International Transmission of Food Price and Volatility

Hyun-Hoon LEE
(Kangwon National University, Korea)

Cyn-Young Park
(Asian Development Bank)

Hyeon-seung Huh
(Yonsei University, Korea)

Vancouver, Canada
September 2012

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1. Motivation

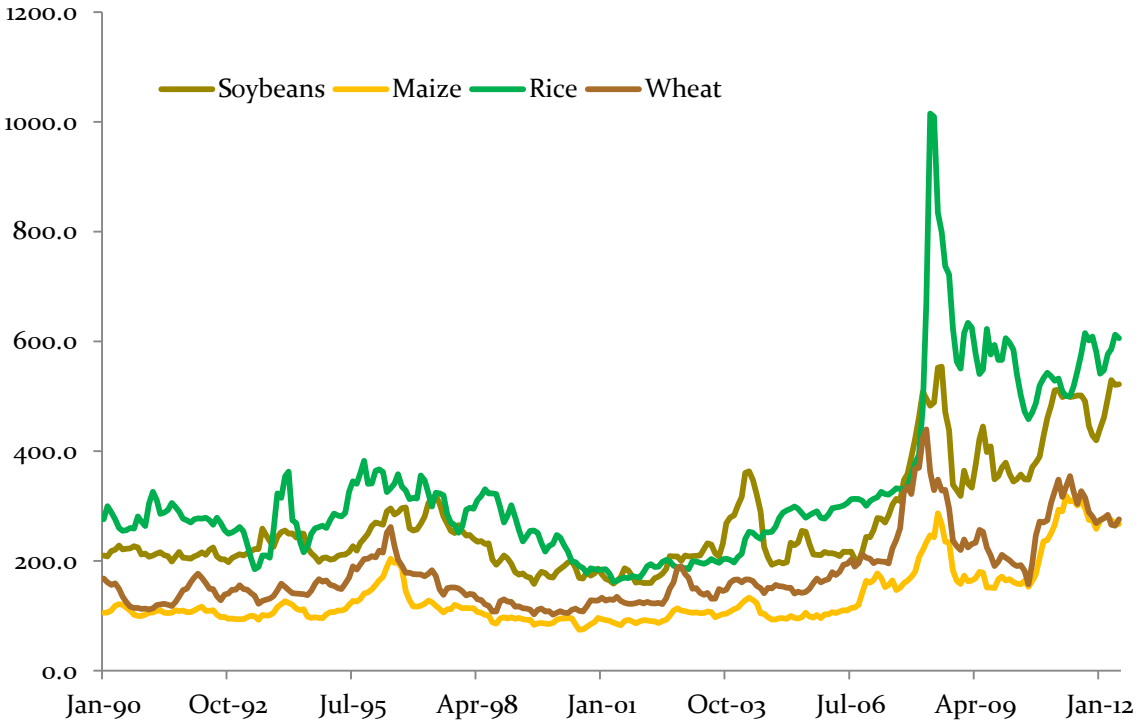
- High food price and volatility pose a significant policy challenge particularly in developing countries
  - High food prices erode purchasing power
  - High volatility of food prices and the associated uncertainty may impede production and investment decisions of food producers, and lead to inefficient resource allocation in agriculture.
- Understanding the dynamics of both food price inflation and its volatility is essential in designing appropriate policy responses.
- A particular concern is whether and to what extent global food prices and volatilities are transmitted to local food prices and volatilities.

Trend of Food Prices

Sharp increase from mid 2007 to mid 2008, especially for rice and Soybeans

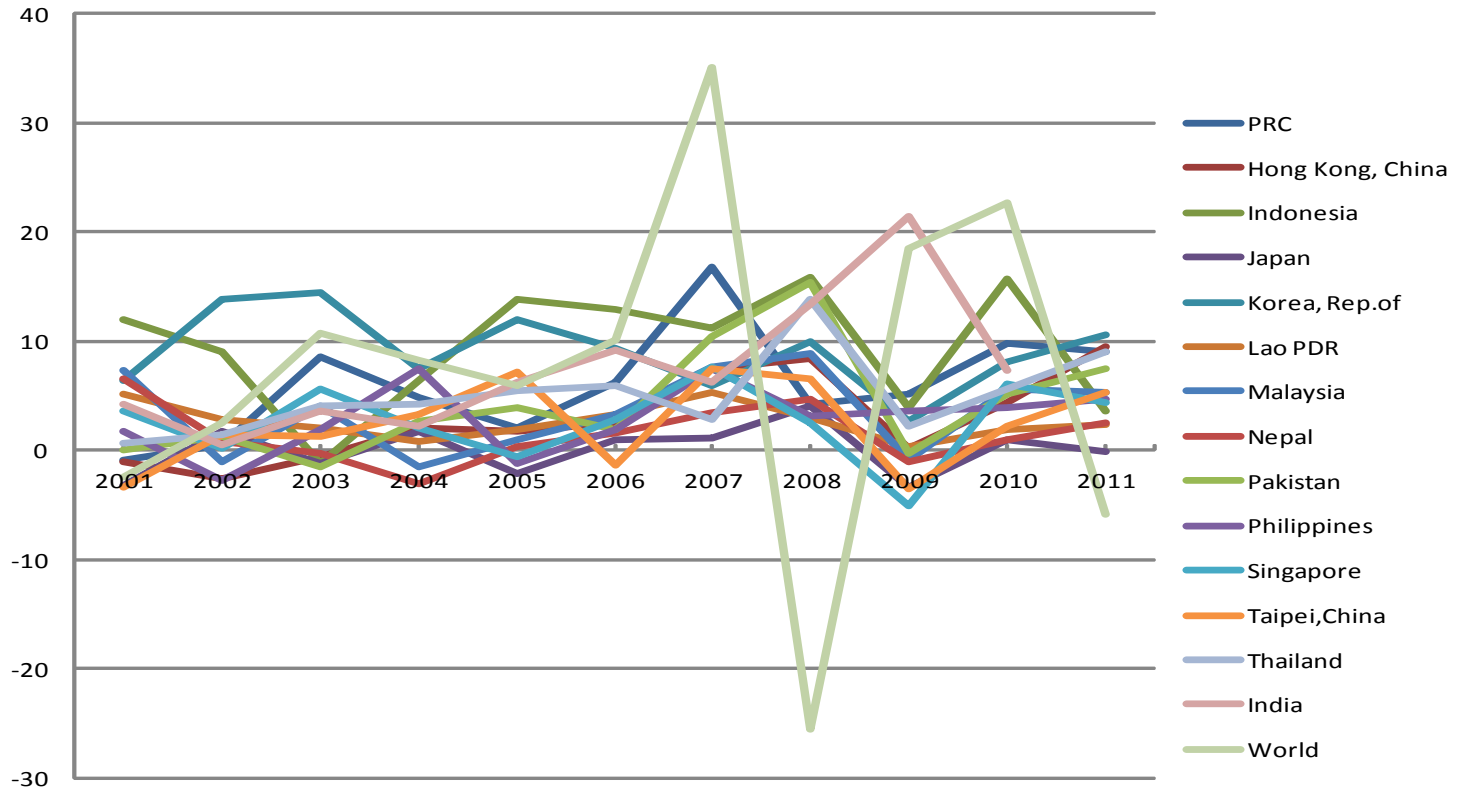
Volatility is an added concern

Figure 1: International prices of maize, rice, soybeans, and wheat, January 1990 to June 2012
(in US dollar per metric ton)



Source: *Primary Commodity Prices*, International Monetary Fund.

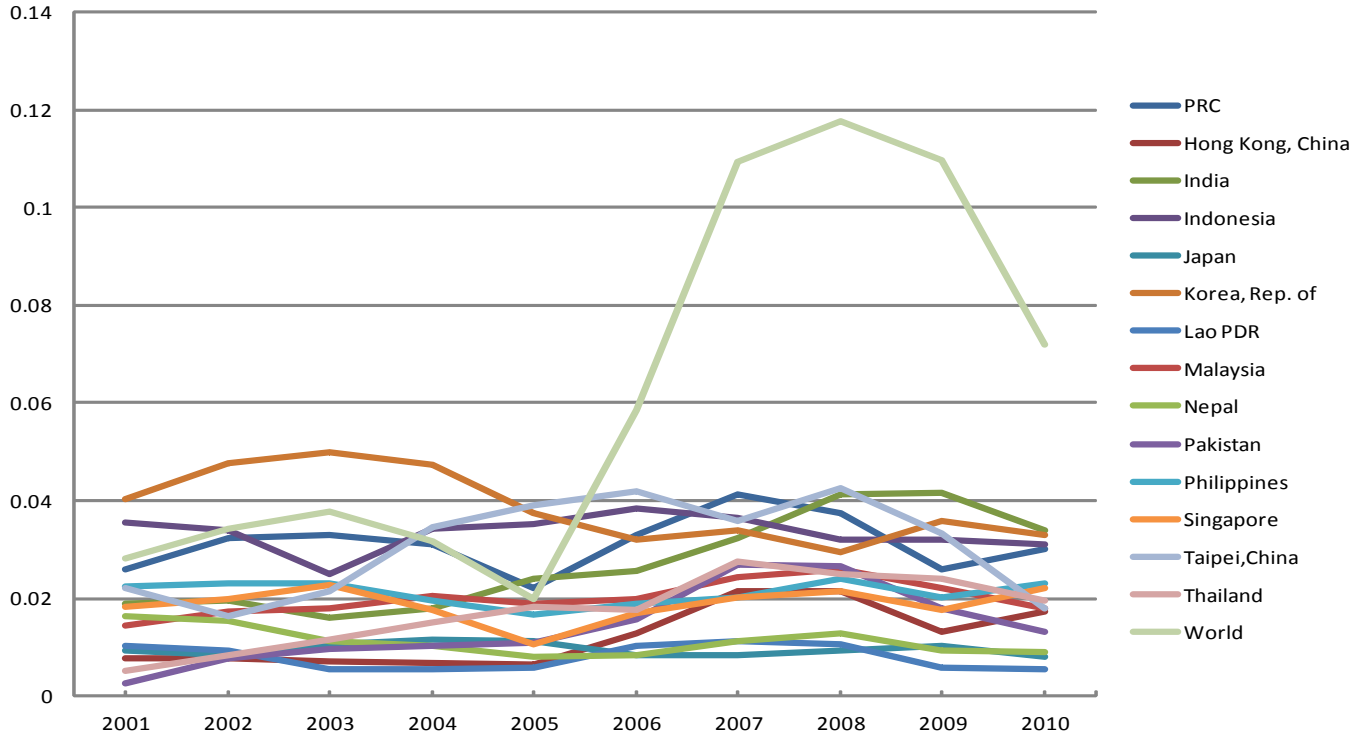
Figure 2: Food Price Inflation Rates for Asian Countries (with FAO's World Food Price Index)



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

1. Compared with the global food prices (FAO's world food price index), the national food price inflation rates of individual countries are more stable.
2. Food price inflation rates of most Asian countries except for India appear to move together, particularly in recent years, rising in 2008, decreasing in 2009 and rising again in 2009.
3. The recent pattern of national food price inflation rates appear to follow the global food prices with roughly one year lag.

Figure 3a: Food Price Volatilities for Asian Countries* (with FAO's World Food Price Index)



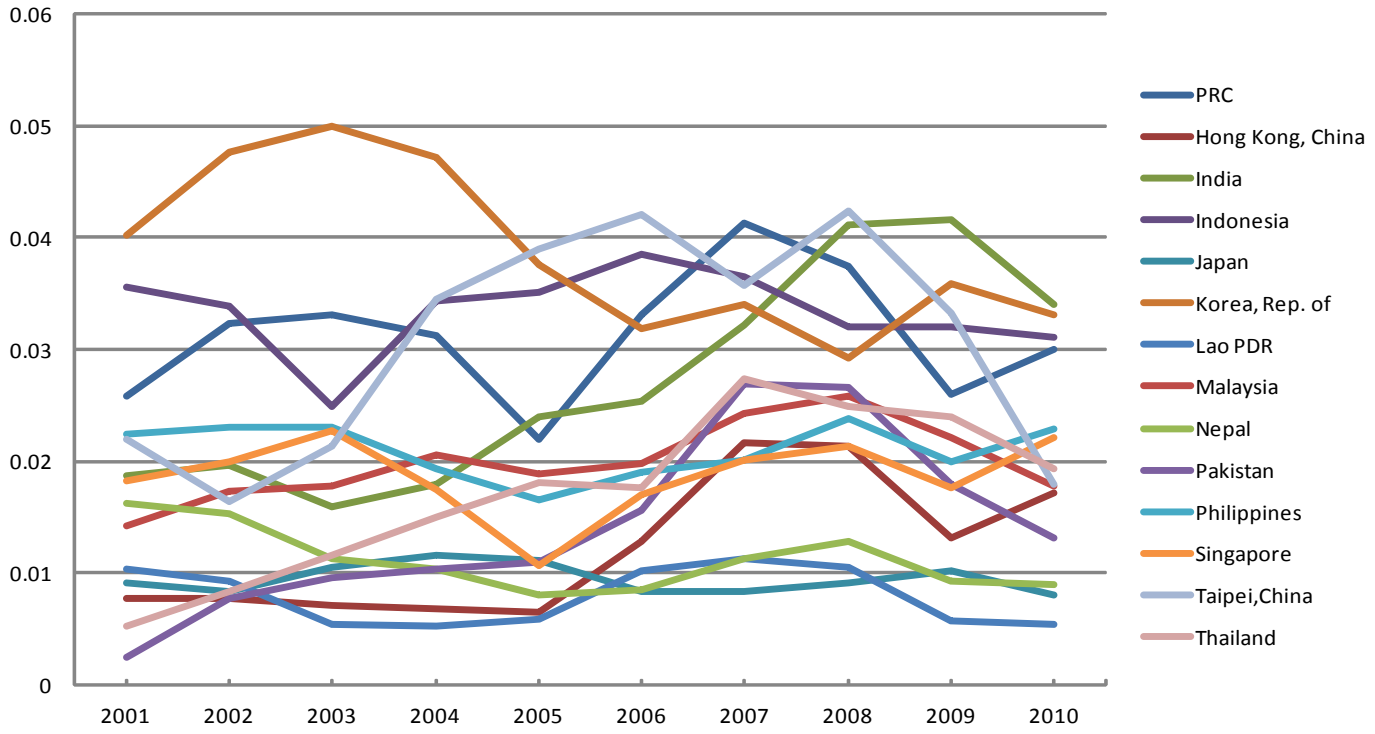
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

1. Volatility of global food prices (measured using FAO's world food price index), is far greater than those of national food prices, but they seem to move together.

* Volatility: the square root of the sum of the squared percentage changes in the quarterly series in a three year moving window.

$$V_2 = 100X\sqrt{\frac{\sqrt{\sum_{j=1}^{12}\left(\Delta \ln\left(p_{i,j,t}\right)\right)^2}}{11}}$$

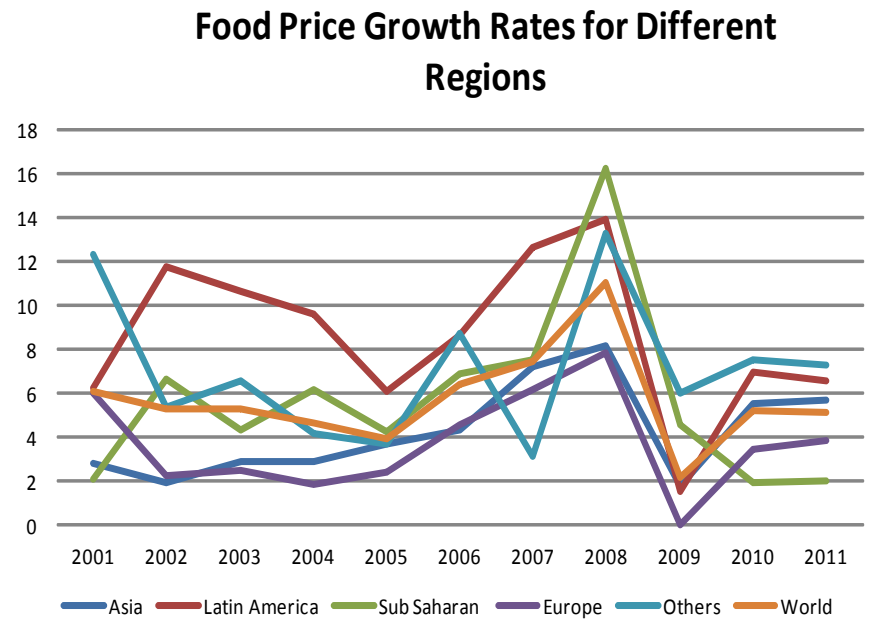
Figure 3b: Food Price Volatilities for Asian Countries (without FAO's World Food Price Index)



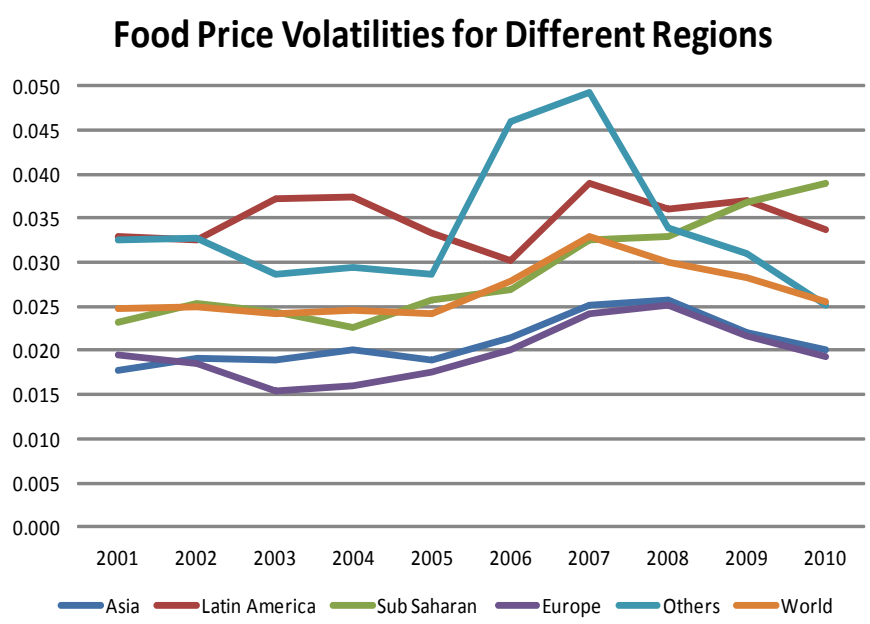
Source: Authors' calculation using data from FAO and national sources accessed through CEIC.

2. Volatilities for some countries are greater than those for other countries throughout the entire period.
3. Volatilities of national food prices have been fluctuating together, particularly in recent years.

Figures 4 and 5: Food Price Inflation Rates and Volatilities for Different Regions



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



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

1. Regional food price growth rates appear to move together, particularly in recent years.
2. Different regions' average volatilities of food prices also fluctuate together.

Food price inflation and volatility in Asia

- Developing countries tend to have higher food price inflation and volatilities
- Food price inflation in Asian countries averaged 4.29% (Latin America , 8.63%; and Sub-Saharan Africa, 5.70%)
- PRC, India, Indonesia, and Korea report relatively high food price inflation
- Asia experiences relatively smaller food price volatility compared with Latin America and Sub-Saharan Africa
- PRC, India, Indonesia, Korea, and Taipei,China report relatively high volatilities of food prices

Literature survey (1)

Incomplete pass-through of global food price shocks to domestic prices

- Average coefficient of pass-through estimated at about 0.30 (or 30%) for most countries (Ianchovichina, et al., 2012; IMF, 2011; and Sharma 2003)
- Pass-through tends to be larger in emerging and developing economies than in advanced economies (IMF, 2011)
- Interventions of local governments in developing countries often hamper full transmission of international prices (Headey and Fan, 2008)

Significant heterogeneity across commodity types

- Rice has on average weaker price pass-through in developing Asia, compared to wheat (Dawe, 2008)

Domestic factors and policies limit the pass-through of food prices.

Literature survey (2)

Renewed focus on food price volatility and its determinants

- Balcombe (2010) finds a strong evidence of transmission of volatilities in the majority of 19 agricultural commodity prices. He also finds that oil price volatility and exchange rate volatility are important determinants of volatility in over half the series.
- Onour and Sergi (2011) show evidence of corn price volatility transmission to wheat market.
- Some studies have also investigated transmission of price volatility between commodity future markets (von Ledebru and Schmitz, 2009; Hernandez, Ibarra-Ramirez, and Trupkin, 2011).
- Rapsomanikis and Mugera (2011) assess volatility spill over between the global and domestic food markets of Ethiopia, India and Malawi and find that volatility spillovers are significant only during periods of extreme world market volatility.

Purpose of the 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.**
  - The global food crisis of 2007-08 suggests a change in the speed and magnitude of international transmission in food prices and their volatilities for more recent years.
  - Fundamental structural changes in global food markets are underway with 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.
- **Aims to capture more recent dynamics and interactions of international food price inflation and volatility**

  (1) Do a time series analysis with VAR: 1995-2011

  (2) Do a panel data analysis: 2001 - 2011

2. VAR Analysis

Model Specification

World block

Oil prices, World GDP, World food prices, and Food price futures

Regional block

Asian real GDP and Asian food prices

Country block

US exchange rates, M1 money supply, Real GDP per capita, and Domestic food prices

- Block exogeneity: the variables in lower blocks cannot affect those in upper blocks
- Within blocks, shocks are identified by assuming the Choleski-type recursive ordering of the variables
- Estimation is carried by seemingly unrelated regression (SUR) in levels

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2. VAR Analysis

Data Specification

- Countries: PRC; Hong Kong, China; Indonesia; Japan; Rep. of Korea; Malaysia; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam
- Sample period: 1995:Q1 – 2011:Q3
- Variables
  - Oil prices: average price of UK Brent, Dubai, and West Texas Intermediate
  - World GDP: sum of the real GDP of the US and EU
  - World food price: FAO's world food price index
  - Food price futures: Dow Jones-UBS Agriculture Sub-index
  - Asian GDP : sum of the real GDP of the 11 countries above
  - Asian food prices: price index constructed by principal component analysis
  - US exchange rates
  - M1 money supply
  - Real GDP per capita
  - Domestic food prices

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)
Rep. of Korea	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)

Table 5: Variance Decomposition of the Food Prices (con't)

Series	Horizons (Quarters)	Shocks									
		POILUS	WR_GDP	WR_FDP	FUTURE	AS_GDP	AS_FDP	XX_USR	XX_MON	XX_GDP	XX_FDP
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)
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.

3. VAR Analysis - Results

Variance Decompositions (Major results)

For the Asian food price

- Most affected by its own shock across the horizons
- The contribution of the world food price shock is minimal

For domestic food prices

- The world food price shock contributes little to the variation
- The same is true for the other world shocks with a possible exception of the world GDP shock
- Mostly accounted for by its own shock in the short run
- The Asian food price shock plays a pivotal role at medium to long horizons
- Consequently, Asian food markets are more integrated regionally than with the world market
- For PRC and Hong Kong, the exchange rate shock explains a significant portion of the variation in the food price

4. Panel Analysis

Model Specification

- **Panel equation:**

$$C_{it} = \beta_0 + EV_{it}\beta_1 + IV_{it}\beta_2 + \varepsilon_{it}.$$

where

C_{jt} = annual food price inflation rates or volatilities

EV= vector of external variables

IV = vector of internal variables

ε_{jt}= error term.

- **External variables (EV)**

- Global factors

World_C1: Global food price inflation rates or volatilities, measured with FAO's world food price index.

L.World_C1: One year lag of global food price inflation rates or volatilities, measured with FAO's world food price index.

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

4. Panel Analysis

$$C_{it} = \beta_0 + EV_{it}\beta_1 + IV_{it}\beta_2 + \varepsilon_{it}.$$

- **External variables (EV) – continued**
- Intra-regional factors

  Asia_Intra_C: Simple average of food price inflation rates or volatilities of other neighboring countries in Asia

  Latin_America_Intra_C:

  Sub_Sahara_Intra_C:

  Europe_Intra_C:

  Other_Intra_C:

- Extra-regional factors

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

  Latin_America_Extra_C:

  Sub_Sahara_Extra_C:

  Europe_Extra_C:

  Other_Extra_C:

4. Panel Analysis

$$C_{it} = \beta_0 + EV_{it}\beta_1 + IV_{it}\beta_2 + \varepsilon_{it}.$$

- **Internal variables (IV)**

➔ **Domestic demand factors**
Income per capita growth rates
Population growth rates

➔ **Domestic supply factors**
Difference in log of food production index.
Share of food in merchandise imports.
Difference in log of share of food in merchandise imports.
Difference in log of exchange rates/ volatilities of exchange rates

➔ **Domestic market's overall condition**
Money (M1) growth rates
Lag of money growth rates
political stability
GDP per capita (US dollars)

5. Panel Analysis: Results

Results Food Price Inflation

- Table 6: Benchmark Model
- Table 7: Differential Effects of Global Food Prices in Different Regions
- Table 8: Intra-regional Co-movement vs. Extra-regional Co-movement

Results Food Price Volatilities

- Table 9a: Benchmark System GMM Model
- Table 9b: Benchmark Fixed Effects Model
- Table 10: Differential Effects of Global Food Prices in Different Regions
- Table 11: Intra-regional Co-movement vs. Extra-regional Co-movement

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 imports	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
R2	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.

1. 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 are associated with lower food price inflation rates.
2. The national food price inflation rates are strongly associated with the lagged value global food price inflation rates (FAO index).
3. The national food price inflation rates fluctuate together.

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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
R2	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.

1. One-year lagged value of global food price inflation rates (FAO index) is highly associated with national food price inflation rate in all regions.
2. In particular, such association is strong among Latin American and Sub-Saharan African countries.
3. Regional food price inflations are highly associated with the global average food price inflation rates.

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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
R2	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

1. Individual countries' food price inflation rates move together not only with counties in the region but also with countries located outside the region.
2. In the case of Sub-Saharan African countries, national food price inflations reveal a stronger co-movement with extra-regional food price inflation rates than with intra-regional food price inflation rates.

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 (Sagan)					
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.

1. Fast growing countries appear to have smaller volatilities of national food prices.
2. Volatility of the global food commodity price index also appears to influence very strongly that of the national food prices.
3. Unlike the case of food price changes, there is a strong contemporaneous association between volatilities of global food prices and national food prices.

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Table 9b: Determinants of Volatilities of National Food Price Index: 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 World	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 merchandise	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
R2	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.

1. Fast growing countries appear to have smaller volatilities of national food prices.
2. Volatility of the global food commodity price index also appears to influence very strongly that of the national food prices.
3. Unlike the case of food price changes, there is a strong contemporaneous association between volatilities of global food prices and national food prices.

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Table 10: Determinants of Volatilities 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
R2		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 (Sagan)				
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

1. Many regions reveal co-movement of their food price volatilities with the global one.

Table 11: Determinants of National Food Price Inflation: 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

1. None of the regions reveal intra-regional co-movement of volatilities (fixed effects model).
2. On the other hand, Column (3) reports the strong existence of extra regional co-movements of volatilities.
3. In particular, Asia's extra-regional co-movement is the strongest.

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6. Summary and Conclusions

- A time series analysis, using the data for the period of 1995-2011, does not reveal global transmission of food prices to national markets – consistent with the previous literature.
- However, a panel analysis using the data for the period of 2001 to 2011, finds that the national food price inflation rates are strongly associated the lagged value of global food price inflation rates.
- Findings also suggest that there is a strong contemporaneous relationship between volatilities of global food prices and national food prices.
- National food price inflation rates and volatilities are strongly associated with both intra- and extra- regional food price inflation rates and volatilities, respectively.

→ Global transmission of food prices (both inflation and volatilities) becomes stronger in recent years (2007-2011).

6. Summary and Conclusions

- Evidence for international transmission of food price inflation and volatility
  - Growth in per capita GDP lowers food price inflation
  - Trade openness helps control food price inflation
  - A temporary increase in food imports associated with domestic food supply disruption contributes to food price inflation
  - Depreciation and monetary growth increase food price inflation
  - Greater political stability and higher per capital GDP lowers food price inflation
  - Per capita GDP growth contributes to smaller volatilities of national food prices (and the only significant variable)

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Thank you

FOR INQUIRIES:

Hyun-Hoon Lee
Department Of International Trade And Business
Kangwon National University
Email: hhlee@kangwon.ac.kr