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Evaluating the Causes of Rising Food Prices in Low and Middle Income Countries

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The effects of population, income, prices of major inputs, and exchange rate of the U.S. dollar on the prices of three key agricultural and food commodities (feed grains, oilseed, and fruits) for 13 low-income countries and seven middle-income countries were evaluated. Given the short time period, a modified seeming unrelated regression-vector autoregressive model that incorporates the lagged exogenous variables property of time series models and the system of equation estimation is employed in the analysis. The study finds no single factor that persistently explains all soaring food prices as reported in the literature. The only factor that persistently explains soaring food prices are the contemporaneous and one-year lagged exchange rates and income.

Key Words: food prices, low and middle-income countries, seeming unrelated regression-vector autoregressive model

JEL Classifications: F1, C3, Q17

Since the second half of 2006, world prices of most major food commodities began to climb. By the first half of 2008, international U.S. dollar prices of cereals had reached their highest levels in almost 30 years, threatening the food security of the poor worldwide and provoking widespread international concern over an apparent world food crisis. Even though the second half of 2008 saw a rapid fall in international food prices as oil prices tumbled and the financial crisis and global recession reduced demand, prices are well above the levels seen in recent years and are expected to remain so (Food and Agriculture Organization (FAO), 2009). Many poor consumers still face high or rising food prices. Moreover, while international food prices may have fallen, many of the adverse supply and market conditions remain unchanged.

While the broad facts of the soaring food prices episode may be well known, questions remain concerning the relative importance of the various factors suggested as being responsible. This is because the more recent price surge is much more broadly-based across food groups (World Bank, 2011). As a result, various factors have been suggested as being responsible. These include biofuel demand, record oil prices, speculation and investment fund inflow, and increasing food demand arising from rapid economic growth in China and India or traditional market drivers such as low stock levels or weather-related supply shortfalls. The price of key inputs such as energy and fertilizer as well as exchange rate and other trade barriers such as import tariffs and export

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taxes have also been suggested as the probable cause.

Each of these factors may affect the prices of specific food and agricultural commodity prices. Biofuel production may reduce the availability of food commodities on the market since this new source of demand has been playing an important role in influencing prices of corn (a feedstock for ethanol production) and rapeseed (a feedstock for the production of biodiesel). The rapid economic growth, and increasing incomes in China and India particularly, are believed to be reflected in stronger demand for higher-value foods (such as livestock products) as opposed to starchy staples (such as wheat). However, the prices of starchy staples are equally rising. Therefore, the widely accepted notion that rising demand in these two most populous countries (China and India) is a reason for soaring food prices warrants re-examination (FAO, 2009).

Furthermore, a proportion of these price increases can be attributed to the depreciation of the U.S. dollar, in which international prices tend to be denominated. Because most commodity prices are commonly expressed in U.S. dollars, depreciation in the value of the U.S. dollar reduces the cost of commodities for countries whose currencies are stronger than the U.S. dollar, resulting in a cushioning of food price increases to a greater or lesser extent. On the other hand, for countries whose local currencies are pegged to or are weaker than the U.S. dollar, depreciation in the U.S. dollar increases the cost of procuring food. More than 30 developing countries peg their currencies to the U.S. dollar. However, the relationship between currencies and commodity prices differ among such countries. This is because the degree of price transmission does not only depend on the U.S. dollar exchange rate, but also on a variety of other factors such as import tariffs, infrastructure, and market structures.

This study employs a modified seeming unrelated regression-vector autoregressive (SUR/VAR) model to determine the effects of population, income, prices of major inputs, and exchange rate of the U.S. dollar on the prices of three key agricultural and food commodities (feed grains, oilseed, and fruits) for 13 low-income countries and seven middle-income countries. The remainder of this study is structured as follows: section two focuses on a literature review on the causes of rising food prices; sections three and four outline the theoretical and empirical models as well as data used for the study; section five presents the empirical results and discussions; and section six focuses on the conclusions and policy recommendations from the study.

Literature Review on the Causes of Rising Food Prices

The persistent rising of worldwide food prices has been described by many as a major crisis that requires immediate remedy (Abbott, Hurt, and Tyner, 2008; Baltzer, Hansen, and Lind, 2008; Helbling, Mercer-Blackman, and Cheng, 2008; Schnepf, 2008; Trostle, 2008; von Braun, 2008). A study by Rosen and Shapouri (2008) shows that from 2004–2006, corn prices globally rose by 54%; wheat, 34%; soybean oil, 71%; and sugar, 75%. A number of factors are known to influence food prices to rise even much more quickly than is desirable.

A wide range of research on this crisis has highlighted the growing commodity demand and changing consumption patterns in some countries, particularly China and India (Abbott, Hurt, and Tyner, 2008; Baltzer, Hansen, and Lind, 2008; Helbling, Mercer-Blackman, and Cheng, 2008; Schnepf, 2008; Trostle, 2008; von Braun, 2008). However, Headey and Fan (2008) more or less reject the rising demand from China and India as an important cause of the crisis. They argue that both India and China have long been self-sufficient in food. Their evidence for such conclusions relies primarily on the fact that China imported less wheat between 2000 and 2007 (33.8 million metric tons) than it did in the preceding eight years (40.3 million metric tons), and its rice imports also declined slightly from already low levels (just over five million metric tons). Indian imports of wheat and corn on the other hand have been negligible. Moreover, India is generally a net exporter of rice. They emphasize that, if there is a China–India story regarding this crisis, it is rather through very indirect channels by which these countries have influenced demand for oil and global trends in stocks.

Speculation in the financial markets is another factor known to influence the surge in global food prices. Some analysts such as Headey and Fan (2008) have established that agricultural commodity markets are now playing a role traditionally reserved for gold and other precious metals. The emergence of futures markets for agricultural commodities has brought about the increasing participation of “nontraditional” participants in agricultural markets. Such participants can now speculate on food price trends and bet on futures contracts as a separate asset class apart from the spot prices of agricultural commodities in today’s market. However, Headey and Fan (2008) assert that financial speculations are most profitable when there is a substantial volatility in the underlying markets. Thus, expectations of future prices may vary considerably when markets are in turmoil. Therefore, speculation may be more of a symptom underlying volatility than a cause of that volatility. They stress that although futures markets may have worsened the volatility in agricultural markets, they are unlikely to be a leading cause of the overall price surge because there is little evidence that these markets significantly influence real supply and demand factors.

Besides increasing global demand for food relative to changes in food supply, there are also a series of commodity-specific factors that probably play a role in increasing prices. For rice, in particular, export restrictions offer a key explanation because of the number of exporting countries that imposed restrictions at some point in time. The 2008 U.S. Department of Agriculture feed grains database shows that rice is much more thinly traded relative to other staples, with only about 7% of global production being traded over the last five years. Still on rice export restriction, India in November of 2007 imposed the first major export restriction, possibly because India has not kept large stocks relative to its high levels of consumption and volatile production patterns. Thus, from November 2007 to May 2008 rice prices increased by 140%, despite production reaching an all time high in 2007 (Slayton and Timmer, 2008). This prompted further export restrictions from Vietnam, Cambodia, and Egypt, and precautionary rice purchases by the Philippines, which imported 1.3 million tons of rice in just the first four months of 2008. This amount (1.3 million tons) alone exceeded their entire import bill of 2007 (Slayton and Timmer, 2008). Severe weather shocks could be another commodity-specific explanation for rising food prices. In 2006 for instance, Australian wheat production was 50 to 60% below trend growth rates in two successive years (2005–2006). Other countries such as Russia, Ukraine, and the United States also experienced modest declines in production and harvest, some 14% lower than the previous year as a result of severe weather (Headey and Fan, 2008).

Some studies suggest significant impacts of biofuels on grain and oilseed prices. Much of biofuel demand depends on oil prices. The higher the oil prices are, the more economically viable biofuel production becomes and the more agricultural products are demanded as feedstocks. Most analyses to date conclude that the diversion of U.S. corn crop for ethanol production is the largest source of demand-induced price pressure (Abbott, Hurt, and Tyner, 2008; Mitchell, 2008; Schnepf, 2008; von Braun, 2008; Helbling, Mercer-Blackman, and Cheng, 2008). Collins (2008) and Lipsky (2008) find that biofuels account for about 60 to 70% of the increase in corn prices and maybe 40% of soybean price increases. Rosegrant et al. (2008) also find that the long-term impact of accelerated biofuel production on maize prices is about 47%. Biofuels have contributed to substantially depleting grain and oilseed stocks globally. This is because the use of maize for ethanol grew rapidly especially from 2004–2007, such that the ethanol industry used 70% of the increase in global maize production over that period (Headey and Fan, 2008). Biodiesels on the other hand used about 7% of global vegetable oil supplies. Increased maize production induced by ethanol production has also had strong ripple effects on other food crops. In the United States for example, rapid expansion of maize area by 23% in 2007 resulted in a 16% decline in soybean area. This contributed to the

75% rise in soybean prices from April 2007 to April 2008 (Mitchell, 2008). In Europe, other oilseeds displaced wheat for the same reason.

In addition, the energy used in agricultural production is mostly oil-related, and oil prices have risen even faster than prices of other energy sources. Oil prices have directly affected the prices of fertilizers, as well as other chemicals used in crop production. For wheat and corn, fertilizer prices alone account for over a third of total operating costs and 15 to 20% of total costs (Mitchell, 2008). These fuel-based cost increases are about 8% of corn price increases, 11% of soybean price increases, and about 20% of wheat price increases (Mitchell, 2008). Oil prices have also affected transport costs, such that the margin between domestic and export prices has added as much as 10.2% to the export prices of corn and wheat (Mitchell, 2008). Thus, the combined increase in production and transport costs for the major U.S. food commodities (corn, soybeans, and wheat) could account for about 20 to 30% of the increase in U.S. export prices (Mitchell, 2008).

The depreciation of the U.S. dollar (USD) relative to other currencies could account for the rise in dollar-denominated food prices. Using U.S. Department of Agriculture's agricultural trade-weighted index of real foreign currency per unit of deflated dollars, Abbott, Hurt, and Tyner (2008) find that from 2002–2007 the USD depreciated 22%. However, the value of agricultural exports increased 54%. Assuming that the United States is a large country in international agricultural markets, which it certainly is in wheat, corn, and soybeans, the depreciation of the USD could lead to higher prices in the United States, but lower prices in the rest of the world. Previous research has indicated that a depreciation of the USD increases dollar-denominated commodity prices with an elasticity between 0.5 and 1.0 (Headey and Fan, 2008). A similar analysis by Mitchell (2008) shows that the depreciation of the dollar has increased food prices by around 20%, assuming an elasticity of 0.75. Compared with previous increases in nominal dollar-denominated food prices, the divergence between the U.S. dollar and some other currencies is quite severe in this current crisis (Abbott, Hurt, and Tyner, 2008).

Low interest rates, especially in the United States, have also caused a general price increase in a wide range of commodities. According to Headey and Fan (2008), low interest rates increase the demand for storable commodities, increase firms' desire to carry inventories, and encourage speculators to shift out of treasury bills into commodity contracts. All three mechanisms highlighted by Headey and Fan (2008) work together to increase the market price of commodities. In addition to low interest rates, the decline in stocks for some agricultural commodities has also influenced price volatility through unstable supply. Stocks have declined for maize, wheat, and rice, often below the FAO (1983) benchmark of 17 to 18% of total consumption that is predicted to stabilize prices and consumption. However, Headey and Fan (2008) believe that there are some significant limitations to the conclusion that the decline in the stocks of agricultural commodities impact price volatility. They are of the view that declining stocks might simply reflect increased demand or reduced production levels. For instance, biofuels could explain the decline in maize stocks whereas bad weather and stagnating production growth could account for the decline in wheat stocks. They therefore conclude that declines in some agricultural commodity stocks are consistent with rising food prices, but they are not as causally convincing, partly because they are a symptom of deeper causes, and partly because what effects they do have on prices are enacted through interactions with other factors.

Theoretical Model

Vector autoregressive (VAR) and vector error correction (VEC) models are two commonly used testing procedures for causal and dynamic relationships between variables in time series analysis. Both VAR and VEC models are flexible in estimating the relationships between variables for stationary and nonstationary with cointegration correction, respectively.

Given the short time framework, to evaluate the importance of rising food prices in low-income and middle-income countries[1] of the world, here we use a modified SUR/VAR model following Yeboah, Shaik, and Allen (2009). As we are interested in examining the short-run implications, the SUR/VAR model with contemporaneous and lagged exogenous and lagged endogenous variables can be represented as:

$$P_{i,nt} = \sum_{s=0}^{S} \alpha_i X_{i,nt-s} + \sum_{r=1}^{R} \beta_i Z_{i,nt-r}, \tag{1}$$

where $P = [p_{1,nt}, P_{2,nt}, ..., P_{k,nt}]'$ represents vector of $i=1, ...I$ endogenous variables, X is the current and lagged exogenous variable, and Z is the lagged endogenous variable; n represents the number of cross-section units and t represents the number of time-series observations; and s and r are lags in exogenous and endogenous variables, respectively.

Equation (1) can be estimated using the traditional VAR or VEC time-series model, used to describe the dynamic interrelationship between stationary variables (Hill, Griffiths, and Lim, 2007). VAR generally estimates relationships between variables treating them all as endogenous. Thus, every variable influences all other variables, including itself. Since we have a short annual time-series data, we have developed a modified time-series model that uses the system of equation estimation model and also the lag structure of the VAR model. In this modified SUR/VAR model, we avoid treating the lagged endogenous variables as exogenous variables, but allow for lagged exogenous variables.

The SUR/VAR model can be represented as:

$$\begin{aligned} P_{i,nt} = {} & \alpha_{0,i} + \sum_{s=0}^{S} \alpha_{1i} X_{1i,nt-s} + \sum_{s=0}^{S} \alpha_{2i} X_{2i,nt-s} \\ & + \sum_{s=0}^{S} \alpha_{3i} X_{3i,nt-s} + \sum_{s=0}^{S} \alpha_{4i} X_{4i,nt-s} \\ & + \varepsilon_{i,nt} \end{aligned} \tag{2}$$

where $X = [x_{1,nt}, x_{2,nt}, ..., x_{K,nt}]'$ represents vector of $k=1,....K$ endogenous variables. In an SUR/VAR analysis, a system of equations is estimated simultaneously with each variable as a function of the current and lagged exogenous variables.

Empirical Model and Data

This study employs an SUR-VAR model to determine the effects of prices of fertilizer and pesticide, gross domestic product per capita based on the population and gross domestic product, and exchange rate of the U.S. dollar to the local currency on major agricultural commodity and food prices. To differentiate between low and middle-income countries, we use a dummy variable in the model. We were also interested in evaluating the importance of biofuel production and import tariffs on major agricultural commodity and food prices but lack of data prevents the analysis. We do so by gathering price data for five key agricultural and food commodities (feedgrains, oilseed, fruits, and energy inputs) in 13 low-income and seven middle-income countries. However, we had to drop meat and poultry due to the lack of data on livestock input prices like feeds and veterinary medicine. All data used are sourced from the FAO database (http://faostat.fao.org/default.aspx).

Next, this study develops a system of equations estimation model that captures the short-run dynamics of exchange rate, gross domestic product (GDP) per capita, and value of imports of fertilizer and pesticide on food grains, oilseed, and fruit prices using a seeming unrelated regression model. The SUR/VAR model is estimated for food grains with three commodities (rice, maize, and sorghum), for oilseeds with two commodities (soybeans and groundnut), and for fruits with four commodities (bananas, mangoes, oranges, and pineapples). The SUR/VAR representation of food grain commodity prices for Equation (2) is:

[1] For operational and analytical purposes, the World Bank's main criterion for classifying economies is gross national income (GNI) per capita. The economies whose per capita GNI falls below the Bank's operational cutoff for "Civil Works Preference" ($1,005 or less) are classified as low-income economies, and economies with per capita GNI between $1,006 and $12,275 are classified as middle-income economies (World Bank, 2010).

$$
\begin{aligned}
(3)\quad & Maize_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Rice_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Sorghum_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt}.
\end{aligned}
$$

Similarly the SUR/VAR representation of oilseed commodity prices is:

$$
\begin{aligned}
(4)\quad & Groundnut_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Soybeans_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt}
\end{aligned}
$$

and the SUR/VAR representation of fruits prices is:

$$
\begin{aligned}
(5)\quad & Bananas_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Mangoes_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Oranges_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt} \\
& Pineapples_{nt} = \alpha_{0,i} + \sum_{s=0}^{1} \alpha_1 Fert_{1,nt-s} + \sum_{s=0}^{1} \alpha_2 Pest_{2,nt-s} + \sum_{s=0}^{1} \alpha_3 E_{3,nt-s} + \sum_{s=0}^{1} \alpha_4 GDPPC_{4,nt-s} + \alpha_5 DumIG + \varepsilon_{nt}.
\end{aligned}
$$

Parameter estimates from Equation (3), Equation (4), and would still allow us to recover the short-run relationships between exchange rate, GDP per capita, fertilizers and pesticides, and the commodity prices.

Empirical Results and Discussions

Table 1 presents the list of countries used in the estimation of SUR/VAR model for different food prices while Table 2 provides a summary of the statistics of per ton prices of fruits, feed grains, and oilseeds as well as import values in thousand U.S. dollars for fertilizer and pesticide in both low-income and middle-income countries.

Table 2 also shows the exchange rate of the U.S. dollar to these countries' currencies. The mean per ton price for fruits in the low-income countries is \$333,800 with standard deviation

Table 1. List of Countries used in the Estimation of SUR/VAR Models for Different Food Prices

Fruits	Food Grains	Oilseeds
Australia	Australia	Australia
Brazil	Brazil	Brazil
China	Burkina Faso	Burkina Faso
Côte d'Ivoire	China	China
India	Côte d'Ivoire	India
Israel	Ghana	Malawi
Mali	India	Mexico
Mexico	Kenya	Nigeria
South Africa	Malawi	South Africa
	Mali	Sri Lanka
	Mexico	
	Niger	
	Nigeria	
	Sri Lanka	
	Sudan	
	Togo	

of $400,000 and that for middle-income is $492,000 and 520,000. As expected, low-income countries pay more for feed grains than middle-income countries since the former consume feed grains as staple foods. On the average, it costs low-income countries $282,700 per ton of feed grains with standard deviation of $209,700. Feed grain buyers in middle-income countries pay $182,700 with standard deviation of $125,300. Oilseeds are consumed more in middle-income countries, $423,000 with standard deviation of $256,600 compared with $381,500 and standard deviation of $293,000 in low-income countries.

Figures 1, 2, and 3 provide the trends in prices of food grain, oilseeds, and fruits by country, respectively. As expected, low-income countries consume less chemical fertilizer and pesticides than middle-income countries. The import values of chemical fertilizers and pesticides are $25.2 million and $25.6 million in low-income countries while the import values of these inputs in middle-income countries are valued at $392 billion and $20 billion. The mean exchange rate of the U.S. dollar to low-income countries' currencies is 0.0038 units and a standard deviation of 0.0039. The middle-income countries' currencies are very competitive with the U.S. dollar. On average, a unit of their currency is equivalent to $0.10 with a standard deviation of $0.077 cents.

Table 3 presents the results of the SUR/VAR model for feed grain prices. The income group classification of a country has a very significant impact on feed grain prices considered in the study. A 1% improvement in an income group classification (from low to middle income) reduces the price of maize by 0.75%, 0.72% for rice, and sorghum by 1.21%. All parameters are

Table 2. Summary Statistics

Variable	Low-Income Countries Mean	Standard Deviation	Middle-Income Countries Mean	Standard Deviation
Fruits				
Bananas	297	266	403	408
Mangoes	247	449	769	646
Oranges	410	541	244	127
Pineapple	381	344	552	901
Mean	333.8	400	492	520.5
Maize	232	176	236	274
Rice	336	235	192	63
Sorghum	280	218	120	39
Mean	282.7	209.7	182.7	125.3
Groundnuts	429	277	578	430
Soybeans	334	309	268	83
Mean	381.5	293	423	256.6
Fertilizer	25,286	41,455	381,948	1,217,414
Pesticide	21,556	24,162	209,316	191,461
Exchange Rate	0.0038	0.0039	0.1000	0.0770

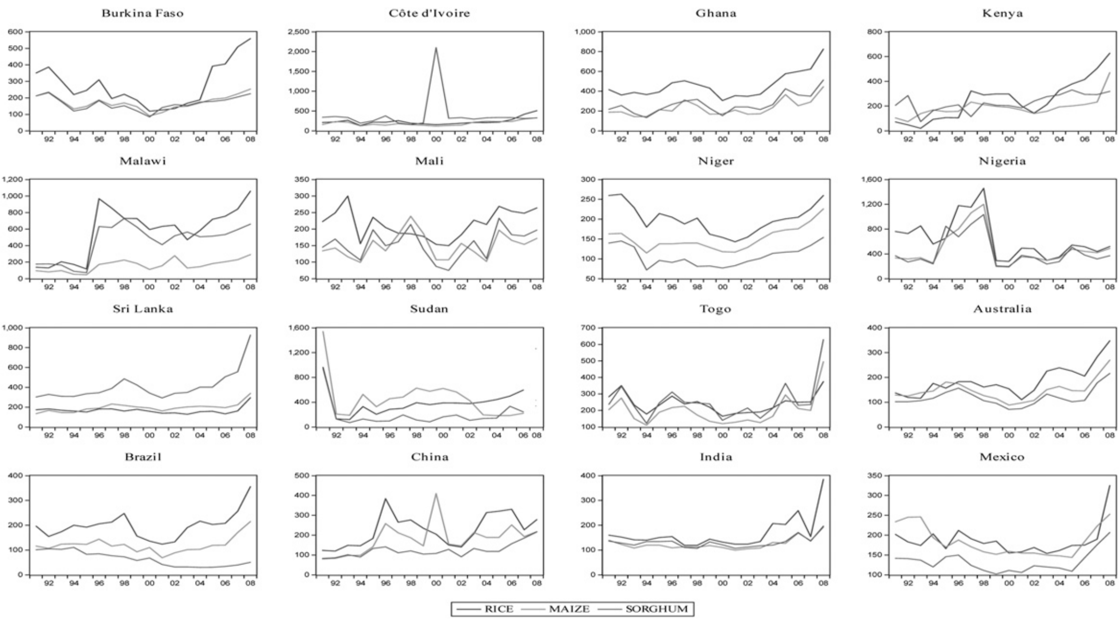

Figure 1. Price Trends of Commodity Prices by Country for Food Grains

statistically significant at 0.01% level. Exchange rates, both contemporaneous and one year lagged, are only significant for maize and rice. This result is consistent with literature, especially with rice. Rice is thinly traded on the world market and very sensitive to changes in macroeconomic variables such as interest and exchange rates and other government policies. A 1% appreciation of the local currency relative to the U.S. dollar reduces the price of maize by

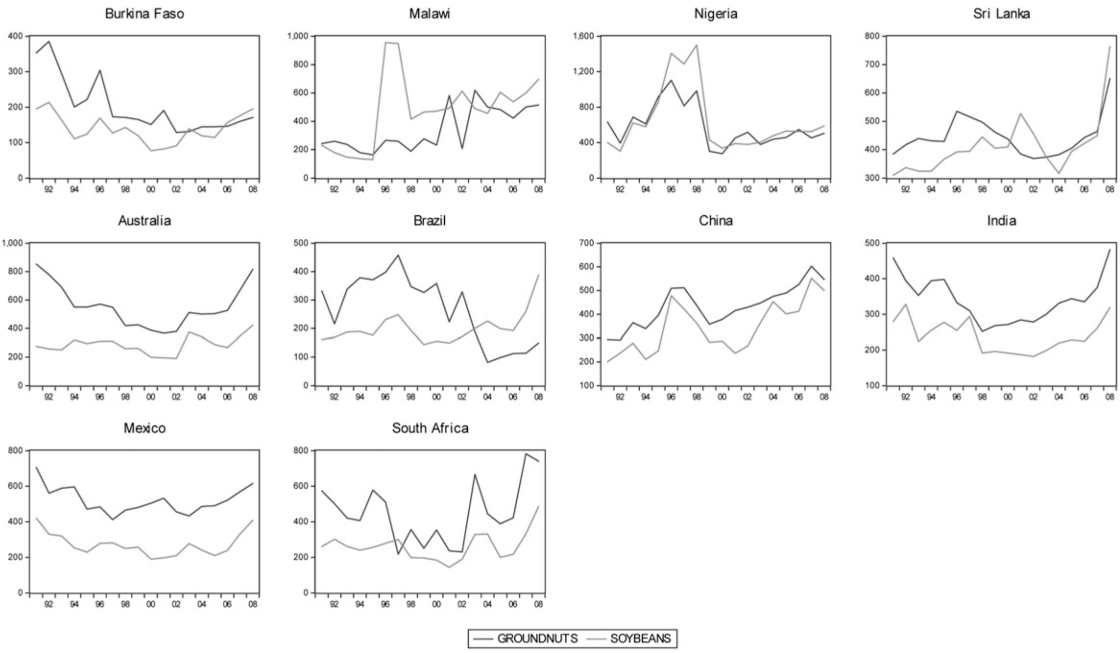

Figure 2. Price Trends of Commodity Prices by Country for Oilseeds

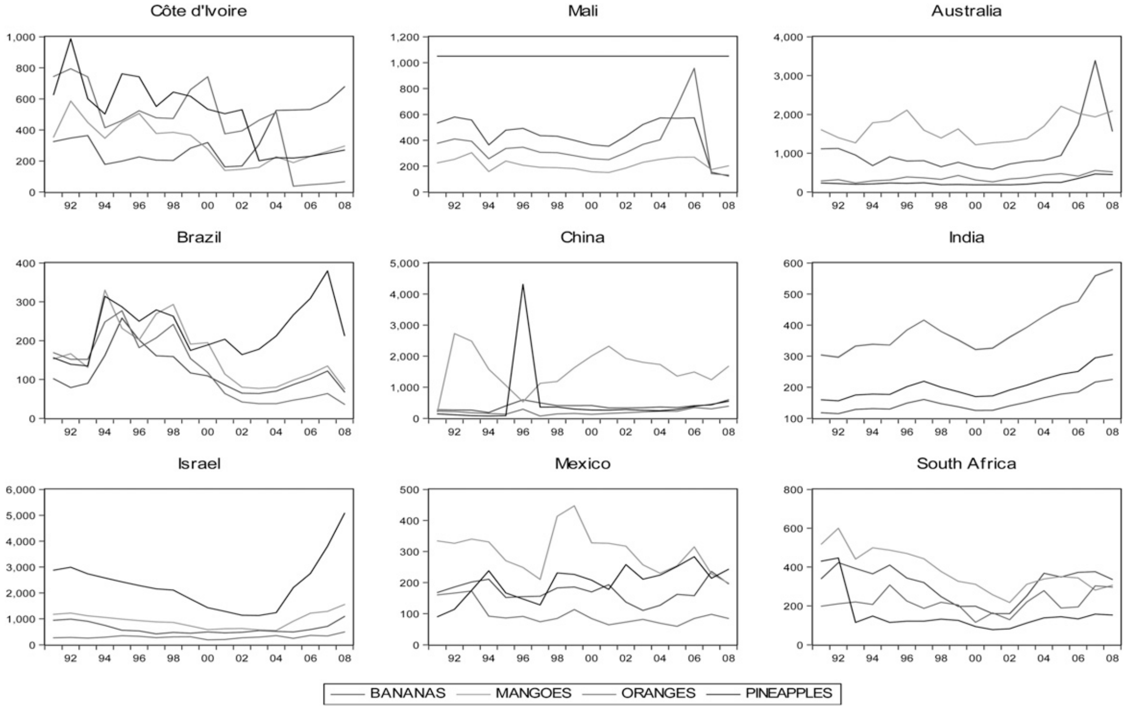

Figure 3. Price Trends of Commodity Prices by Country for Fruits

0.18% and rice, 0.31% in one year lagged while the current prices of these commodities rise by 0.22% and 0.40%. These results are consistent with Abbott, Hurt, and Tyner (2008) and Mitchell (2008). For example, Mitchell finds the depreciation of the dollar has increased food prices by around 20%, assuming an elasticity of 0.75.

The effects of both pesticide and chemical fertilizer inputs, either contemporaneous or one-year lagged, are insignificant on prices of feed grains. Per capita GDP, both contemporaneous and one year lagged, have only significant effects on maize prices. This is not a surprising result because maize is the major feed grain for poultry and livestock, and countries with rising incomes such as India and China are now consuming more meat and poultry products.

Presented in Table 4 are results of the SUR/VAR model for oilseed prices. A country's income group only affects soybean prices. A percent drop in the income classification reduces the price of soybean by about 0.95%. Soybean is another major feed besides corn for poultry and livestock and as an economy moves away from middle to low-income per capita consumption of meat and poultry products fall. Just as in the case of feed grains, exchange rates both contemporaneous and one year lagged, are significant for the two oilseeds, groundnuts and soybeans. A 1% appreciation of the local currency relative to the U.S. dollar reduces the price of groundnuts by 0.22% and soybeans 0.39% within in one year while the current prices of these commodities rise by 0.30% and 0.58%. As expected, fertilizer inputs have no effect on the prices of oilseeds but pesticides have contemporaneous effects on soybean prices at the 5% significant level. An elasticity of 0.200 indicates a 1% increase in import value of pesticides will raise the short-run price of soybeans by 0.20%. Per capita GDP, either contemporaneous or one year lagged, has no effect on the prices of oilseeds.

The results of the SUR/VAR model for fruit prices are displayed in Table 5. Income group classification is only relevant in the prices of pineapples as the parameter is statistically significant at the 5% level. The elasticity of −0.725 implies a 1% increase from the income bracket

Table 3. SUR/VAR Model Results for Food Grain Prices

	Maize		Rice		Sorghum	
	Parameters	t-Values	Parameters	t-Values	Parameters	t-Values
Intercept	5.197	17.95	6.486	18.47	5.149	13.42
Fertilizer	0.008	0.23	0.019	0.42	0.079	1.62
Pesticide	0.100	1.77	0.074	1.08	0.104	1.39
Exchange rate	0.222	2.73	0.401	4.07	0.124	1.15
GDP capita	1.602	2.55	0.586	0.77	−0.826	−0.99
Fertilizer_1	−0.022	−0.61	−0.006	−0.13	0.017	0.36
Pesticide_1	−0.001	−0.02	0.001	0.02	−0.018	−0.24
ExchangeRate_1	−0.176	−2.36	−0.309	−3.42	−0.123	−1.24
GDPcapita_1	−1.567	−2.53	−0.677	−0.9	0.793	0.96
Income Group	−0.751	−7.56	−0.725	−6.02	−1.206	−9.15

and reduces the per ton price of pineapples by about 0.72%. Exchange rates and the import value of fertilizer affect banana prices only contemporaneously at the 1% and 5% statistical levels. For example, the exchange rate elasticity value of 0.583 in the bananas model implies a 1% appreciation of the local currency to the U.S. dollar will reduce the price of bananas by 0.58%. The one year lagged and the contemporaneous per capita GDP on the other hand, significantly affects prices of all fruits (bananas, mangoes, oranges, and pineapples) considered in the study. All parameters are significant at the 1% level except bananas, where the contemporaneous effect is only significant at the 10% level.

Conclusions

Consistent to what has been reported in the literature, there is no single explanation for the soaring food prices revealed in the study. The only factor that persistently provides explanation for the increasing prices of most of the commodity groups considered in the study is probably the exchange rate to the U.S. dollar. But even that, the contemporaneous effect is reduction in prices while the one year lagged raises prices. Exchange rates, both contemporaneous and one year lagged, have effects on two feed grains (maize and rice) prices and two oilseeds (soybean and grounds) but in different directions. Consistent with theory, the contemporaneous exchange rate is price-increasing for all four commodities while the lagged raises prices. Because most commodity prices are commonly expressed in U.S. dollars, depreciation in the value of the U.S. dollar reduces the cost of commodities for countries whose currencies are stronger than the U.S. dollar, resulting in a cushioning of food price increases to a greater or lesser extent. However, for

Table 4. SUR/VAR Model for Oilseed Prices

	Groundnuts		Soybeans	
	Parameters	t-Values	Parameters	t-Values
Intercept	6.217	11.20	6.853	12.74
Fertilizer	−0.028	−0.54	0.026	0.52
Pesticide	0.127	1.17	0.200	1.91
Exchange rate	0.301	2.31	0.576	4.57
GDP capita	1.562	1.57	0.885	0.92
Fertilizer_1	0.018	0.37	0.031	0.65
Pesticide_1	−0.139	−1.33	−0.104	−1.03
ExchangeRate_1	−0.219	−2.03	−0.395	−3.77
GDPcapita_1	−1.500	−1.52	−1.004	−1.05
Income Group	−0.187	−1.26	−0.952	−6.62

Table 5. SUR/VAR Model for Fruits Prices

	Bananas		Mangoes		Oranges		Pineapples	
	Parameters	t-Values	Parameters	t-Values	Parameters	t-Values	Parameters	t-Values
Intercept	6.903	6.53	4.799	3.65	8.407	6.86	8.281	5.59
Fertilizer	−0.172	−2.27	−0.257	−2.73	0.013	0.15	−0.159	−1.50
Pesticide	−0.135	−0.67	−0.181	−0.72	−0.143	−0.61	−0.249	−0.88
Exchange rate	0.583	3.00	0.330	1.37	0.049	0.22	0.088	0.32
GDP capita	9.444	6.24	14.133	7.51	5.910	3.37	9.580	4.52
Fertilizer_1	0.074	0.99	0.136	1.46	0.032	0.37	0.050	0.48
Pesticide_1	0.038	0.19	0.154	0.62	−0.310	−1.34	−0.037	−0.13
ExchangeRate_1	−0.502	−0.15	−0.314	−1.69	−0.095	−0.55	−0.143	−0.68
GDPcapita_1	−9.072	1.49	−13.820	−7.44	−5.771	−3.33	−9.197	−4.40
Income Group	−1.039	0.24	0.151	0.50	0.176	0.62	−0.725	−2.13

countries whose local currencies are pegged to or are weaker than the U.S. dollar, depreciation in the U.S. dollar increases the cost of procuring food. It was very difficult to obtain data on tariffs especially for low-income countries to be able to isolate all the effects. This same data constraint prevented the authors from developing separate models for low and middle-income countries.

Another important factor is per capita GDP. Per capita GDP, both contemporaneous and one year lagged, explain only the rising prices of maize but are a major explanatory factor for fruit prices. It explains soaring prices of all the fruits (bananas, mangoes, oranges, and pineapples) considered in the study. This result is consistent with what has been highlighted in a recent study by the International Food Policy Research Institute (Ahmed et al., 2007). This argues that rapid economic growth in certain developing economies has pushed up middle-class consumers' purchasing power and increased demand for livestock products such as meat and milk and, hence, the demand for feed grains. The report asserts that in the case of both China and India, there is no evidence of a sudden increase in imports of oilseeds, meats, and oils to indicate that they have contributed to the price hike. Increasing incomes generally also lead to changes in diets, often reflected in stronger demand for higher-value foods such as livestock products and fruits and vegetables as opposed to starchy staples such as wheat.

Contrary to what has been reported in the literature (that the rising prices of some key inputs are constraining smallholder production which has translated into higher food prices), the study finds that the prices of energy inputs such as fertilizer and pesticides rarely explain soaring food prices. Both pesticide and chemical fertilizer inputs, either contemporaneous or one year lagged, have no effect on prices of either feed grains or oilseeds.

The study finds no single factor that persistently explains all soaring food prices as reported in the literature. However, the demand side factors such as exchange rates and GDP and population to some extent are the very few delineated factors.

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