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Propagation of Shocks to Food and Energy Prices: A Cross-Country Analysis*

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Abstract
The present paper analyzes the propagation of shocks to food and energy prices in 46 countries with data from the period 1999–2010. Empirical evidence suggests that in all but one country shocks to either energy or food prices propagate to prices of goods and services included in the core inflation measures. In general, the propagation effect of food price shocks is larger than that of energy price shocks. Emerging economies are more affected by propagation than are advanced ones, which is supported by analysis of variance decompositions, which suggests that especially food components explain the larger part of the variability of core inflation in emerging countries. The weights of food components in the consumer baskets seem to impact the magnitude of propagation, particularly in emerging economies. The results advocate that policymakers concerned with price stability should pay special attention to shocks affecting domestic food prices.

1. Introduction

Energy and food prices are among the most volatile components included in the consumer basket as they may be affected by several types of supply shocks, which could be caused by either swings in international prices or by domestic factors. These domestic factors include energy price shocks caused by, for example, interruptions of the usual supply channels and food price shocks caused by, for example, droughts affecting local production. Changes in these specific prices could cause variations in other prices through, for example, a cost-push effect. This is referred to as propagation of inflationary shocks, which is the subject analyzed in the present paper.

It is of great importance particularly but not exclusively for inflation-targeting central banks to understand how specific price shocks may propagate to other prices. While monetary policy usually has a limited impact on the direct price effect, for example the effect of a drought on food prices, it is intended to affect possible propagation of the initial shock to other prices by influencing, for instance, demand and inflation expectations. To design the policy appropriately, however, it is important to understand how the propagation mechanism works with respect to size, duration and time lag. Due to different structural characteristics, inflationary shocks propagate differently in different economies and a main contribution of the present study is to analyze these differences as a first and important step in understanding why inflationary shocks propagate differently across countries. The starting hypothesis is that

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countries where energy and food have higher weights in the consumer basket are the most affected by propagation to core prices and the data will reveal the extent to which this is true.

The results obtained with a sample of 46 countries (17 emerging and 29 advanced) suggest that food price shocks propagate more, i.e. have stronger effects on core prices, than energy price shocks, while the duration is more or less the same. In general, emerging countries are more affected by propagation than are advanced ones and variance decompositions show that food explains a larger part of core inflation variability in emerging countries. Finally, the weight of the food component in the consumer basket seems to affect the magnitude of the propagation, especially in emerging countries.

The present study contributes to the sparse literature that focuses directly on the propagation of inflationary shocks[1] and the vast amount of literature concerned with the pass-through of shocks to international oil[2] and food[3] prices. One conclusion from the aforementioned literature seems to be that the inflationary impact is generally stronger in emerging than in advanced countries. Evidence from the analysis in the present paper will shed some light on whether this is because of direct pass-through or rather propagation to other prices and, hence, if there is a role for monetary policy when, for example, oil price shocks occur.[4]

The rest of the paper is organized as follows: The next section presents a case study exemplifying the different impact that common shocks have on core prices in different countries. Section 3 discusses the methodology utilized to obtain the results, which are presented in Section 4. Section 5 discusses the importance of consumption weights, and Section 6 offers some concluding remarks.

2. Case Study

As an example of a common shock, it is useful to consider the 2007–2008 surges in international oil and food prices as an illustration of the different impacts local food and energy price shocks have on core prices in different countries. *Figure 1* shows the average inflation rates in the 46 countries.[5] While there seems to be little correlation between inflation of the energy component and the non-food and non-energy component (henceforth referred to as core inflation), correlation between

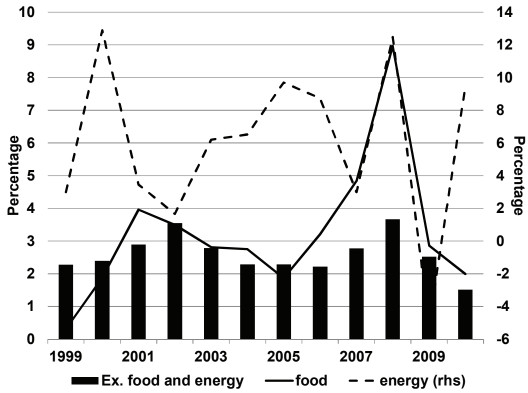
[1] See Levin *et al.* (2004), Kim and Park (2006) and Pedersen (2010).

[2] A review of the literature on the effect of energy price shocks on the U.S. economy can be found in Killian (2008), while cross-country studies of the pass-through of oil price shocks include Hunt *et al.* (2001), Dalsgaard *et al.* (2001), LeBlanc and Chinn (2004), de Gregorio *et al.* (2007), Pincheira and Garcia (2007), Peersman and van Robays (2009) and Baumeister *et al.* (2010). Papers concerned with appropriate policy reactions to oil price shocks include Bernanke *et al.* (1997), Hooker (2002) and, more recently, Blanchard and Galí (2010) and Kilian (2010).

[3] Jalil and Zea (2011) and Lora *et al.* (2011) study the pass-through of international food prices in Latin American countries. Rigobon (2010) investigates the pass-through of changes in commodity prices with micro data from 50 countries, while Pistelli and Riquelme (2010) analyze the impact of the commodity boom-and-bust cycle during 2007 and 2008 using a sample of 44 countries.

[4] Peersman and van Robays (2009) find that inflationary effects of oil price shocks in the U.S. are mainly due to direct pass-through and indirect effects of higher production costs, while inflation rates in the euro area react sluggishly and are driven by second-round effects of increasing wages. Baumeister *et al.* (2010) argue that second-round effects tend to be very different across oil-importing countries and that these effects are important for explaining differences in the overall impact of an oil supply shock on inflation.

Figure 1 Average Inflation Rates



Source: Author's elaboration.

the core and food prices is more apparent. The two years with the highest core rates (2002 and 2008) came after a period of increasing food inflation rates.

In 37 of the 46 countries, the 2008 inflation rate of the energy component was higher than the average rate over the period 1999–2007; in 22 of these countries it was more than twice as high. In 2008 the average rate for advanced countries was 2.5 times the average of the nine preceding years, while the same ratio was 1.5 for the emerging economies.[6] Particularly East Asian countries experienced large increases in energy prices in 2008. With respect to food prices, in 2008 the inflation rates were higher than the historical average in 43 countries. Excluding Hong Kong, where food inflation in 2008 was 190 times the historical rate, on average food prices increased 3.5 times more than they did in the period 1999–2007. Particularly European and Latin American countries experienced faster than normal acceleration in food prices in 2008.

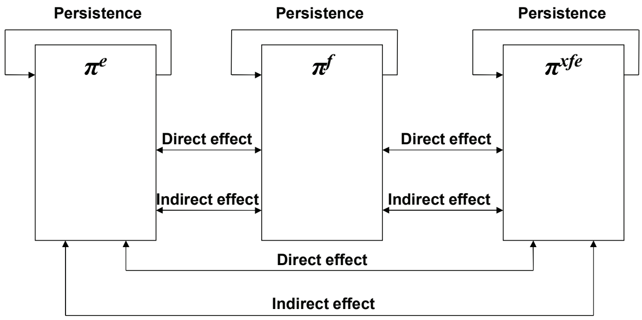
In more than half of the countries (27 of the 46), the core rate was higher in 2008 than in the nine preceding years, and in 19 countries it was more than 25% higher than the historical average. In 2009, 17 countries experienced core rates higher than the historical average; in thirteen it was more than 25% higher. There is no clear geographical distinction, though the 2008 rates were relatively higher in East Asia and lower in the two North American countries.[7] Considering the rapid acceleration of international food and oil prices, it is no surprise that these were passed on to

[5] Austria (AUT), Belgium (BEL), Bulgaria (BGR), Brazil (BRA), Canada (CAN), Switzerland (CHE), Chile (CHL), Colombia (COL), Cyprus (CYP), Czech Republic (CZE), Germany (DEU), Denmark (DNK), Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), Great Britain (GBR), Greece (GRC), Hong Kong (HKG), Hungary (HUN), Ireland (IRL), Iceland (ISL), Israel (ISR), Italy (ITA), Japan (JPN), Republic of Korea (KOR), Lithuania (LTU), Luxembourg (LUX), Latvia (LVA), Mexico (MEX), Malta (MLT), Netherlands (NLD), Norway (NOR), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Romania (ROM), Singapore (SGP), Slovakia (SVK), Slovenia (SVN), Sweden (SWE), Turkey (TUR), Taiwan (TWN) and the United States (USA).

[6] According to the Dow-Jones list of emerging markets: BGR, BRA, CHL, COL, CZE, EST, HUN, LTU, LVA, MEX, PER, PHL, POL, ROM, SVK, TUR and ZAF.

[7] Mexico is included in Latin America and, hence, North America refers to Canada and USA in the present context.

Figure 2 The Propagation Mechanism



Notes: π^e indicates inflation of the energy component, π^f inflation of the food component, and π^{xfe} inflation of the non-food and non-energy (core) component.

Source: Author's elaboration.

higher local food and energy prices. The fact that core inflation rates were also higher in several of the countries may be attributed to propagation of the original price shocks.

3. Methodology

Propagation of inflationary shocks implies that prices that are not directly affected by the original shock may experience variations due to this initial shock. To the author's knowledge, there exist no theoretical models explaining the mechanism of propagation of inflationary shocks, which seems to be an empirical issue. The process can, however, be illustrated as in *Figure 2*, which includes three components of the consumer price index (CPI) basket: the energy part, whose inflation rate is π^e, the food part $\left(\pi^f\right)$ and the rest of the basket, which is referred to as the core part $\left(\pi^{xfe}\right)$. To exemplify the mechanism, assume that local energy prices are hit by a shock, for example because a local supply channel is interrupted. This energy price shock may have direct effects on food prices (e.g. higher costs of producing bread) but also an indirect effect, for example because of higher energy prices a smaller part of households' income can be spent on food and this lower demand may result in a downward adjustment of food prices. The same line of argument can be applied for products included in the core inflation measure. All of these adjust-ments can happen instantaneously or with a time delay. Furthermore, there may also be effects in the other direction, i.e. higher prices of, say, food create upward pressure on salaries, which forces firms to raise their prices. This is merely a simplified example, but one can easily think of other mechanisms explaining the arrows of direct and indirect effects illustrated in *Figure 2*. Finally, each of the three components in the figure may have some degree of persistence, which also affects the entire propagation mechanism.[8]

In a nutshell, there are two principal effects which influence the propagation mechanism: a cost-push effect and a demand-pull effect. Whereas the first effect

[8] Altissimo *et al.* (2006) report that reduced form estimates of inflation persistence in the euro area ranges from 0.74 to 1.04. When allowing for time-variation in the mean, however, persistence estimates fall significantly.

results in positive propagation, i.e. upward pressure on core prices, the second causes downward pressure. If the cost-push effect dominates the demand-pull effect, propagation is positive and *vice versa*. It could also happen that one effect dominates in the short-term and the other in the long-term such that, for example, the initial propagation is positive for a while and later it becomes negative.

The econometric model utilized for describing the propagation mechanism is a VAR model, where the data vector spans the entire CPI basket. Particularly for analyzing the propagation of energy and food price shocks, this implies a three-dimensional model where the data vector includes the inflation rate of the energy component (π^e), the inflation rate of the food component $\left(\pi^f\right)$ and core inflation $\left(\pi^{xfe}\right)$. Simplifying the notation by excluding deterministic terms and restricting the lag order to one, the model is presented as:

$$\begin{bmatrix} \pi_t^e \\ \pi_t^f \\ \pi_t^{xfe} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \pi_{t-1}^e \\ \pi_{t-1}^f \\ \pi_{t-1}^{xfe} \end{bmatrix} + \begin{bmatrix} u_t^e \\ u_t^f \\ u_t^{xfe} \end{bmatrix}$$

where a_{ij} (i,j = 1,2,3) are coefficients and u_t^k ($k = e, f, xfe$) are unobservable i.i.d. zero-mean error terms. The assumption that all three variables are potentially endogenous relies on the fact that the prices considered in the analysis are those facing consumers such that they include, for example, mark-ups and salaries, which potentially are related to increases in prices of other goods and services.

To model the propagation mechanism discussed above, a Cholesky decomposition is applied to identify shocks such that the energy component is the most exogenous one, followed by the food component, and then the core component is the most endogenous one. In other words, an initial shock to energy prices may have contemporaneous effects on food and core prices, but not vice versa. Food price shocks may affect core prices in the same period the shock occurs, but not the other way around. The argument for treating energy prices as the most exogenous component relies on the fact that energy directly enters as an input in the production of goods and services included in food and core prices, but the opposite is not the case. Food prices are assumed to be more exogenous than core prices because they are more likely to be affected by supply shocks.

The empirical analysis is conducted with monthly data of annual CPI inflation rates for 46 countries and, unless stated otherwise, the period considered is January 1999 to December 2010, i.e. the annual inflation rates are calculated with CPI data starting in January 1998.[9] All level series have been rebased to 2005 = 100. Data is mainly extracted from three sources: the OECD's Main Economic Indicator (MEI) database, Eurostat and the CEIC database. Further details can be found in *Appendix A*.[10]

The analysis of propagation consists of impulse-response analyses in VAR models, which are estimated by ordinary least squares (OLS), and to evaluate

[9] See Pedersen (2010) for a discussion of the advantages of using annual inflation rates in the case of Chile.

[10] The *Appendices* are available on the website of this journal.

whether or not propagations of shocks are statistically significant, 95% confidence intervals are bootstrapped as described by Hall (1992), setting the number of replications equal to 2,000. Details of the specifications of the models are provided in *Appendix B*.[11]

As the first step of the empirical analysis, a panel VAR (PVAR) including all of the countries is estimated in order to explore what the "normal" reaction of core prices is when energy and food prices are subjected to shocks. The results of this exercise may help to distinguish between common and country-specific effects in the propagation mechanism. The standard model is written as:

$$\mathbf{Z_{it}} = \boldsymbol{\alpha}_\mathbf{0} + \sum_{q=1}^{p} \boldsymbol{\beta}_\mathbf{q} \mathbf{Z_{it\text{-}q}} + \boldsymbol{\mu}_\mathbf{i} + \mathbf{d_{c,t}} + \boldsymbol{\varepsilon}_\mathbf{it} \tag{1}$$

where $\mathbf{Z_{it}}$ is the vector $\left(\pi_{it}^{e}, \pi_{it}^{f}, \pi_{it}^{xfe}\right)$, $\boldsymbol{\alpha}_\mathbf{0}$ is a vector containing constant terms, $\boldsymbol{\beta}_\mathbf{q}$ is the matrix of coefficients for lag q, $\boldsymbol{\mu}_\mathbf{i}$ contains country-specific effects, $\mathbf{d_{c,t}}$ are country specific time dummies, and $\boldsymbol{\varepsilon}_\mathbf{it}$ is distributed as $\left(0, \boldsymbol{\sigma}_\mathbf{\iota}^\mathbf{2}\right)$ with $E\left(\boldsymbol{\varepsilon}_\mathbf{it}' \boldsymbol{\varepsilon}_\mathbf{is}\right) = 0$ for all $t \neq s$. The notation i is used to index countries and t to index time.[12]

A Cholesky decomposition of the variance-covariance matrix of residuals is imposed to identify shocks such that energy price shocks have a contemporary impact on food and core prices and food price shocks have a contemporary impact on core prices. To obtain the 95% confidence interval, standard errors of impulse-response functions are generated with 500 Monte Carlo simulations.

4. Propagation of Shocks to Energy and Food Prices

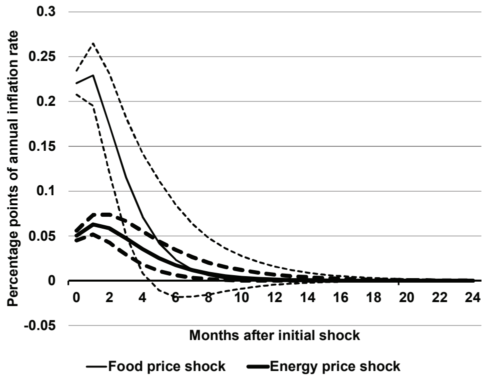
A PVAR is estimated to evaluate a "common" reaction among the economies included in the analysis and the results for energy and food price shocks are shown in *Figure 3*.

Commonly across the countries, the effect of both energy and food price shocks peaks in the month after the initial shock. The maximum effect on core inflation of an energy price shock is 0.06 percentage point (pp), while it is more than three times larger for a food price shock. Energy price shocks have a duration of almost a year, while the duration of propagation of food price shocks is four months.[13]

[11] As shown in *Table B1*, in most of the models the largest root of the companion matrix is close to but less than one and often tests cannot reject the presence of a unit root. Assuming non-stationarity in the present context, however, would imply that unanticipated shocks have permanent effects on the inflation rate. In other words, the propagation of shocks to, say, energy prices would cause permanently higher core inflation rates. This seems very unlikely and the propagation analysis is conducted under the assumption of stationary but, in some cases, highly persistent systems.

[12] Individual heterogeneity is allowed for by introducing fixed country effects in (1). However, since fixed effects are correlated with regressors due to lags of dependent variables, forward mean-differencing, i.e. the Helmert procedure (see Arellano and Bover, 1995), is applied and coefficients are estimated by the system generalized method of moments (GMM). Country time dummies are introduced to capture country-specific macro shocks that may affect prices in the countries the same way. These are eliminated by subtracting the means of each of the variables of each of the countries calculated each year. The routine applied for the estimations is the one utilized by Love and Ziccino (2006).

Figure 3 PVAR(2) Results
Effect of Unit Shocks on Core Inflation



Source: Author's elaboration.

The results of the propagation exercise for shocks to energy and food prices are reported for sets of countries in *Table 1* and for individual countries in *Appendix C*. The results suggest that in all but one of the countries propagation is statistically significant for at least one of the shocks. In general, propagation of a unit food price shock is larger than that of a unit energy price shock, and emerging countries are more affected by both shocks than are their advanced counterparts.

4.1 Propagation of Shocks to Energy Prices

In 38 countries a unit shock to energy prices propagates statistically significantly to other prices. In two of the Nordic countries, propagation is negative, i.e. a positive energy price shock results in negative pressure on core prices. In 15 of the countries where propagation is significantly different from zero, the effect on core prices is immediate, i.e. propagation starts in the same month of the initial shock. On average, however, propagation starts four months after the original shock and lasts almost until the nineteenth month after the shock. The average maximum effect (0.06 pp of the annual inflation rate) occurs after eleven months. These effects are, however, very diverse, ranging from -0.08 to 0.66 pp. In seven emerging countries the maximum effect is larger than 0.10 pp.

Propagation effects are significant in 88% of the emerging countries and in 83% of the advanced ones. Propagation to core prices occurs faster in emerging countries and the average maximum impact is larger. Distinguishing between countries that have inflation targeting as their monetary anchor (ITers[14]) and those that do

[13] The size of propagation is quite robust to different lag lengths, while periods in which the effect of energy price shocks is statistically significant diminish when more lags are included in the PVAR. When more than four lags are included in the model, the impact of food price shocks turns statistically significantly negative after eight to nine months and the same happens for energy price shocks after eleven to twelve months.

[14] Countries which at the time of writing have adopted inflation targeting as their monetary policy anchor (the year of adoption according to Lim, 2009, in parentheses): BRA (1999), CAN (1991), CHE (2000), CHL (1991), COL (1999), CZE (1998), GBR (1992), HUN (2001), ISL (2001), ISR (1992), KOR (1998), MEX (1999), NOR (2001), PER (2002), PHL (2002), POL (1998), ROM (2005), SVK (2005), SWE (1993), TUR (2006) and ZAF (2000).

Table 1 Average Effect on Core CPI (percentage points of annual inflation rate)

Unit shock to energy prices							
	First(a)	Last(a)	3M(b)	6M(b)	12M(b)	Max(c)	Month(c)
All	4.0	21.9	0.04	0.04	0.05	0.06	11.0
OECD	3.0	18.2	0.03	0.04	0.04	0.06	11.4
Europe	4.1	18.5	0.03	0.04	0.05	0.06	11.2
Adv.	4.7	19.3	0.01	0.02	0.02	0.03	10.9
Emer.	2.9	16.8	0.08	0.09	0.10	0.13	12.0
E. Asia	1.8	22.8	0.05	0.05	0.05	0.08	10.0
N. Am.	1.0	16.0	0.00	0.01	0.01	0.02	15.5
Latin Am.	1.0	12.0	0.07	0.08	0.07	0.09	8.8
Advanced	3.8	19.6	0.01	0.02	0.02	0.03	11.2
Emerging	2.5	15.6	0.08	0.08	0.08	0.11	10.8
IT	0.8	14.3	0.06	0.06	0.06	0.08	9.0
Non-IT	5.4	21.4	0.02	0.03	0.03	0.04	12.8
Unit shock to food prices							
	First(a)	Last(a)	3M(b)	6M(b)	12M(b)	Max(c)	Month(c)
All	3.2	21.2	0.11	0.13	0.12	0.14	10.0
OECD	3.1	16.3	0.06	0.08	0.08	0.08	11.3
Europe	2.3	18.3	0.10	0.12	0.11	0.12	11.4
Adv.	2.2	14.0	0.07	0.08	0.06	0.07	11.0
Emer.	2.6	27.4	0.15	0.20	0.21	0.23	12.0
E. Asia	3.0	10.0	0.11	0.11	0.05	0.15	5.8
N. Am.	2.5	7.5	-0.02	0.00	0.04	-0.01	4.5
Latin Am.	2.6	22.4	0.13	0.18	0.18	0.22	8.4
Advanced	2.8	13.2	0.06	0.07	0.06	0.07	9.8
Emerging	2.4	24.9	0.19	0.24	0.23	0.27	10.5
IT	3.0	19.4	0.13	0.17	0.15	0.19	10.9
Non-IT	2.4	16.0	0.09	0.11	0.10	0.11	9.3

Notes: (a) First (last) month with statistically significant effect. (b) Effect after three, six and twelve months. (c) Maximum effect in absolute value reached in the month reported in the last column. IT: Inflation-targeting economies.

Source: Author's elaboration.

not (non-ITers), it appears that the impact is faster and larger in IT economies. This result, however, is affected by the fact that 13 of the 21 ITers are emerging countries. In emerging ITers the average maximum impact is more than twice as large as in emerging non-ITers.

In advanced European countries the propagation of a shock to energy prices is statistically significant in 86% of the countries; it starts almost five months after the shock and lasts until month 19. Propagation, however, is very small and the average maximum effect occurs after eleven months. There is no clear distinction between northern and southern Europe. While differences in maximum impact are not large among countries, there is more diversity in duration and timing of the propagation. In several countries it is significant more than two years after the initial energy price shock. To sum up, even though the impacts of propagation of an energy price shock in advanced European countries are similar, the timing and duration are very diverse.

In seven of the ten emerging European countries, propagation of a shock to energy prices is statistically significant. The effect is larger and longer lasting compared to the advanced part of Europe. On average, propagation starts about three months after the initial shock and lasts until month 17. The impacts are, however, very different in the emerging European countries as the maximum effects in six countries are comparable to those in the advanced European countries, whereas they are larger in four of the countries. In three countries propagation is still significant after three years.

Propagation is significant in all of the East Asian countries and the average duration is longer than in any of the other geographic areas in the sample. In most countries propagation is relatively fast and the maximum impact is smaller than in the emerging European and Latin American countries, but notably larger than in the advanced European countries. The largest impact occurs in the only emerging country in the region which is included in the sample, the Philippines.

The propagation effect of shocks to energy prices is significantly different from zero in only one of the two North American countries in the sample, but the impact is very limited. In the Latin part of the continent, where all economies are emerging, propagation is significant in all countries. A shock to energy prices in Latin America propagates to prices in the core index after one month, the average duration is one year, and the average maximum effect occurs about nine months after the initial shock.

Even though propagation of energy price shocks is statistically significant in all of the East Asian countries, it is not evident that the magnitude and duration of propagation of energy price shocks are determined by geographical location. On the other hand, there is some evidence that the state of development (emerging or advanced) is an important factor, as the impact is generally larger in emerging countries, whereas the duration appears to be a bit shorter. Compared with the results of the PVAR estimation, the impact in advanced countries is smaller than the common effect, while it is larger in emerging countries. Generally, core price adjustments happen later than indicated by the PVAR and propagation lasts longer, suggesting that idiosyncratic characteristics of the economies play an important role in the propagation of energy price shocks.

4.2 Propagation of Shocks to Food Prices

Also in 38 of the 46 countries a unit shock to food prices has significant effects on core inflation. Propagation is significantly negative in five countries. Propagation is statistically significant in all emerging countries and in 72% of the advanced countries. On average, propagation starts 3.2 months after the initial shock and lasts until month 21 with a maximum impact of 0.14 pp of annual core inflation rate after ten months.

In emerging countries the average maximum impact is more than three times as large as in advanced ones and the duration is almost twice as long. Propagation is statistically significant in all emerging countries and, with two exceptions, the maximum impact is 0.20 pp or higher. In all but four emerging economies the effect of propagation is still statistically significant after one year.

In IT economies, the duration is longer than in non-ITers and the average impact is higher. As in the case of energy price shocks, this is influenced by the large proportion of emerging economies that have adopted inflation targeting. Considering only emerging economies, the impact is bigger in those that are non-ITers and the duration is longer. For advanced countries, the average maximum impact and average duration are more or less the same in IT and non-IT economies.

Propagation of food price shocks is statistically significant in two-thirds of the advanced European countries and in all of the emerging economies. The time between the initial shock and the first month when propagation is significant is more or less the same in the advanced and emerging European countries. On the other hand, the duration of propagation is almost twice as long in emerging countries despite the fact that in six advanced economies it is still significant after two years. The maximum effect in Europe occurs after a year, but the average impact in the emerging economies is more than three times as large as in the advanced ones. Considering only the countries where propagation is statistically significant, the duration of a shock is still six months longer in the emerging European countries and the maximum impact is 0.11 pp larger.

In East Asia the propagation effect is statistically significant in all countries but one. The average impact is larger than in the advanced European countries, but smaller than in the emerging European countries. The duration is on average shorter than in Europe and Latin America.

Propagation of food price shocks is different in the two North American countries, i.e. negative in the U.S. and positive in Canada. In both countries propagation starts within the first quarter following the original shock, but the duration is longer in Canada. In all five of the Latin American economies, propagation of food price shocks to core prices is statistically significant. On average, propagation starts 2.6 months after the original shock and lasts about 20 months. The average maximum effect is 0.22 pp of annual core inflation.

Also in the case of food price shocks, propagation seems to depend more on the state of development than on geographical location. It is noteworthy, however, that propagation of food price shocks is found to be significantly positive in all Latin American countries, suggesting that inflation rates in this region are particularly affected by these shocks. Idiosyncratic characteristics seem to play an important role in the same way they do for energy price shocks.

Evidence from the analysis of propagation of energy and food price shocks suggests that emerging countries are more affected than advanced economies. As the food component in particular has a higher weight in the consumer baskets of emerging economies, this supports the hypothesis raised in the introduction that countries where weights in the consumer basket are higher are more affected by propagation.

Table 2 Forecast-Error Variance Decomposition (average percentages)

	6 months		1 year		2 years		5 years	
	Energy	**Food**	**Energy**	**Food**	**Energy**	**Food**	**Energy**	**Food**
All	9	9	14	15	19	20	21	21
OECD	9	7	14	12	19	18	22	19
Europe	8	8	12	15	17	21	19	22
Adv.	6	7	11	12	17	16	20	18
Emer.	11	12	13	21	16	30	18	32
E.Asia	13	6	20	8	26	9	30	8
N. Am.	4	7	10	9	24	9	28	9
Latin Am.	18	14	23	22	22	26	23	27
Advanced	7	6	13	10	19	14	22	15
Emerging	13	14	16	23	17	29	19	31
IT	13	11	17	17	18	21	19	22
Non-IT	6	7	11	14	19	19	23	20

Note: The numbers in the columns "Energy" and "Food" show the percentage of the forecast-error variance of core inflation explained by energy and food inflation.

Source: Author's elaboration.

4.3 Variance Decomposition

As a supplement to the impulse-response analyses, *Table 2* presents contributions of energy and food components to the variance decomposition of core inflation. When looking at the whole sample, energy and food explain the same part of the variation of core inflation, and together the two components explain approximately 20% of the variance in the short run and 40% in the long run. In Europe the picture is similar, but in the emerging part of the continent the percentage of the two components is higher than in the advanced part, in particular with respect to the food component, which on average explains 12% in the short run and 32% in the long run. In East Asia and North America the energy component explains a larger proportion of variability of core inflation than the food component, while the proportions are more or less the same in Latin America. When splitting the sample between advanced and emerging countries, in the short run the two components explain approximately twice as much of the variation of core inflation in emerging countries compared to the advanced world. In the long run, however, the contribution of the energy component is more or less the same, while the food item explains twice as much in the emerging countries.

In general terms, the results of the variance decomposition analyses suggest that shocks to energy and food prices do have an important impact on core prices, particularly in the long run. In emerging countries the food component has the largest impact, while this is not so in the more advanced countries. There is, however, a great amount of heterogeneity among countries, as shown in *Table 3*. In the short run, energy explains less than 5% of core inflation variability in 22 countries, of which 15 are advanced, while for food this figure is 21 countries (17 advanced). On the other hand, energy explains more than 25% of core inflation variability in only two

Table 3 Forecast-Error Variance Decomposition by Countries

Energy			
6 months		**5 years**	
<5%	**>25%**	**<5%**	**>25%**
AUT, BEL, BGR, CAN, CYP, CZE, DEU, DNK, FRA, GBR, GRC, HKG, HUN, ISR, ITA, LUX, LVA, MEX, NLD, ROM, SVN, ZAF	CHL, TUR	CZE, GBR, HUN, LVA, POL	BGR, BRA, CHE, CHL, ESP, HKG, JPN, KOR, MLT, NLD, PRT, SVK, SWE, TUR, TWN, USA
Food			
6 months		**5 years**	
<5%	**>25%**	**<5%**	**>25%**
AUT, CHE, CHL, CYP, DEU, FIN, GRC, HKG, IRL, ISR, ITA, JPN, NLD, NOR, PRT, ROM, SGP, SVK, SVN, SWE, TUR	BEL, ISL, LVA, PER, ZAF	CHE, GRC, NOR, PRT, SGP, SWE, TWN, USA	BEL, BGR, COL, CZE, DEU, DNK, EST, FRA, GBR, LTU, LVA, PER, POL, ROM, SVN, ZAF

Note: The table shows countries where the energy or food component explains less than 5% and more than 25% of the variability of core inflation.

Source: Author's elaboration.

countries, while food explains more 25% of the same variability in five countries. Turning to the long run, of the 16 countries where food accounts for more than 25% of core inflation variability, ten are emerging, while this is the case for only five of the 16 where energy explains more than 25% of core inflation variability.

The starting hypothesis is to some extent supported by the variance decomposition analysis, in the sense that the food component, which has a relatively higher weight in the consumer baskets of emerging economies, has a relatively larger impact on the core inflation variability in these countries.

As argued in Section 3, the order of the variables in the VAR models estimated is chosen to focus the analysis on propagation of energy and food price shocks to core prices. *Appendix D* presents sensitivity analyses with respect to the order of the variables.[15] Generally speaking, the results are quite robust to the order of the variables in the sense that both minimum and maximum values are usually within the confidence bands estimated for each of the countries.

5. Importance of Consumption Weights

A natural question concerning the analysis of propagation of inflationary shocks is whether or not it is affected by the relative weight in the consumer basket of the component hit by the original shock. A priori one might expect this to be the case since if the relative weight is big, a shock has a greater impact on households' expenditures.

[15] While the sign-restriction approach may not be appropriate for investigating propagation of inflationary shocks, a robustness check was made by applying this method, restricting the initial impact to being positive in the first month. The impacts are generally larger than those reported in this paper, but the analysis supports the quantitative findings that food price shocks propagate more than energy price shocks and that impacts are larger in emerging economies. The results are available upon request.

Table 4 Average Weights in the Consumer Price Basket (percentage)

	Energy			Food		
	Average	Min.	Max.	Average	Min.	Max.
Europe	10.2	6.3	16.7	18.2	10.4	43.7
Advanced	8.5	6.3	12.0	14.7	10.4	23.5
Emerging	13.8	11.6	16.7	26.5	16.1	43.7
E. Asia	6.6	3.9	7.5	25.8	14.4	46.6
North America	8.9	8.6	9.3	9.6	7.8	11.5
Latin America	7.4	4.4	9.2	25.4	18.9	37.8

Sources: OECD; Eurostat and CEIC database; author's elaboration.

Table 4 reports regional average weights of the energy and food components. The average energy weight for the advanced countries is 8.0%, while it is 11.1% for the emerging economies. Food plays a relatively greater role in households' budgets in the emerging countries than in the advanced countries, with averages of 26.9% and 15.6%, respectively.

In Europe the average weight of the energy component is higher than in the other regions and the weights are highest in the emerging part of the continent. Energy weights are lowest in Asia and Latin America. On the other hand, foodstuffs are much more important in these two regions and in the emerging European countries compared to the advanced European countries and North America. Taking a look at the weights and countries where propagation is statistically significant, it appears that there may be a connection with food prices, while it is not evident for energy prices where, for example, propagation is not significant in the two countries with the highest weights.

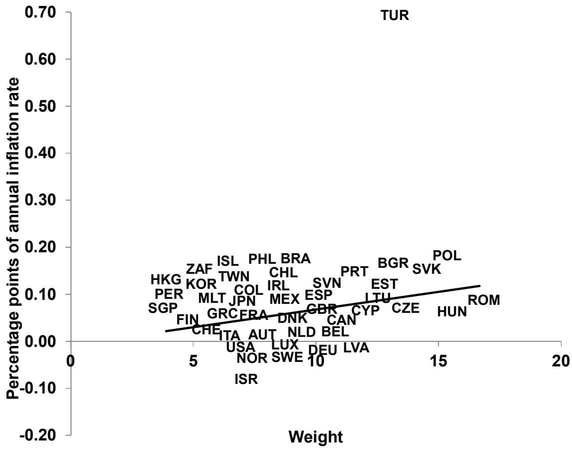
Turning to the more detailed analysis of energy price shocks, *Figure 4* shows a plot of weights and the maximum impact of the shock. There seems to be a positive relationship between the weight of the energy component in the consumer price basket and the maximum impact of propagation. A simple regression, however, yields a slope of 0.008, which is not statistically different from zero when testing with a 5% significance level.[16]

Similar plots were made for the number of months after the shock when the maximum impact occurs, the first month in which the impact is statistically significant, and the duration of the propagation.[17] With respect to the month in which the maximum impact occurs, there is no relation to the energy weight; the slope of the estimated regression is positive but not statistically significant. Is it not evident either that there is a relationship between the weight and the speed with which propagation affects core inflation (counter-intuitively, the sign of the estimated regression slope is positive but not statistically different from zero) or between the energy weight and duration. Hence, the overall conclusion is that there is no strong evidence suggesting a connection between the weight of the energy component and the propagation of shocks to energy prices.

[16] The slope decreases when Turkey is deleted from the sample.

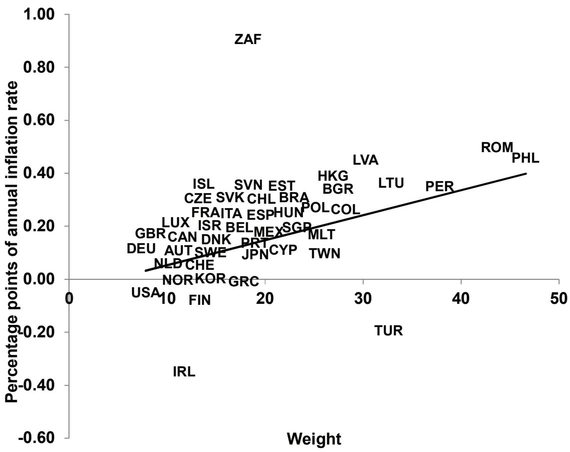
[17] Graphs are available upon request.

Figure 4 Weight of the Energy Component and Maximum Impact



Source: Author’s elaboration.

Figure 5 Weight of the Food Component and Maximum Impact



Source: Author’s elaboration.

With respect to the propagation of food price shocks, *Figure 5* shows the same plots as *Figure 4*, but with respect to food components. As illustrated in *Figure 5*, a higher weight leads to a greater maximum impact. A simple regression shows that the sign of the slope is positive, as expected, and statistically significant. This also holds when excluding the three outliers (IRL, TUR, and ZAF), but only for emerging countries, as the estimated regression slope turns out not to be statistically significant when considering the advanced economies only.

Also with respect to the month in which the maximum impact is registered, the relationship is as expected; a higher weight implies that the maximum impact occurs faster. This connection, however, is not statistically significant in either the advanced or the emerging countries. The size of the food weight does seem to have an impact on when propagation starts, but this slope is not significant either. Concerning food weights and the duration of the propagation, the slope is positive, as expected, but not statistically significant. All in all, there does seem to be some connection between the weights of the food component and the propagation of food price shocks in the sense that estimated regression slopes have the expected signs, but they are, more often than not, not statistically different from zero.

Concluding the analysis of the importance of consumption weights, it appears that they are more important for the propagation of food price shocks than for energy price shocks. In the first case, the connection between statistically significant propagation and weight in the consumer basket is quite clear, whereas it is not evident that the same relationship exists for shocks to energy prices. Although the plots indicate some association between the propagation of energy price shocks and the weight of the energy component, the slopes of companioning regressions are not significantly different from zero. On the other hand, there is some evidence that the weights of the food components affect the propagation of food price shocks in terms of the magnitude of the propagation, particularly in emerging economies, while it is not evident that the weight has an impact on the duration and rapidity of propagation.

The evidence presented in this section supports the starting hypothesis only partially, i.e. energy and food price shocks generally do propagate to core prices, but in the case of energy prices, no strong evidence suggests that this is because of energy's share in consumption. With food prices, on the other hand, the impact on core prices can be explained by the relatively high weight in the consumer basket, particularly in emerging economies. A plausible reason for this result is that in all but one of the countries the weight of food is higher than that of energy. Another possible explanation is that food prices seem to be more rigid than energy prices,[18] such that food price shocks are more likely to affect inflation expectations and thus propagate to core prices.[19]

6. Concluding Remarks

Different from pass-through of international price shocks, the analysis of propagation is concerned with how changes in the prices of some components of the CPI basket may affect the prices of other goods and services and thus the overall inflation rate. The present study focused on the propagation of shocks to food and energy prices, and the empirical analysis provided evidence that indeed propagation effects are important since in all but one of the countries considered the effect of at least one of the shocks was statistically significant. Inflationary propagation was discussed with respect to size of the effect, its duration and the speed with which other prices are affected. On average, the propagation effect of food price shocks is stronger and longer lasting than the effect of energy price shocks, which suggests that policy-

[18] Dyhne *et al.* (2009) document that energy prices change more frequently than food prices in the euro area.

[19] The International Monetary Fund (IMF, 2011) argues that food price shocks are likely to have larger second-round effects if inflation is above target and the economy is affected by excess demand pressure. It also states that these shocks have larger effects on inflation expectations in economies where medium-term expectations are weakly anchored and that second-round effects tend to be larger if central bank credibility is limited and the share of food in consumption is high.

makers should pay more attention to shocks affecting domestic food prices than to those affecting energy prices.

As a starting point, a hypothesis was made stating that countries where the shares of energy and food in total consumption are higher are those most affected by propagation. Evidence suggested that the impact of both energy and food price shocks is greater in emerging economies, where consumption shares of these two items are higher, than in advanced economies. Furthermore, the duration of propagation of food price shocks is longer in emerging economies and therefore these observations support the hypothesis stated in the introduction. When analyzing the links between shares in the consumer baskets and propagation effects, however, the hypothesis was only partly supported. It was established that the larger impact of food price shocks in emerging economies may be partly related to the weights in the consumer price basket, whereas the same relationship is not evident with respect to energy price shocks. It was suggested that different price rigidities might explain this finding.

It is important to clarify that the nature of the shocks identified in the present paper does not necessarily have its origin in international commodity price shocks, but the source of the shocks may very well be domestic. In this sense, the results presented are quite robust to whether the original shock is caused by demand- or supply-side factors, since what matters is what happens after direct pass-through has taken place. In other words, for analysis of propagation mechanisms, what matters is how much, say, an international oil price shock affects national energy prices and not if it is supply-driven, like the shock in the 1980s, or demand-driven, like the shock in the 2000s. Hence, results are quite general in that sense, though of course they do to some degree depend on the period analyzed because of country-specific factors, e.g. the policy regimes in place.

Given the results of the present analysis it is recommended that policymakers concerned with price stability, especially in emerging countries, carefully monitor how international commodity price shocks and idiosyncrasy-related shocks directly affect local energy and food prices, in order to react appropriately to these shocks. Obviously, policy reactions also have to take into account, among other things, local demand conditions and inflation expectations at the time a shock occurs. To fully understand the propagation mechanism and why it differs across countries, research is still needed, e.g. exploration of the importance of factors such as rigidities in prices and salaries and the degree of openness.

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