are also presented in Column (2). The results are similar in the sense that many regions reveal co-movement of their food price volatilities with the global one, but are dissimilar in the sense that such regional groups are different.

Column (3) reports the corresponding result when the average of national food price volatilities is used in place of volatilities of FAO's world food price index. In contrast to Column (1), Arellano-Bond tests reveal the presence of not only first-order correlation but also second order correlation in the residuals of the differenced specification. Therefore, results obtained from the fixed-effects model are also reported in Column (4). Both columns show that volatilities of national food prices of countries in Europe and "Others" are strongly and positively linked with the overall volatilities of world-wide food prices.

Finally, Table 11 reports the results for assessing the intra- and extra-regional co-movement of food price volatilities. Column (1) reports the results with the inclusion of the simple average of food price volatilities of the neighboring countries in the same region. Food price volatilities of countries in all the regions except for Sub-Saharan Africa appear to reveal a co-movement within the region. However, the System GMM model may not be consistent as there exists the first order correlation in the residuals of the differenced specification. And the Sargan test suggests that the System GMM model may be over identified. Therefore, Column 2 also reports the results from the fixed effects model. Surprisingly, none of the regions reveal intra-regional co-movement of volatilities. On the other hand, Column (3) reports the strong existence of extra regional co-movements of volatilities. In particular, Asia's extra-regional co-movement is the strongest.

5. Summary and Policy implications

The main purpose of this paper is to assess comprehensively what influences national food price inflation and its volatilities during the period 2000-2011. In particular, this paper has analyzed whether and, if so, to what extent domestic food price inflation and volatilities of Asian countries are influenced by those of the other countries in the region as well as the global food price inflation and volatility.

We find that the domestic food price inflation in Asia is strongly associated the lagged value of global food price inflation (using the FAO food price index). Interestingly, volatility spillovers from global to domestic food prices seem to be contemporaneous.

We also find that both national food price inflation rates and volatilities are strongly associated with both intra- and extra- regional food price inflation rates and volatilities, respectively. In short, the national food price inflation rates fluctuate together. Thus, it seems that the global food prices (both inflation and volatilities) affect the national food markets in all regions, simultaneously, but with a time lag and hence the national and regional food prices are fluctuating together.

Thus, unlike the previous studies, this paper finds that countries in all regions do not fully weather global food price shocks. This finding may due to the fact that the present data utilized the data up to 2011, while earlier studies such as Byerlee et al. (2006), Dawe (2008), and Headey and Fan (2008) use data before the recent (since 2007) spikes of the global cereal prices.

Therefore, it is crucial for governments and international society to understand how to limit the transmission of global food prices and their volatilities to the national markets. Our findings suggest that higher economic growth rates, greater share of food in merchandise imports, smaller increase in share of food in merchandise imports, appreciation of local currency, greater political stability, and higher income level lead to lower domestic food price inflation. For volatilities of food prices, none of the domestic factors but economic growth rates matters: countries with higher economic growth rates appear to have lower volatilities of national food prices.

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Table 1: Annual Growth Rates of Food Prices, (2000-2011)

Unit: %

Asia		Latin America		Sub Saharan		Europe		Others	
PRC	6.05	Argentina	12.29	Botswana	9.64	Austria	2.64	Algeria	5.25
Hong Kong, China	2.95	Bolivia	3.94	Cote d'Ivoire	2.23	Belgium	2.69	Canada	2.85
India	7.43	Brazil	7.89	Kenya	12.36	Croatia	2.82	Cyprus	4.49
Indonesia	9.39	Chile	4.99	Malawi	3.33	Denmark	2.58	Egypt	9.77
Japan	0.07	Dominican Republic	13.11	Mauritius	5.64	Finland	2.55	Iran	9.06
Korea, Rep. of	9.18	Ecuador	3.54	Nigeria	1.36	France	2.02	Israel	3.16
Lao PDR	2.63	El Salvador	4.13	South Africa	5.39	Germany	1.88	Jordan	5.83
Malaysia	3.65	Guatemala	8.79			Greece	3.19	Malta	7.32
Nepal	1.52	Honduras	6.72			Hungary	5.96	Morocco	8.88
Pakistan	4.23	Jamaica	11.37			Iceland	5.54	New Zealand	13.67
Philippines	2.93	Mexico	2.10			Ireland	1.13	Saudi Arabia	2.27
Singapore	2.66	Panama	10.86			Italy	2.48	Turkey	17.36
Taipei,China	2.43	Paraguay	3.29			Luxembourg	9.36	United States	2.81
Thailand	5.04	Peru	5.08			Netherlands	3.23		
		Trinidad & Tobago	11.52			Norway	11.12		
		Venezuela	29.70			Poland	1.57		
						Portugal	4.68		
						Slovakia	7.97		
						Spain	3.13		
						Sweden	1.91		
						Switzerland	0.27		
						United Kingdom	3.61		
Regional average	4.29	Regional average	8.63	Regional average	5.70	Regional average	3.74	Regional average	7.12
World_1	7.30	World_1	7.30	World_1	7.30	World_1	7.30	World_1	7.30
World_2	5.73	World_2	5.73	World_2	5.73	World_2	5.73	World_2	5.73

Note: World_1 is FAO's world food price index. World_2 is a simple average of nationl food prices of all countries included in this study.

Source: Authors' calculation.

Table 2: Correlation between National and Global Food Price Growth Rates, (2000-2011)

Asia				Latin America				Sub Saharan				Europe				Others			
Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World	World_2	Correlation	World_1	L.World_1	World_2
PRC	0.60	0.18	0.14	Argentina	0.01	0.18	-0.12	Botswana	-0.44	0.52	0.81	Austria	0.16	0.56	0.46	Algeria	-0.19	0.29	0.35
Hong Kong, China	-0.15	0.74	0.52	Bolivia	0.82	0.74	-0.32	Cote d'Ivoire	-0.64	0.24	0.56	Belgium	-0.02	0.68	0.69	Canada	-0.86	0.69	0.73
India	-0.03	-0.28	-0.05	Brazil	-0.12	0.47	0.39	Kenya	-0.07	0.03	0.43	Croatia	0.12	0.53	0.53	Cyprus	-0.58	0.51	0.44
Indonesia	-0.12	0.47	0.48	Chile	-0.16	0.72	0.72	Malawi	-0.54	0.81	0.75	Denmark	-0.07	0.68	0.67	Egypt	-0.08	0.01	0.23
Japan	-0.26	0.72	0.70	Dominican Republic	-0.05	0.31	0.05	Mauritius	-0.42	0.56	0.69	Finland	-0.65	0.93	0.87	Iran	-0.70	0.17	0.05
Korea, Rep. of	-0.37	0.31	0.17	Ecuador	-0.25	0.40	0.48	Nigeria	0.03	-0.08	0.23	France	-0.34	0.67	0.60	Israel	0.17	0.22	0.64
Lao PDR	0.00	0.40	0.59	El Salvador	-0.17	0.71	0.65	South Africa	-0.42	0.62	0.40	Germany	0.26	0.51	0.51	Jordan	-0.10	0.51	0.68
Malaysia	-0.20	0.71	0.75	Guatemala	-0.31	0.60	0.54					Greece	-0.24	0.69	0.50	Malta	0.14	0.45	0.70
Nepal	-0.36	0.60	0.65	Honduras	-0.12	0.77	0.81					Hungary	0.43	0.18	0.32	Morocco	-0.07	0.08	0.17
Pakistan	-0.30	0.77	0.75	Jamaica	0.17	0.22	0.51					Iceland	-0.74	0.48	0.68	New Zealand	-0.39	0.24	0.11
Philippines	0.32	0.22	0.13	Mexico	-0.29	0.62	0.86					Ireland	-0.16	0.65	0.69	Saudi Arabia	-0.07	0.69	0.70
Singapore	0.18	0.62	0.50	Panama	0.13	0.73	0.10					Italy	-0.30	0.35	0.68	Turkey	-0.24	-0.14	0.12
Taipei,China	-0.10	0.73	0.41	Paraguay	-0.36	0.81	0.66					Luxembourg	-0.26	-0.02	-0.06	United States	-0.35	0.81	0.73
Thailand	-0.62	0.81	0.62	Peru	-0.52	-0.28	0.56					Netherlands	-0.38	0.74	0.84				
				Trinidad & Tobago	-0.48	-0.21	0.42					Norway	-0.19	0.60	0.58				
				Venezuela	-0.43	-0.10	0.65					Poland	-0.28	0.74	0.56				
												Portugal	-0.04	0.73	0.73				
												Slovakia	-0.42	0.29	0.60				
												Spain	0.01	0.32	0.39				
												Sweden	-0.16	0.48	0.79				
												Switzerland	-0.18	0.25	0.66				
												United Kingdom	-0.29	0.68	0.81				
Regional average	-0.15	0.81	0.77	Regional average	-0.21	0.56	0.78	Regional average	-0.44	0.39	0.76	Regional average	-0.36	0.79	0.92	Regional average	-0.68	0.50	0.60

Note: World_1 is FAO's world food price index. L.World_1 is a one-year lag of FAO's world food price index. World_2 is a simple average of nationl food prices of all countries included in this study.

Source: Authors' calculation.

Table 3: Average of Food Price Volatilities, (2000-2011)

Asia		Latin Amarica		Sub Saharan		Europe		Others	
PRC	3.12	Argentina	4.13	Botswana	2.88	Austria	1.33	Algeria	4.28
Hong Kong, China	1.22	Bolivia	2.91	Cote d'Ivoire	4.35	Belgium	1.09	Canada	1.24
India	2.71	Brazil	2.75	Kenya	6.61	Croatia	2.08	Cyprus	1.86
Indonesia	3.34	Chile	2.37	Malawi	1.11	Denmark	1.15	Egypt	4.19
Japan	0.95	Dominican Repub	4.53	Mauritius	1.88	Finland	1.62	Iran	9.13
Korea, Rep. of	3.87	Ecuador	5.24	Nigeria	1.30	France	1.06	Israel	1.74
Lao PDR	0.80	El Salvador	2.15	South Africa	2.10	Germany	1.29	Jordan	2.50
Malaysia	1.99	Guatemala	2.79			Greece	2.33	Malta	2.19
Nepal	1.12	Honduras	2.36			Hungary	2.75	Morocco	4.07
Pakistan	1.41	Jamaica	3.73			Iceland	2.92	New Zealand	5.34
Philippines	2.10	Mexico	1.89			Ireland	1.12	Saudi Arabia	0.78
Singapore	1.87	Panama	4.45			Italy	0.82	Turkey	5.55
Taipei,China	3.04	Paraguay	1.28			Luxembourg	9.99	United States	0.97
Thailand	1.72	Peru	1.70			Netherlands	1.18		
		Trinidad & Tobago	6.40			Norway	3.50		
		Venezuela	7.23			Poland	1.01		
						Portugal	1.61		
						Slovakia	2.31		
						Spain	1.08		
						Sweden	0.97		
						Switzerland	0.76		
						United Kingdom	1.36		
Regional average	2.09	Regional average	3.49	Regional averag	2.89	Regional averag	1.97	Regional averag	3.37
World_1	6.19	World_1	6.19	World_1	6.19	World_1	6.19	World_1	6.19
World_2	2.67	World_2	2.67	World_2	2.67	World_2	2.67	World_2	2.67

Note: World_1 is FAO's world food price index. World_2 is a simple average of nationl food prices of all countries included in this study. Volatilities are calculated as the square root of the sum of the sqared percentage changes in the quarterly series in three year moving windows. See the text for details.

Source: Authors' calculation.

Table 4: Correlation between National and Global Food Price Volatilities, (2000-2011)

Asia				Latin America				Sub Saharan				Europe				Others			
Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2	Correlation	World_1	L.World_1	World_2
PRC	0.55	0.02	0.70	Argentina	-0.57	-0.46	-0.54	Botswana	0.75	0.22	0.88	Austria	0.32	-0.06	0.59	Algeria	-0.35	-0.63	-0.06
Hong Kong, China	0.90	0.64	0.88	Bolivia	0.94	0.58	0.95	Cote d'Ivoire	0.53	0.83	0.18	Belgium	0.11	-0.23	0.43	Canada	0.64	0.51	0.67
India	0.90	0.88	0.69	Brazil	-0.12	-0.09	-0.14	Kenya	0.44	0.47	0.33	Croatia	-0.29	-0.49	-0.01	Cyprus	0.34	0.57	0.16
Indonesia	-0.02	-0.28	0.31	Chile	0.86	0.37	0.95	Malawi	0.95	0.67	0.90	Denmark	0.62	0.19	0.83	Egypt	0.55	0.58	0.32
Japan	-0.38	-0.19	-0.46	Dominican Repub	-0.47	-0.48	-0.48	Mauritius	0.29	-0.09	0.35	Finland	0.80	0.89	0.58	Iran	0.32	-0.32	0.68
Korea, Rep. of	-0.68	-0.55	-0.66	Ecuador	-0.56	-0.31	-0.44	Nigeria	-0.27	-0.18	-0.18	France	0.00	0.09	0.12	Israel	0.83	0.39	0.89
Lao PDR	0.31	-0.09	0.61	El Salvador	0.94	0.65	0.90	South Africa	-0.15	0.37	-0.48	Germany	0.01	-0.16	0.24	Jordan	0.51	0.10	0.66
Malaysia	0.81	0.48	0.80	Guatemala	0.17	0.41	0.06					Greece	-0.71	-0.75	-0.55	Malta	0.49	-0.11	0.79
Nepal	-0.15	-0.07	-0.07	Honduras	0.87	0.43	0.94					Hungary	0.71	0.59	0.71	Morocco	0.90	0.83	0.72
Pakistan	0.89	0.52	0.91	Jamaica	0.52	-0.06	0.69					Iceland	0.76	0.36	0.85	New Zealand	-0.74	-0.80	-0.46
Philippines	0.23	0.40	0.03	Mexico	0.01	-0.15	0.18					Ireland	0.74	0.72	0.64	Saudi Arabia	0.84	0.39	0.95
Singapore	0.39	0.35	0.24	Panama	-0.36	-0.90	-0.06					Italy	0.20	-0.08	0.41	Turkey	-0.43	-0.30	-0.35
Taipei,China	0.38	0.00	0.51	Paraguay	0.78	0.56	0.70					Luxembourg	0.64	0.77	0.43	United States	0.96	0.70	0.89
Thailand	0.84	0.64	0.79	Peru	0.84	0.55	0.81					Netherlands	0.85	0.86	0.70				
				Trinidad & Tobago	0.54	0.80	0.21					Norway	0.94	0.83	0.78				
				Venezuela	0.83	0.57	0.73					Poland	0.53	0.84	0.39				
												Portugal	0.86	0.47	0.91				
												Slovakia	0.34	0.13	0.44				
												Spain	-0.01	-0.47	0.36				
												Sweden	0.52	0.27	0.65				
												Switzerland	0.11	0.55	-0.06				
												United Kingdom	0.90	0.57	0.92				
Regional average	0.90	0.50	0.93	Regional average	0.46	0.34	0.40	Regional average	0.80	0.90	0.54	Regional averag	0.86	0.57	0.90	Regional average	0.38	-0.26	0.75

Note: World_1 is FAO's world food price index. L.World_1 is a one-year lag of FAO's world food price index.World_2 is a simple average of nationl food prices of all countries included in this study. Volatilities are calculated as the square root of the sum of the sqared percentage changes in the quarterly series in three year moving windows. See the text for details.

Source: Authors' calculation.

Table 5. Variance Decomposition of the Food Prices

Series	Horizons (Quarters)	Shocks									
		POILUS	WR_GDP	WR_FDP	FUTURE	AS_GDP	AS_FDP	XX_USR	XX_MON	XX_GDP	XX_FDP
Asia	0	0.02 (0.1)	10.27 (7.5)	0.06 (0.1)	0.10 (0.1)	0.37 (0.1)	89.19 (7.6)				
	4	0.06 (0.1)	5.93 (5.5)	1.70 (0.4)	0.11 (0.1)	0.59 (0.2)	91.61 (5.9)				
	8	0.07 (0.1)	7.82 (5.6)	1.46 (0.4)	0.12 (0.1)	0.60 (0.3)	89.94 (5.8)				
	12	0.07 (0.1)	7.81 (5.6)	1.35 (0.4)	0.12 (0.1)	0.60 (0.2)	90.06 (5.8)				
	24	0.07 (0.1)	7.53 (5.6)	1.28 (0.4)	0.11 (0.1)	0.60 (0.2)	90.41 (5.8)				
PRC	0	0.01 (0.1)	0.01 (2.4)	5.48 (0.1)	0.20 (0.1)	0.01 (0.1)	14.74 (4.1)	2.75 (5.5)	0.00 (0.7)	2.89 (2.1)	73.91 (8.0)
	4	0.04 (0.1)	44.76 (1.0)	2.05 (0.1)	0.48 (0.1)	2.31 (0.1)	3.88 (4.1)	26.02 (26.8)	2.50 (1.5)	2.30 (1.1)	15.67 (20.0)
	8	0.08 (0.1)	38.50 (1.4)	3.23 (0.1)	1.62 (0.1)	2.67 (0.3)	10.76 (4.0)	26.99 (29.3)	2.71 (1.6)	3.14 (1.0)	10.30 (21.4)
	12	0.10 (0.1)	33.24 (1.6)	3.98 (0.1)	1.83 (0.1)	2.37 (0.3)	15.41 (4.3)	29.74 (29.5)	2.61 (1.7)	3.51 (1.0)	7.21 (21.0)
	24	0.11 (0.1)	33.38 (1.6)	3.50 (0.1)	1.29 (0.1)	1.51 (0.3)	18.92 (4.2)	30.45 (29.1)	3.05 (1.8)	4.34 (1.0)	3.45 (20.6)
Hong Kong, China	0	0.05 (0.1)	0.03 (4.7)	0.16 (0.8)	0.01 (0.1)	0.02 (0.2)	5.46 (3.0)	69.70 (13.1)	0.00 (0.1)	0.32 (0.2)	24.25 (13.7)
	4	0.02 (0.1)	1.67 (0.7)	0.33 (0.1)	0.01 (0.1)	0.08 (0.1)	3.32 (2.2)	86.51 (5.7)	0.02 (0.1)	0.11 (0.4)	7.92 (3.4)
	8	0.02 (0.1)	3.30 (0.9)	0.52 (0.1)	0.05 (0.1)	0.10 (0.1)	8.86 (2.5)	80.68 (7.7)	0.02 (0.1)	0.36 (0.2)	6.09 (4.1)
	12	0.02 (0.1)	3.32 (0.9)	0.50 (0.1)	0.06 (0.1)	0.16 (0.1)	11.38 (2.4)	78.70 (7.5)	0.03 (0.1)	0.33 (0.2)	5.50 (4.1)
	24	0.03 (0.1)	4.23 (0.9)	0.49 (0.1)	0.07 (0.1)	0.16 (0.1)	12.26 (2.4)	77.30 (7.8)	0.03 (0.1)	0.38 (0.2)	5.06 (4.2)
India	0	0.00 (0.1)	5.83 (11.2)	0.00 (0.1)	0.39 (0.1)	0.06 (0.2)	25.81 (1.5)	0.31 (2.0)	1.95 (0.9)	15.73 (5.8)	49.91 (9.8)
	4	0.06 (0.1)	23.23 (4.8)	0.82 (0.2)	0.41 (0.1)	0.89 (0.1)	50.87 (15.4)	2.00 (3.8)	4.35 (2.9)	3.74 (6.2)	13.62 (12.9)
	8	0.05 (0.1)	31.70 (5.0)	1.43 (0.1)	0.36 (0.1)	0.69 (0.1)	46.94 (10.7)	1.74 (12.9)	3.34 (3.6)	2.99 (7.8)	10.75 (1.9)
	12	0.06 (0.1)	31.53 (5.5)	1.41 (0.1)	0.39 (0.1)	0.71 (0.1)	47.22 (10.3)	1.73 (18.3)	3.39 (4.0)	2.90 (7.8)	10.67 (3.5)
	24	0.06 (0.1)	31.34 (5.7)	1.48 (0.1)	0.39 (0.1)	0.70 (0.1)	48.24 (10.8)	1.67 (21.0)	3.18 (4.2)	2.74 (7.8)	10.21 (5.8)
Indonesia	0	1.27 (0.1)	7.00 (13.4)	1.35 (1.4)	0.00 (0.4)	1.03 (0.2)	26.00 (10.2)	2.08 (0.3)	0.85 (0.3)	19.52 (2.0)	40.89 (16.8)
	4	0.34 (0.1)	21.43 (8.4)	0.84 (0.4)	0.13 (0.1)	0.25 (1.1)	68.06 (18.0)	0.85 (0.1)	1.59 (0.6)	3.28 (19.5)	3.24 (2.3)
	8	0.24 (0.1)	25.57 (8.5)	0.67 (0.5)	0.14 (0.1)	0.31 (0.9)	62.88 (22.7)	0.90 (0.3)	1.29 (1.0)	5.90 (25.0)	2.09 (3.7)
	12	0.24 (0.1)	30.00 (9.1)	0.67 (0.5)	0.13 (0.2)	0.29 (0.8)	58.87 (24.0)	0.88 (0.3)	1.18 (1.1)	5.94 (29.0)	1.80 (4.7)
	24	0.23 (0.1)	33.72 (9.1)	0.69 (0.5)	0.12 (0.3)	0.28 (1.2)	54.67 (26.6)	0.94 (0.3)	1.16 (1.1)	6.55 (31.3)	1.63 (5.1)
Korea, Rep. of	0	0.00 (0.1)	22.22 (13.9)	0.48 (0.3)	0.00 (0.1)	0.15 (0.3)	3.29 (1.1)	0.05 (0.1)	0.78 (0.9)	0.98 (1.4)	72.04 (14.2)
	4	0.07 (0.1)	34.09 (15.7)	1.53 (0.4)	0.30 (0.1)	1.16 (0.1)	7.26 (7.4)	0.57 (0.2)	4.46 (0.8)	3.11 (5.7)	47.45 (17.6)
	8	0.07 (0.1)	33.96 (11.9)	1.97 (0.6)	0.48 (0.1)	1.61 (0.3)	7.59 (5.9)	0.66 (0.3)	5.07 (0.5)	5.00 (6.0)	43.58 (13.0)
	12	0.11 (0.1)	35.28 (12.0)	2.09 (0.6)	0.41 (0.1)	1.66 (0.1)	18.67 (6.4)	0.73 (0.3)	3.94 (0.5)	5.60 (7.9)	31.50 (12.0)
	24	0.14 (0.1)	38.70 (11.6)	2.33 (0.5)	0.27 (0.1)	2.04 (0.1)	32.62 (7.4)	0.86 (0.4)	1.77 (0.5)	7.06 (10.2)	14.21 (11.1)
Malaysia	0	0.00 (0.1)	13.24 (0.6)	0.05 (0.1)	0.07 (0.1)	0.03 (0.1)	0.13 (0.2)	0.03 (0.3)	0.06 (0.1)	0.79 (3.2)	85.61 (3.0)
	4	0.08 (0.1)	6.35 (2.6)	1.14 (0.1)	0.09 (0.1)	0.98 (0.1)	42.63 (2.0)	1.30 (0.2)	0.35 (1.2)	5.81 (4.0)	41.26 (4.5)
	8	0.15 (0.1)	12.55 (2.7)	1.62 (0.1)	0.18 (0.1)	2.42 (0.1)	49.71 (2.6)	1.24 (0.1)	0.22 (1.7)	7.35 (5.5)	24.55 (6.4)
	12	0.14 (0.1)	18.62 (2.4)	3.55 (0.1)	0.37 (0.1)	2.89 (0.1)	45.38 (3.9)	1.68 (0.2)	0.21 (1.7)	9.18 (5.6)	17.97 (7.6)
	24	0.16 (0.1)	22.36 (1.5)	3.70 (0.1)	0.30 (0.1)	2.28 (0.1)	51.68 (5.7)	1.21 (0.9)	0.12 (1.5)	6.08 (5.7)	12.12 (10.0)

Table 5 (Continued)

Philippines	0	0.00 (0.1)	26.60 (5.9)	0.38 (0.1)	0.00 (0.1)	0.06 (0.1)	2.94 (5.0)	0.08 (0.6)	0.12 (1.7)	0.70 (0.4)	69.12 (8.3)
	4	0.00 (0.1)	15.39 (2.5)	0.30 (0.2)	0.04 (0.1)	0.28 (0.8)	22.39 (6.1)	2.73 (0.4)	0.18 (1.1)	4.95 (2.2)	53.73 (9.8)
	8	0.02 (0.1)	15.91 (2.3)	0.53 (0.2)	0.09 (0.1)	0.33 (0.6)	22.71 (5.9)	4.10 (1.4)	0.32 (2.5)	4.51 (2.1)	51.48 (10.5)
	12	0.04 (0.1)	11.69 (1.7)	0.59 (0.2)	0.09 (0.1)	0.26 (0.7)	16.33 (4.7)	9.70 (1.6)	0.35 (2.3)	6.67 (4.6)	54.28 (10.8)
	24	0.03 (0.1)	5.90 (3.6)	0.46 (0.2)	0.20 (0.1)	0.08 (0.6)	5.96 (4.2)	13.08 (0.6)	0.64 (2.4)	8.25 (9.5)	65.40 (10.5)
Singapore	0	0.00 (0.1)	6.09 (0.8)	0.06 (0.1)	0.01 (0.1)	0.01 (0.1)	3.17 (0.2)	0.34 (0.1)	0.68 (0.1)	0.01 (0.1)	89.63 (0.7)
	4	0.01 (0.1)	6.06 (0.9)	0.68 (0.1)	0.10 (0.1)	0.36 (0.1)	4.65 (6.3)	3.64 (0.2)	1.62 (0.2)	0.60 (1.5)	82.27 (4.9)
	8	0.02 (0.1)	5.14 (0.9)	0.50 (0.1)	0.06 (0.1)	0.34 (0.1)	2.42 (7.6)	3.22 (0.2)	1.65 (0.3)	0.37 (1.4)	86.27 (6.2)
	12	0.01 (0.1)	3.26 (0.9)	0.35 (0.1)	0.04 (0.1)	0.30 (0.1)	3.44 (7.5)	4.31 (0.2)	2.07 (0.3)	0.42 (1.4)	85.78 (6.1)
	24	0.00 (0.1)	1.78 (0.9)	0.11 (0.1)	0.00 (0.1)	0.33 (0.1)	3.78 (7.5)	4.45 (0.2)	2.19 (0.3)	0.39 (1.4)	86.97 (6.1)
Taipei,China	0	0.00 (0.1)	17.91 (16.6)	0.30 (0.3)	0.05 (0.3)	0.03 (0.3)	44.99 (8.8)	0.94 (5.0)	0.07 (3.8)	6.41 (0.9)	29.30 (10.1)
	4	0.02 (0.1)	23.69 (4.8)	1.59 (0.7)	0.25 (0.1)	0.35 (0.5)	44.79 (4.7)	0.88 (12.4)	2.60 (4.0)	6.88 (2.0)	18.95 (1.6)
	8	0.03 (0.1)	40.71 (3.8)	2.65 (0.4)	0.51 (0.1)	0.46 (1.1)	36.19 (7.6)	0.86 (9.0)	1.95 (2.7)	4.40 (0.8)	12.24 (6.0)
	12	0.04 (0.1)	46.81 (6.6)	3.02 (0.1)	0.51 (0.1)	0.45 (1.0)	32.88 (21.3)	0.75 (8.5)	1.71 (2.6)	3.66 (0.5)	10.17 (11.2)
	24	0.05 (0.1)	48.26 (8.9)	3.06 (0.2)	0.51 (0.2)	0.46 (0.6)	32.05 (31.3)	0.72 (9.8)	1.65 (3.3)	3.51 (0.5)	9.74 (14.3)
Thailand	0	0.13 (0.1)	12.00 (7.5)	2.22 (0.7)	0.79 (0.6)	0.02 (0.3)	26.13 (1.6)	0.43 (0.8)	0.10 (1.8)	1.25 (5.5)	56.93 (6.4)
	4	0.18 (0.1)	39.58 (11.9)	3.21 (1.1)	0.74 (0.3)	1.15 (0.1)	30.12 (9.1)	0.13 (1.1)	1.65 (2.9)	0.70 (0.5)	22.53 (18.6)
	8	0.56 (0.1)	34.29 (10.2)	5.28 (0.8)	1.20 (0.3)	1.52 (0.1)	24.53 (11.5)	3.12 (1.0)	5.70 (2.0)	0.60 (1.8)	23.20 (18.4)
	12	0.95 (0.1)	29.47 (9.9)	5.00 (0.7)	0.99 (0.3)	3.20 (0.2)	23.93 (11.2)	3.89 (1.0)	12.38 (2.0)	0.78 (2.3)	19.42 (17.7)
	24	1.14 (0.1)	21.04 (9.6)	3.60 (0.7)	0.74 (0.3)	4.15 (0.2)	23.66 (11.3)	8.46 (1.0)	23.07 (2.0)	1.74 (2.3)	12.41 (17.5)
Viet Nam	0	0.08 (0.1)	1.27 (3.1)	3.82 (0.4)	0.14 (0.0)	4.58 (0.1)	0.01 (0.9)	11.59 (0.1)	6.65 (0.1)	22.99 (13.4)	48.87 (8.9)
	4	0.02 (0.1)	2.75 (1.1)	0.45 (0.2)	0.10 (0.1)	0.29 (0.1)	3.66 (4.4)	1.59 (0.5)	0.19 (0.2)	89.20 (2.2)	1.76 (2.8)
	8	0.03 (0.1)	6.03 (0.7)	0.65 (0.1)	0.15 (0.0)	0.30 (0.1)	6.22 (5.8)	1.69 (1.2)	0.17 (0.2)	83.25 (3.2)	1.52 (2.2)
	12	0.03 (0.1)	5.21 (0.7)	0.53 (0.1)	0.12 (0.0)	0.22 (0.1)	5.46 (5.6)	1.41 (1.7)	0.12 (0.1)	85.80 (3.8)	1.09 (1.5)
	24	0.02 (0.1)	3.14 (0.8)	0.25 (0.1)	0.05 (0.0)	0.09 (0.1)	3.04 (5.6)	0.80 (1.6)	0.05 (0.1)	92.13 (4.0)	0.42 (1.3)

Note: The table reports the percentage contribution of the shocks to the forecast-error variance in the food prices. Figures in parentheses are one-standard errors computed using 500 bootstrap replications of the model.
Source: Authors' calculation.

Table 6: Determinants of National Food Price Inflation: Benchmark Model

	(1)	(2)	(3)	(4)	(5)
Change in FAO world food index (t)		-0.019		0.060***	
		(0.015)		(0.019)	
Change in FAO world food index (t-1)			0.101***	0.144***	
			(0.017)	(0.021)	
Change in average of national food prices (t)					0.007***
					(0.001)
GDP per capita growth rate	-0.260**	0.057	-0.151*	-0.254***	-0.083
	(0.102)	(0.086)	(0.089)	(0.093)	(0.083)
Population growth rate	-0.265	0.322	-0.006	-0.128	-0.007
	(0.644)	(0.686)	(0.661)	(0.655)	(0.648)
Free trade index of Economic Freedom of the World	0.011	0.020***	0.016**	0.016**	0.015**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Change in Food Production Index	-0.003	0.010	0.006	0.015	-0.013
	(0.038)	(0.040)	(0.038)	(0.038)	(0.037)
Share of food imports in merchandise imports	-0.006***	-0.007***	-0.005***	-0.005***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Change in share of food imports in merchandise	0.006***	0.007***	0.006***	0.006***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Change in exchange rate (LOC/US$)	0.108***	0.117***	0.087***	0.096***	0.089***
	(0.017)	(0.017)	(0.016)	(0.016)	(0.015)
M1 growth rate	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
M1 growth rate (t-1)	0.0002*	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Political stability index	-0.038***	-0.039***	-0.037***	-0.033***	-0.040***
	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)
Log of GDP per capita	0.081*	0.053*	0.032	0.024	-0.005
	(0.046)	(0.030)	(0.029)	(0.029)	(0.029)
Constant	-0.711*	-0.486*	-0.294	-0.225	0.005
	(0.410)	(0.279)	(0.270)	(0.268)	(0.272)
Year dummies	Yes	No	No	No	No
Country dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	497	497	497	497	497
Number of groups	64	64	64	64	64
R^2	0.330	0.212	0.272	0.290	0.300

Notes: Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively.
Source: Authors' calculation.

Table 7: Determinants of National Food Price Inflation: Differential Effects of Global Food Prices in Different Regions

	(1)	(2)	(3)	(4)
Change in FAO world food price index (t) * Asia dummy	-0.014		0.066	
	(0.035)		(0.041)	
Change in FAO world food price index (t) * Latin America dummy	-0.025		0.106***	
	(0.030)		(0.036)	
Change in FAO world food price index (t) * Europe dummy	0.001		0.090***	
	(0.025)		(0.030)	
Change in FAO world food price index (t) * Sub-Saharan Africa dummy	-0.096**		-0.034	
	(0.042)		(0.049)	
Change in FAO world food price index (t) * Others dummy	-0.005		0.026	
	(0.035)		(0.040)	
Change in FAO world food price index (t-1) * Asia dummy		0.078**	0.121***	
		(0.034)	(0.042)	
Change in FAO world food price index (t-1) * Latin America dummy		0.161***	0.240***	
		(0.031)	(0.039)	
Change in FAO world food price index (t-1) * Europe dummy		0.091***	0.157***	
		(0.027)	(0.033)	
Change in FAO world food price index (t-1) * Sub-Saharan Africa dummy		0.134***	0.118**	
		(0.042)	(0.050)	
Change in FAO world food price index (t-1) * Others dummy		0.045	0.069	
		(0.035)	(0.042)	
Change in average of nationa food prices (t) * Asia dummy				0.006***
				(0.002)
Change in average of nationa food prices (t) * Latin America dummy				0.008***
				(0.002)
Change in average of nationa food prices (t) * Europe dummy				0.007***
				(0.002)
Change in average of nationa food prices (t) * Sub-Saharan Africa dummy				0.010***
				(0.003)
Change in average of nationa food prices (t) * Others dummy				0.006***
				(0.002)
All internal variables are included but not shown				
Constant	-0.495*	-0.294	-0.198	0.000
	(0.279)	(0.269)	(0.266)	(0.272)
Year dummies	No	No	No	No
Country dummies	Yes	Yes	Yes	Yes
Number of observations	497	497	497	497
Number of groups	64	43	64	43
R^2	0.220	0.286	0.317	0.303

Notes: All internal variables are included but not shown for brevity. Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively.

Source: Authors' calculation.

Table 8: Determinants of National Food Price Inflation: Intra-regional Co-movement vs. Extra-regional Co-movement

	(1)	(2)
Change in intra-regional food prices (Asia)	0.005*	
	(0.002)	
Change in intra-regional food prices (Latin America)	0.005***	
	(0.002)	
Change in intra-reginal food prices (Europe)	0.007***	
	(0.002)	
Change in intra-regional food prices (Sub-Saharan Africa)	0.004***	
	(0.001)	
Change in extra-regional food prices (Asia)		0.005**
		(0.002)
Change in extra-regional food prices (Latin America)		0.006***
		(0.002)
Change in extra-reginal food prices (Europe)		0.007***
		(0.002)
Change in extra-regional food prices (Sub-Saharan Africa)		0.009***
		(0.003)
All internal variables are included but not shown		
Constant	-0.137	-0.000
	(0.292)	(0.294)
Year dummies	No	No
Country dummies	Yes	Yes
Number of observations	405	405
Number of groups	64	64
R^2	0.310	0.316

Notes: All internal variables are included but not shown for brevity. Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively.

Source: Authors' calculation.

Table 9a: Determinants of Volatilities of National Food Price Index: Benchmark System GMM Model

	(1)	(2)	(3)	(4)	(5)
Volatility of national food price index (t-1)	0.834***	0.388***	0.255	0.772***	0.763***
	(0.121)	(0.126)	(0.191)	(0.117)	(0.114)
Volatility of FAO world food price index (t)		0.095***		0.134***	
		(0.014)		(0.016)	
Volatility of FAO world food price index (t-1)			0.042**	-0.093***	
			(0.019)	(0.020)	
Average of national food price volatilities (t)					0.990***
					(0.102)
GDP per capita growth rate	-6.231***	-1.527	-0.832	-3.842**	-3.010**
	(1.808)	(1.461)	(1.454)	(1.616)	(1.494)
Population growth rate	-3.642	4.470	12.879	-4.924	-3.191
	(11.341)	(14.586)	(19.696)	(9.543)	(10.757)
Free trade index of Economic Freedom of the World	-0.103	0.117	0.291	-0.097	-0.008
	(0.186)	(0.194)	(0.195)	(0.185)	(0.199)
Change in Food Production Index	-0.301	-1.342**	-1.291**	-0.941*	-0.761
	(0.699)	(0.557)	(0.580)	(0.555)	(0.537)
Share of food imports in merchandise imports	-0.038	-0.149***	-0.134**	-0.072*	-0.102**
	(0.039)	(0.043)	(0.053)	(0.039)	(0.043)
Change in share of food imports in merchandise imports	-0.035	-0.014	0.010	-0.049*	-0.035
	(0.027)	(0.026)	(0.029)	(0.026)	(0.028)
Volatility of exchange rate (LOC/US$)	0.210	0.836	1.696	0.525	0.292
	(0.704)	(0.844)	(1.324)	(0.598)	(0.537)
M1 growth rate	0.001	0.002	0.002	0.003	0.002
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
M1 growth rate (t-1)	0.000	0.002	0.002	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Political stability index	0.039	0.025	-0.045	0.258	0.206
	(0.240)	(0.247)	(0.246)	(0.219)	(0.217)
Log of GDP per capita	-0.260	-1.373***	-1.011**	-0.655**	-0.874***
	(0.369)	(0.341)	(0.445)	(0.315)	(0.273)
Constant	3.888	13.472***	9.496**	7.447**	6.749**
	(3.734)	(3.445)	(4.366)	(3.114)	(2.835)
Year dummies	Yes	No	No	No	No
Number of observations	497	497	497	497	497
Number of groups	64	64	64	64	64
Arellano-Bond test					
AR(1)	-2.032	-1.140	-0.567	-1.819	-1.968
p-value	0.042	0.254	0.571	0.069	0.049
AR(2)	-1.577	-1.410	-1.442	-1.429	-1.514
p-value	0.114	0.159	0.149	0.153	0.129
Overidentification test (Sargan)					
Chi-squared	12.477	16.567	20.780	13.942	13.898
p-value	0.488	0.220	0.077	0.378	0.381

Notes: Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively.

Source: Authors' calculation.

Table 9b: Determinants of Volatilities of National Food Price Index: Benchmark Fixed Effects Model

	(1)	(1)	(2)	(3)	(4)
Volatility of FAO world food price index (t)		0.076***		0.114***	
		(0.025)		(0.034)	
Volatility of FAO world food price index (t-1)			0.019	-0.061*	
			(0.027)	(0.036)	
Average of national food price volatilities (t)					0.927***
					(0.277)
GDP per capita growth rate	-8.718***	-6.386***	-7.746***	-8.343***	-8.649***
	(2.354)	(2.460)	(2.738)	(2.711)	(2.327)
Population growth rate	-1.503	0.373	-0.339	-2.433	-3.064
	(18.790)	(18.628)	(18.876)	(18.659)	(18.574)
Free trade index of Economic Freedom of the	0.495**	0.528***	0.508**	0.503**	0.515**
	(0.205)	(0.203)	(0.206)	(0.203)	(0.202)
Change in Food Production Index	-0.720	-1.119	-0.797	-1.072	-1.005
	(1.089)	(1.087)	(1.095)	(1.085)	(1.080)
Share of food imports in merchandise imports	-0.148***	-0.137**	-0.151***	-0.124**	-0.120**
	(0.054)	(0.053)	(0.054)	(0.054)	(0.054)
Change in share of food imports in	0.060	0.020	0.055	0.015	0.014
	(0.053)	(0.054)	(0.054)	(0.054)	(0.054)
Volatility of exchange rate (LOC/US$)	2.471*	2.027	2.383*	2.088*	2.059
	(1.270)	(1.267)	(1.277)	(1.265)	(1.261)
M1 growth rate	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
M1 growth rate (t-1)	0.006**	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Political stability index	-0.673**	-0.624*	-0.668**	-0.615*	-0.614*
	(0.321)	(0.319)	(0.322)	(0.318)	(0.318)
Log of GDP per capita	1.640**	-0.721	1.151	-0.332	-0.451
	(0.825)	(1.138)	(1.084)	(1.158)	(1.028)
Constant	-13.817*	5.949	-9.738	2.750	1.569
	(7.721)	(10.125)	(9.699)	(10.276)	(8.911)
Number of observations	497	497	497	497	497
Number of groups	64	64	64	64	64
R^2	0.111	0.130	0.112	0.136	0.134

Notes: Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively.

Source: Authors' calculation.

Table 10: Determinants of Volatilities of National Food Price Index: Differential Effects of Global Food Prices in Different Regions

	System GMM	Fixed Effects	System GMM	Fixed Effects
	(1)	(2)	(3)	(4)
Volatility of national food price index (t-1)	0.614***		0.692***	
	(0.117)		(0.134)	
Volatility of FAO world food price index * Asia dummy	0.095***	0.040		
	(0.020)	(0.049)		
Volatility of FAO world food price index * Latin America dummy	0.088***	0.081*		
	(0.018)	(0.042)		
Volatility of FAO world food price index * Europe dummy	0.031**	0.079**		
	(0.012)	(0.033)		
Volatility of FAO world food price index * Sub-Saharan dummy	0.005	0.098*		
	(0.035)	(0.052)		
Volatility of FAO world food price index * Others dummy	0.203***	0.062		
	(0.061)	(0.042)		
Average of volatilities of national food prices * Asia dummy			0.018	0.034
			(0.021)	(0.062)
Average of volatilities of national food prices * Latin America dummy			-0.028	0.021
			(0.033)	(0.056)
Average of volatilities of national food prices * Europe dummy			0.042***	0.095**
			(0.012)	(0.046)
Average of volatilities of national food prices * Sub-Saharan dummy			-0.037	-0.011
			(0.054)	(0.075)
Average of volatilities of national food prices * Others dummy			1.893***	0.913*
			(0.411)	(0.500)
All internal variables are included but not shown				
Number of observations	497	497	497	497
Number of groups	64	64	64	64
R^2		0.132		0.127
Arellano-Bond test				
AR(1)	-1.512		-1.664	
p-value	0.131		0.096	
AR(2)	-1.441		-1.711	
p-value	0.150		0.087	
Overidentification test (Sargan)				
Chi-squared	17.503		14.626	
p-value	0.177		0.331	

Notes: All internal variables are included but not shown for brevity. Shown in parentheses are standard errors.
***, **, and * denote one, five, and ten percent level of significance, respectively

Source: Authors' calculation.

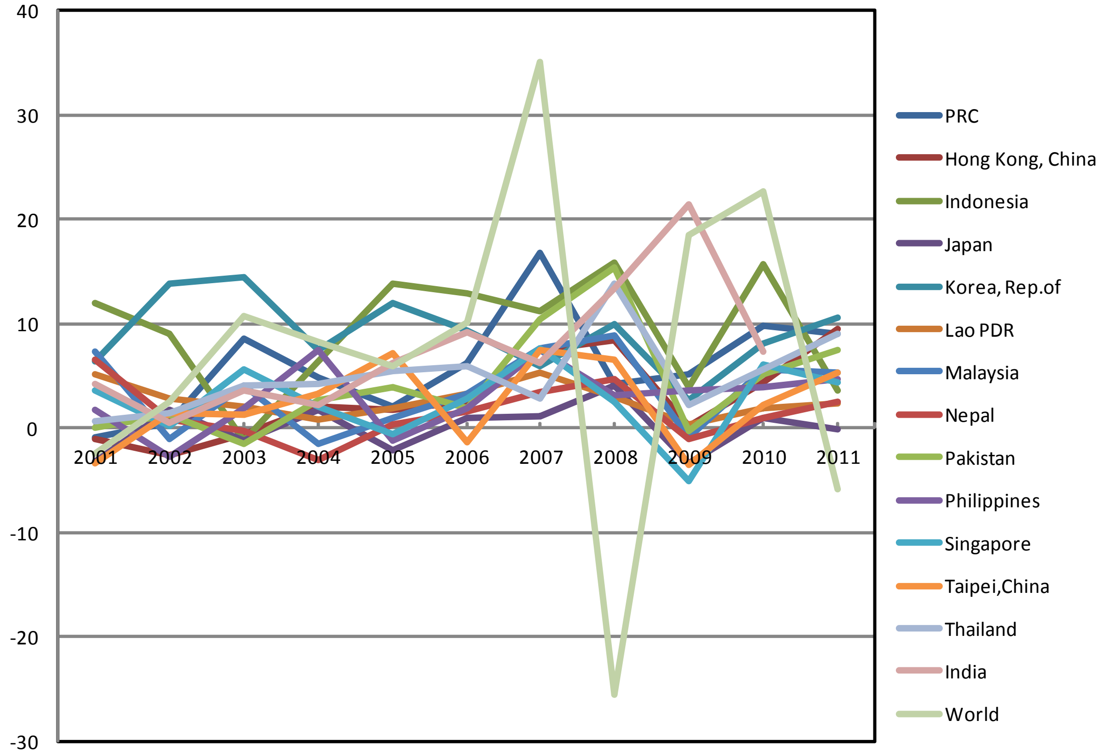
Table 11: Determinants of Volatilities of National Food Price Index: Intra-regional Co-movement vs. Extra-regional Co-movement

	System GMM	Fixed Effects	System GMM	Fixed Effects
	(1)	(2)	(3)	(4)
Volatility of national food price index (t-1)	0.408***		0.648***	
	(0.119)		(0.104)	
Volatility of intra-regional food prices (Asia)	132.972***	-22.876		
	(30.180)	(31.172)		
Volatility of intra-regional food prices (Latin America)	42.873***	3.316		
	(13.969)	(17.212)		
Volatility of intra-reginal food prices (Europe)	76.032***	-37.998		
	(19.792)	(25.949)		
Volatility of intra-regional food prices (Sub-Saharan Africa)	-7.252	4.592		
	(31.576)	(16.003)		
Volatility of extra-regional food prices (Asia)			101.255***	53.326**
			(20.641)	(23.796)
Volatility of extra-regional food prices (Latin America)			60.721***	79.995***
			(13.884)	(21.616)
Volatility of extra-reginal food prices (Europe)			36.639***	44.081**
			(10.456)	(21.041)
Volatility of extra-regional food prices (Sub-Saharan Africa)			52.011**	77.040***
			(24.069)	(26.578)
All internal variables are included but not shown				
Constant	11.656***	-0.795	7.216**	-1.408
	(4.207)	(1.946)	(3.618)	(2.362)
Number of observations	405	405	405	405
Number of groups	52	52	52	52
R^2		0.121		0.183
Arellano-Bond test				
AR(1)	-1.330		-2.165	
p-value	0.183		0.030	
AR(2)	-1.009		-0.922	
p-value	0.312		0.356	
Overidentification test (Sagan)				
Chi-squared	20.222		15.783	
p-value	0.089		0.261	

Notes: All internal variables are included but not shown for brevity. Shown in parentheses are standard errors. ***, **, and * denote one, five, and ten percent level of significance, respectively

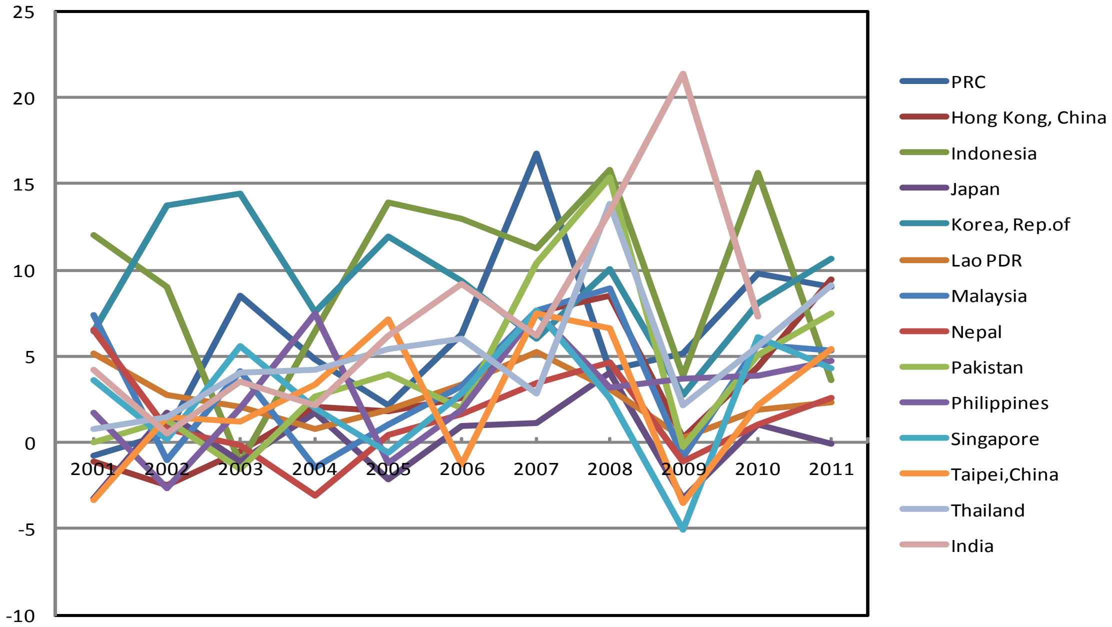
Source: Authors' calculation.

Figure 1a: Food Price Growth Rates for Asian Countries
(with FAO's World Food Price Index)



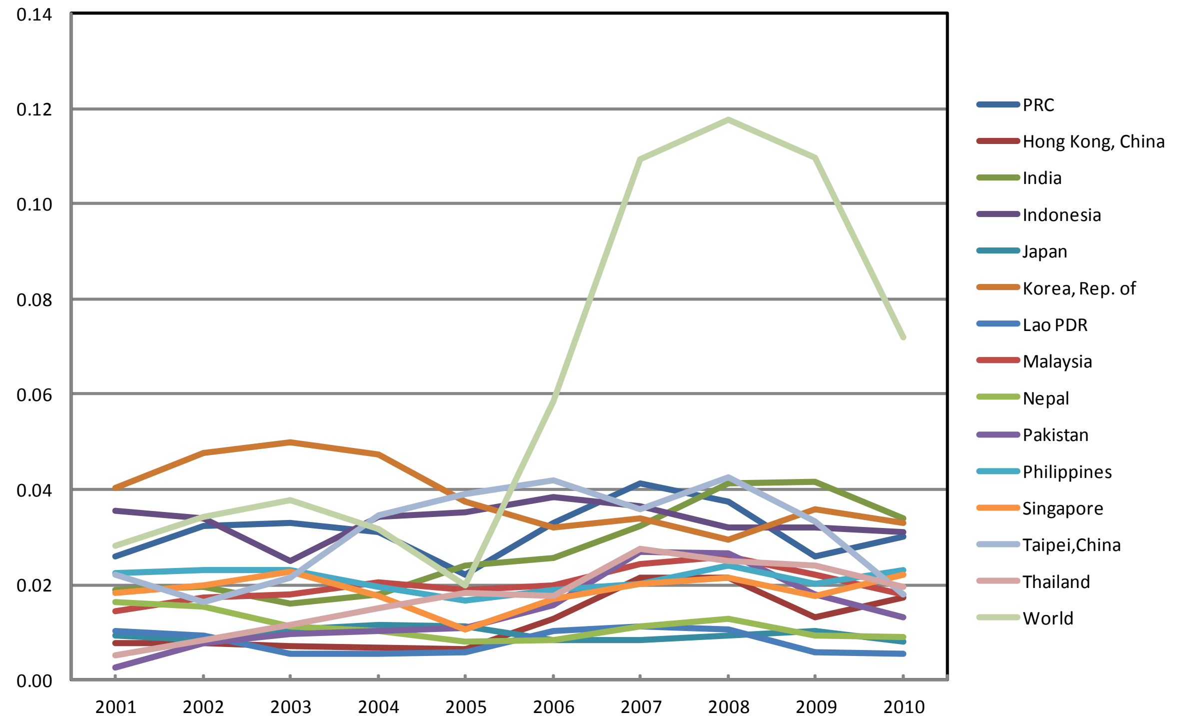
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

Figure 1b: Food Price Growth Rates for Asian Countries
(without FAO's World Food Price Index)



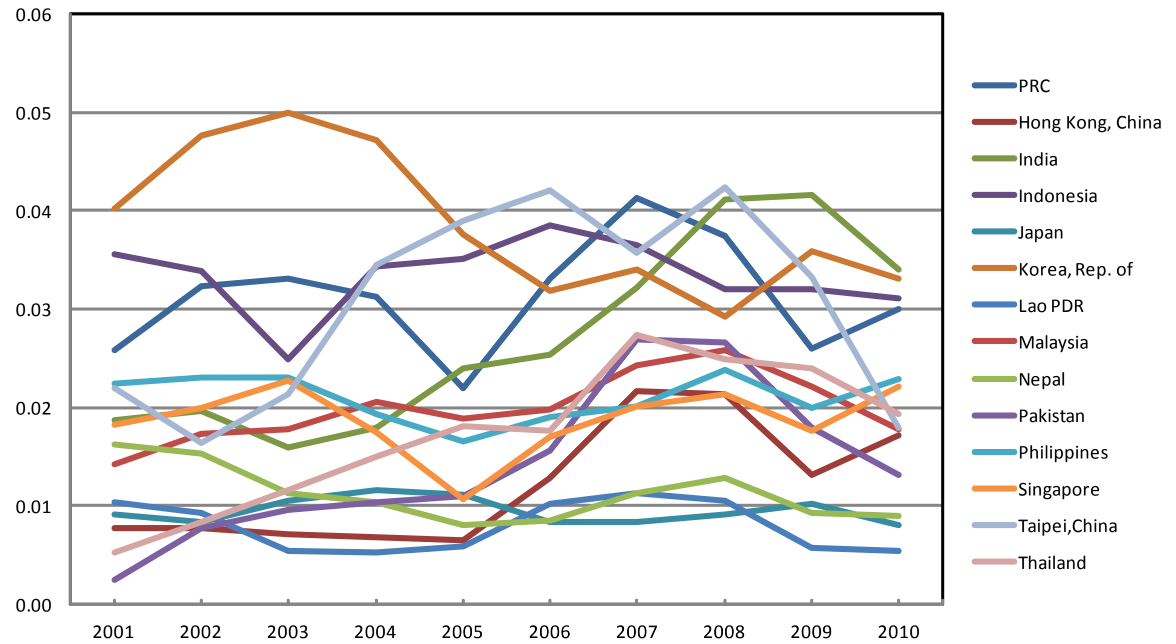
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

Figure 2a: Food Price Volatilities for Asian Countries
(with FAO's World Food Price Index)



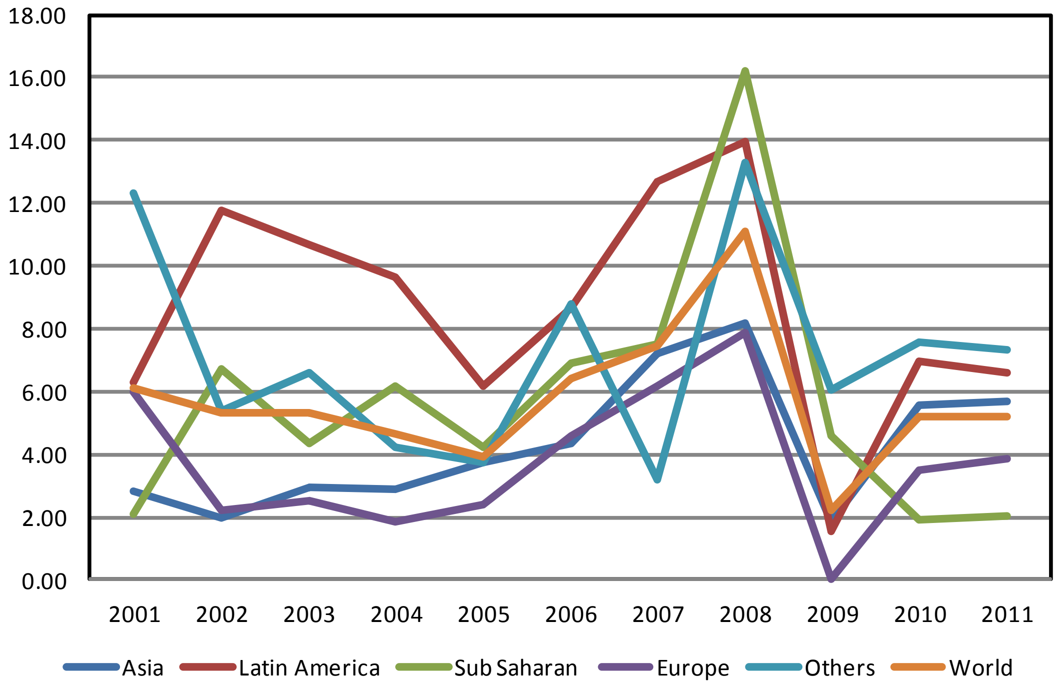
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

Figure 2b: Food Price Volatilities for Asian Countries
(without FAO's World Food Price Index)



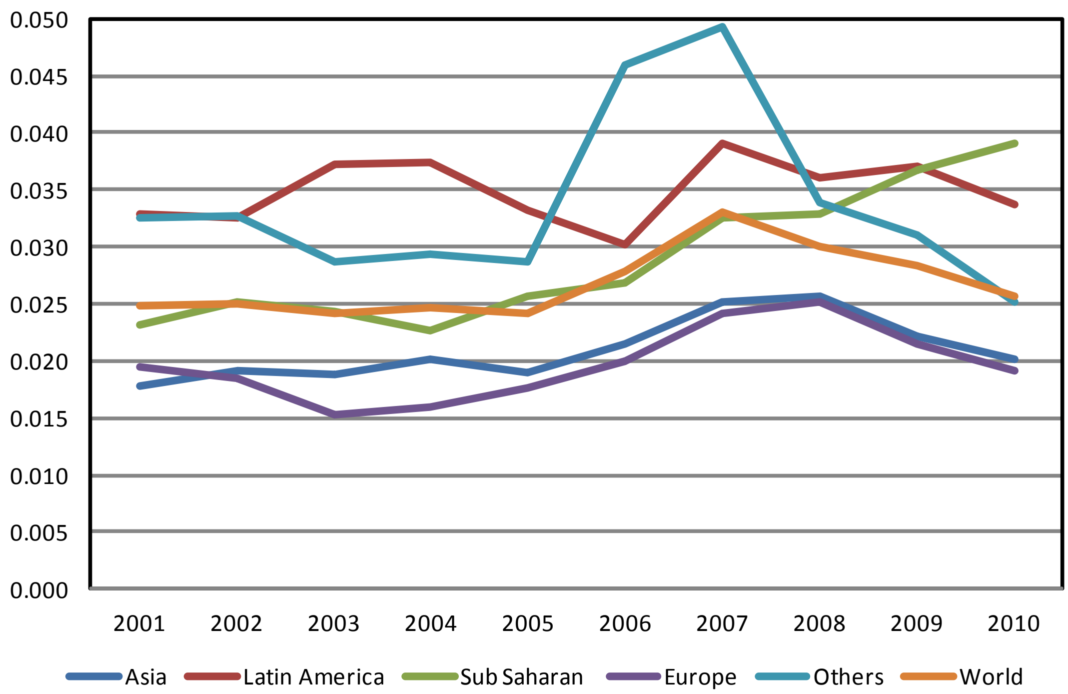
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

Figure 4: Food Price Inflation Rates for Different Regions



Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

Figure 5: Food Price Volatilities for Different Regions



Source: Authors' calculation using data from FAO and national sources accessed through CEIC.