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Grain Price and Volatility Transmission from International to Domestic Markets in Developing Countries

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Summary. — Understanding the sources of domestic food price volatility in developing countries and the extent to which it is transmitted from international to domestic markets is critical to help design better global, regional, and domestic policies to cope with excessive food price volatility and to protect the most vulnerable groups. This paper examines short-term price and volatility transmission from major grain commodities to 41 domestic food products across 27 countries in Africa, Latin America, and South Asia. We follow a multivariate GARCH approach to model the dynamics of monthly price return volatility in international and domestic markets. The period of analysis is 2000 through 2013. In terms of price transmission, we only observe significant interactions from international to domestic markets in few cases. To calculate volatility spillovers, we simulate a shock equivalent to a 1% increase in the conditional volatility of price returns in the international market and evaluate its effect on the conditional volatility of price returns in the domestic market. The transmission of volatility is statistically significant in just one-quarter of the maize markets tested, more than half of rice markets tested, and all wheat markets tested. Volatility transmission seems to be more common when trade (imports or exports) are large relatively to domestic requirements.

Key words — volatility transmission, price transmission, grain commodity prices, domestic markets

1. INTRODUCTION

The global food crisis of 2007–08 was characterized by a sharp spike in grain and other commodity prices. These price increases have been attributed to supply shortages, increased bio-fuel production, reduced stock-to-use ratios, export bans by major grain exporters, and panic buying by some major importers (Garrido, Brummer, M'Barek, Meusissen, & Morales-Opazo, 2016; Gilbert, 2010). Commodity prices rose rapidly again in 2010 and 2011. Overall, since 2007 global grain markets have seen an increase in price volatility, defined as the standard deviation of monthly price returns. For example, comparing the 27-year period before the crisis (1980–2006) with the four-year period during and after the crisis (2007–10), the unconditional volatility of monthly international prices rose 52% for maize, 87% for rice, and 102% for wheat (Minot, 2014).

To the extent that this price volatility is transmitted to markets in developing countries, it may have serious implications for farmers and low-income consumers. As noted by Diaz-Bonilla (2016), producers and consumers alike are affected by both price levels and volatility. Low-income consumers, for example, spend a large share of their income on food in general and on staple foods in particular, making them more vulnerable to food price volatility. In some countries, such as Tanzania, Sri Lanka, and Vietnam, low-income households allocate more than 60% of their budgets to food (Seale, Regmi, & Bernstein, 2003). Food price volatility also affects poor, small-scale farmers who rely on food sales for a significant part of their income and possess limited capacity for timing their sales. In addition, price volatility is likely to distort input allocation, inhibit agricultural investment, and reduce agricultural productivity growth, especially in the absence of efficient risk-sharing mechanisms, with long-run implications for poor consumers and farmers. Martins-Filho and Torero (2011) further note that high volatility might increase the expected losses of producers, affecting their household consumption decisions; similarly, increased volatility through time may promote speculative trading as larger price fluctuations create the opportunity for larger net returns (see also FAO-OECD, 2011). Magrini, Morales Opazo, and Baile (2015) estimate household willingness to pay to eliminate cereal price volatility in five countries. The willingness to pay ranges from 0.06% of income in Bangladesh (where price volatility is low) to above 1% in Niger, Ethiopia, and Malawi (where price volatility is higher).

A key question, however, is whether food price volatility in world grain markets is indeed transmitted to local markets in developing countries. If so, efforts to reduce price volatility should perhaps be focused on concerted regional and international actions through the World Trade Organization or other multilateral bodies. Alternatively, if food price volatility in developing countries is mostly attributed to domestic factors, then the most effective policy remedies would likely include domestic investment to stabilize food production, reduce storage and transport costs, and strengthen safety nets.

One approach to answering this question has been to examine the transmission of prices from world markets to local markets.[1] Although it seems reasonable to assume that markets with high transmission of prices would also be characterized by high transmission of volatility, this may not necessarily be the case. For example, prices from highly volatile world markets may only be transmitted to local markets with a one- to six-month lag, thus insulating local markets from international turmoil and resulting in local prices that exhibit much less volatility. Alternatively, even if there were no direct price transmission, it is possible for local market volatility to be determined by the degree of uncertainty among local traders, which could be influenced by a sudden increase in the volatility of world markets.

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The objective of this paper is to estimate both grain price and volatility transmission from world markets to local markets in developing countries. In particular, we focus on the short-term effect of the world price returns of maize, rice, wheat, and sorghum on 41 domestic price returns of grain products in 27 countries in Latin America, Africa, and Asia. The price data are monthly, and most cover the period from January 2000 to December 2013, though there is some variation in starting and ending points. The analysis is based on a multivariate generalized auto-regressive conditional heteroskedasticity (MGARCH) model using the BEKK specification proposed by Engle and Kroner (1995).[2]

We work with price returns (month-to-month price variations) to account for the non-stationarity of the prices in levels. For conceptual clarity, throughout the paper we use the terms "price transmission" and "volatility transmission", which refer to measures calculated from price returns. Hence, the analysis of price transmission corresponds to interactions in price returns at the mean level while the analysis of volatility transmission corresponds to interactions in price returns at the volatility level.

The main contribution of this paper is that it is the first to estimate the transmission of food price volatility from international markets to local markets across several developing countries and regions. As discussed below, other studies have examined the transmission of (mean) price levels from global markets to developing countries, and some have analyzed the transmission of price volatility from one global commodity market to another. Focusing on market interactions in terms of the conditional second moment and allowing for volatility spillovers provides better insight into the dynamic international–domestic price relationship.

The remainder of the paper is organized as follows. Section 2 provides a review of recent research on transmission of prices and volatility. Section 3 details the methodology used in the study. Section 4 describes the data. Section 5 presents and discusses the estimation results while Section 6 summarizes the findings and draws some conclusions for future research.

2. PREVIOUS RESEARCH ON TRANSMISSION OF PRICES AND VOLATILITY

There is a large body of research on the transmission of prices between markets within developing countries (see Abdulai, 2000; Baulch, 1997; Lutz, Kuiper, & van Tilburg, 2006; Moser, Barrett, & Minten, 2009; Myers, 2008; Negassa & Myers, 2007; Rashid, 2004; Van Campenhout, 2007). Most of these studies use cointegration analysis in the form of error-correction models, though some of the more recent ones apply threshold cointegration models and asymmetric response to positive and negative price shocks (e.g., Meyer & von Cramon-Taubadel, 2004). The size of the literature is indicated by a meta-analysis that summarizes the results of 57 cointegration studies with analysis of 1,189 market price pairs (Kouyate & von Cramon-Taubadel, 2016). The results indicate that both distance and an international border between the markets reduce the probability that the prices will be cointegrated and slow the speed of adjustment if it is cointegrated.

Fewer studies have examined the transmission of prices from world markets to local markets. Mundlak and Larson (1992) estimate the transmission of world food prices to domestic prices in 58 countries using annual price data. They find very high rates of price transmission, but the analysis is carried out in levels rather than first differences, so the results probably reflect spurious correlation due to nonstationarity. Quiroz and Soto (1995) repeat the analysis of Mundlak and Larson (1992) using cointegration analysis and an error correction model. They find no relationship between domestic and international prices for 30 of the 78 countries examined. Conforti (2004) examines price transmission in 16 countries, including three in Sub-Saharan Africa, using an error correction model. In general, he finds that the degree of price transmission in Sub-Saharan African countries is less than in Asian and Latin-American countries. Robles and Torero (2010) find empirical evidence of price transmission from international markets to domestic prices of several food products across four countries in Latin America. Minot (2011) analyzes the transmission of prices from world grain markets to 60 markets in sub-Saharan Africa, finding a statistically significant long-term relationship in only 13 of the 62 prices examined. He also finds that rice prices are more closely linked to world markets than are maize prices, presumably because most African countries are close to self-sufficient in maize but import a large share of their rice requirements. Baquedano and Liefert (2014) also examine price transmission from world grain markets to local food markets, using a single-equation error-correction model. They find a long-term relationship in 51 of 61 local prices tested. More recently, Garcia-German, Bardaji, and Garrido (2016) evaluate price transmission between global agricultural markets and consumer food price indices in the European Union member states using error correction models. They find that consumer prices in different member states respond differently to specific world price indices, suggesting some disparities in the structure and efficiency of their food markets.

Another set of studies has focused on the co-movement of world commodity prices. In their seminal paper, Pindyck and Rotemberg (1990) find "excessive co-movement" of seven commodity prices, which they attribute to herd behavior among traders in financial markets. The hypothesis of excess co-movement, however, was challenged by Deb, Trivedi, and Varangis (1996) and Ai, Chatrath, and Song (2006). These studies argue that the Pindyck and Rotemberg results suffer from model misspecification and that fundamental supply and demand factors are sufficient to explain the co-movement.[3] In the case of international agricultural commodity prices, Gilbert (2010) indicates that price shocks for individual commodities are often supply related whereas joint price movement can be explained by macro-economic and monetary conditions.

Fewer studies have examined the co-movement of conditional price volatility. As noted by Gallagher and Twomey (1998), dynamic models of conditional volatility like MGARCH models, widely used in empirical finance, can provide a better understanding of the dynamic price relationship between markets by evaluating volatility spillovers. Volatility transmission between commodity markets may occur through substitution and complementary effects or as a result of common underlying macroeconomic factors, such as uncertainty in financial factors (Saadi, 2011, chap. 9).

Some of the recent studies that evaluate market interactions between agricultural commodities using MGARCH models include Le Pen and Sévi (2010), Zhao and Goodwin (2011), Hernandez, Ibarra, and Trupkin (2014), Beckmann and Czudaj (2014) and Gardebroek, Hernandez, and Robles (2016), with mixed results. Le Pen and Sévi (2010) use different multivariate models, including a factor model and a dynamic conditional correlation (DCC) model, to examine the interrelationship between eight agricultural and non-agricultural commodities and find moderate co-movement in prices and volatility. Zhao and Goodwin (2011) find important volatility