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COMMODITY PRICES PASS-THROUGH

Roberto Rigobon

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Agustinas 1180, Santiago, Chile
Teléfono: (56-2) 3882475; Fax: (56-2) 3882231

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COMMODITY PRICES PASS-THROUGH

Roberto Rigobon
MIT and NBER

Abstract
I use a unique micro price data to estimate the pass-through from commodity prices to retail prices in several countries. The paper presents and develops a simple methodology to estimate the pass-through from the prices of different commodities into various sectors across several countries. This is the first exercise of this type. As expected, countries respond differently to the different shocks; and sectors respond differently across countries and commodities. A third of all the explained variation is driven by sectoral characteristics, which is a dimension mostly disregarded by the literature.

Resumen
Utilizo datos únicos de precios micro para estimar el traspaso de precios de bienes primarios hacia ítems e índices de precios en varios países. El trabajo presenta y desarrolla una metodología simple para estimar el traspaso desde los precios de distintos bienes primarios hacia diferentes sectores a través de varios países. Este es el primer ejercicio de este tipo. Como era de esperar, los países responden de manera distinta a distintas perturbaciones; y los sectores responden de manera distinta a través de países y bienes. Un tercio de toda la variación explicada es conducida por características sectoriales, que es una dimensión rara vez considerada en la literatura.

This paper would have not happen if it were not for the collaboration of several individuals helping in the collection of the micro data. Alberto Gonzales, Osmel Manzano, Andrew Powell, Cesar Calderon, Pablo Garcia, and Alfredo Pistelli, placed a key role in the integration of the data. I thank them tremendously for their help, comments, and efforts. I want to thank Eduardo Ley for extremely helpful comments on the procedures dealing with the seasonality. I have benefited from presenting these results in several seminars – far too many to enumerate. I thank the Banco Central de Chile, IDB and the WB for financial support. All remaining errors are mine.

I. Introduction

During the first decade of the 21st century, the world experienced large swings in the prices of mineral and food commodities. Those movements were rare in several dimensions. First, their size: both set of goods exhibited almost synchronized increases by four times from 2000 until 2007, to see their prices drop by more than three quarters the following couple of years. We haven't seen this magnitude of price changes since the 70's. Second, their co-movement: in normal times prices of minerals and food commodities are usually negatively correlated. Indeed, the unconditional correlation between the two in the last 120 years is negative. Periods of positive co-movement have been only observed during mayor supply disruptions in the last 100 years – where these disruptions were associated with wars and/or revolutions.

These tremendous shifts in relative prices have had implications on changes in domestic relative prices of food and energy for all countries, and these changes have had important effects in emerging markets inflation rates. The impact of international commodity prices into the economy depends on the degree of pass-through from the commodity price to the retail prices; something that has received little attention in the literature. The objective of this paper is to document the pass-through from commodities to retail prices for several Latin American countries, and to evaluate the role that plays the exchange rate in the overall effect. In other words, the purpose of this paper is to estimate simple pass-through regressions from commodity prices to item prices for several countries in Latin America. We are interested in cross-country and cross-sector comparisons, and to evaluate the impact that the different commodity prices have on inflation and changes in domestic relative prices.

Commodities affect domestic prices through very different channels. First, they affect the costs of raw materials. Second, they have an impact on the real exchange rate and the nominal exchange rate. Third, they have an impact on the automatic fiscal and monetary policy stance. Finally, they have an impact on the degree of competition – or markups – in the economy. In this paper we are interested in estimating the overall effect taking into account the exchange rate movement, but not paying attention to the other channels. In other words, we evaluate how the price of bread increases when the price of wheat increases internationally, as well as the price of wheat at the border – hence to evaluate the role of the exchange rate movement – but we will not disentangle how much of the transmission is due to cost, markups, fiscal policy, etc.

One advantage of this approach is that for most countries both the price of the commodity and the exchange rate movement could be considered exogenous to movements of the relative price of a particular sector of good. Nevertheless, there are still several challenges that have to be considered. First, seasonality at the item level is much more damaging and dramatic than at the aggregate level. This complicates the interpretation of the pass-through regressions and needs to be taken into account. Second, several countries have experienced significant disinflation processes that are not necessarily synchronized with commodity price movements. In this regard, if the disinflation occurs at a time in which commodity prices are trending in some direction, then the pass-through regressions might assign a spurious correlation. This problem is particularly pervasive in the beginning of the 2000's in some countries in Latin American and in Eastern Europe (if we were to use that data). Third, commodity prices are denominated in dollars (most of the time) and therefore their pass-through to domestic prices is

affected by exchange rate movements which sometimes might not reflect fundamental movements in the short run.

This paper is related to the relatively new literature that studies large micro price datasets. This literature has become an increasingly important and productive area of research in macro and international economics. Several papers have used data -- at the item level and at monthly frequencies -- to study the degree of stickiness, the price change behavior, its synchronization, the behavior of sales, the degree of real rigidities, tests of the theories of price stickiness, and the degree of pass-through; See Bils and Klenow (2004), Gopinath and Rigobon (2008) and Gopinath, Itskhoki, and Rigobon (2009), Kehoe and Midrigan (2007), Klenow and Kryvtsov (2008), Lach and Tsiddon (1996), Nakamura and Steinsson (2007), Klenow and Willis (2006) just to mention a few. These papers have used US data, and similar analysis has been performed for European data with similar success by others. So far, there is no comprehensive study of the properties of micro prices in emerging markets, and in particular the estimation of the pass-through. This is a gap this paper is partially trying to fill.

The paper is organized as follows: section 2 describes the data; section 3 describes the methodology; section 4 presents the results; and section 5 concludes.

II. Data

The data was collected by the Banco Central de Chile, the IDB and the World Bank through the different central banks. We obtained monthly data for as many countries as possible, at the finest possible level of detail. We needed at least 10 years of data. The reason is the following: the pass through regressions require eliminating the seasonality, with slow moving trends (disinflation processes), and dealing with long lags. For this reason, we will need at least 10 years of data, at relatively high frequencies - monthly. Countries with less than this will not be included in the analysis. I had three sources of data and for this project I combined all the data sets taking the best possible one for each country. The countries that satisfy these restrictions are: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK, USA, Argentina, Brazil, Chile, Colombia, Peru, Mexico, Uruguay, Algeria, Pakistan, India, China, South Korea, Israel, Taiwan, Japan, Singapore, Philippines, and Russia.

The starting year and the number of items in each country are summarized in Table 1. As can be seen, there is significant variation. Some countries have very detailed information, while others are sparse.

Table 1
Number of items and starting date for each country in the database

	Number of Items	Starting Date		Number of Items	Starting Date
Austria	166	Apr-94	Slovenia	16	Jan-95
Belgium	159	Apr-94	Spain	159	Jun-94
Bulgaria	164	Jan-97	Sweden	163	Mar-94
Cyprus	167	Feb-96	Turkey	163	Jan-96
Czech Republic	16	Jan-95	UK	161	Dec-95
Denmark	165	Mar-94	USA	244	Dec-97
Estonia	123	Mar-95	Uruguay	231	Mar-97
Finland	170	Jul-94	Argentina	7	Jan-90
France	172	Dec-94	Brazil	73	Jul-89
Germany	174	Jul-94	Chile	491	Jan-97
Greece	166	Feb-94	Colombia	103	Jan-97
Hungary	16	Jan-95	Switzerland	44	Jan-90
Iceland	164	Jan-95	Peru	4	Jan-95
Ireland	164	Oct-94	Mexico	434	Jan-88
Italy	166	Feb-94	Algeria	10	Jan-94
Latvia	166	Jan-96	Pakistan	9	Jul-91
Lithuania	166	Nov-95	India	7	Jan-90
Luxembourg	168	Jan-95	China	7	Jan-94
Malta	165	Jan-96	Korea	112	Jan-90
Netherlands	161	Aug-94	Israel	159	Jan-91
Norway	156	Jan-95	Taiwan	103	Jan-90
Poland	180	Jan-96	Japan	118	Jan-90
Portugal	164	Mar-94	Singapore	96	Jan-90
Romania	16	Jan-95	Philippines	137	Jan-90
Slovakia	173	Dec-95	Russia	19	Jan-95

To increase the cross-country comparability instead of concentrating on individual items – which are not frequently repeated across all the countries – we have decided to use relatively aggregated series. From each country we have different sets of items and aggregates series, and for some of them the item data is already an index. We classify the items in different categories: Bread, rice, maize, flour, oat meal, cereals, cookies, pastas, other cereals, other basic, dairy, oils, sugar and condiments, meat and fish, vegetables, processed food, beverages, restaurant, real estate, housing expenses, services of water, gas, electricity, phone, and other services, gasoline, public, private and other forms of transportation, electronics, electro domestics, medicines, beauty products, health services, education, education products, clothing, and all other products. Good by good we reclassifying them according to these categories.

We study the impact of the following commodities: agricultural commodities such as wheat, maize, rice, and mineral commodities such as oil, copper, iron, aluminum, and gold. In this paper we present results

for only those in which there are interesting and significant results. The exchange rate data and the commodity price data is at least 20 years long.

III. Methodology

This section describes the steps in the estimation procedure. First, each individual series is cleaned up of the seasonality. The second step is to correct for the disinflation effort that was present in several countries. This is a particularly difficult problem to resolve because the disinflation might be confounded with the commodity price trend. In several countries a disinflation occurred at the beginning of the decade. This means that the disinflation occurred exactly at the same time commodity prices were booming. This will add a negative spurious relationship. Third, we estimate simple pass-through regressions.

A. Seasonality

Each series – i.e. each item price series – will be separately de trended and seasonally adjusted using the TRAMO and SEATS procedure. This is a procedure that is used in the Bank of Spain (and the ECB) and is the one that takes into account stochastic seasonality and de-trending. The documentation of the procedures can be found in Gomez and Maravall (1997).[2]

TRAMO is a program for estimation and forecasting of regression models that allows for nonstationary errors (ARIMA). The program also corrects for missing values, although that is unlikely to be a problem in our data set. SEATS, on the other hand, is a program that estimates unobservable components in a time series. Using signal extraction methods, the series are split between trend, seasonal, cyclical, and irregular components.

B. Disinflation

A difficult challenge in our data set is that several countries have implemented significant disinflation programs at the same time commodity prices where trending up. This adds a negative spurious relationship between the two. In order to deal with this problem a system of equations will be estimated where the aggregate inflation index, short term interest rates, and the commodity prices are included in the regression. The idea is to control for the disinflation effort in each country.

C. Pass through regressions.

Once the problem of disinflation at the aggregate index has been resolved, the pass-through regressions at the item level will be estimated as follows:

$$q_{it} = \frac{p_{it}}{P_t}$$

$$\Delta \ln\left(q_{it}\right) = c_{0i} + \sum_{k=1}^{K}\sum_{j=0}^{L} \alpha_{ijk} \Delta \ln\left(c_{t-j,k}\right) + \varepsilon_{it}$$

[2] See http://www.bde.es/servicio/software/dose.htm for a detailed description.

Where p_{it} is the price of the item of interest, P_t is the aggregate price index, which means that q_{it} is the relative price of the item with respect to the aggregate index. We regress $\Delta \ln(q_{it})$ on a constant and lags of the log change in the commodity price index of interest. We allow for k different commodities.

The advantages of this specification are several: First, the price of the item has been seasonally adjusted before running the regression, and because we are computing relative prices as opposed to the price itself, we do not have to correct for the error-correction that is likely to appear if the price of the item and the commodity price are cointegrated. Additionally, because we have corrected by the disinflation process, the disinflation effort will not appear in the regression, so the coefficients α_{ijk} are unlikely to suffer from spurious correlation.

The disadvantage is that the computation of impulse responses is much harder. In typical regressions we are only interested in the coefficients α_{ijk}. In general, they reflect the short run pass-through (α_{i1k}) and their sum across all lags is the long run pass-through of item *I* with respect to commodity *K*. In fact, it is usually the case that the plot the cumulative sum of these coefficients is what the researcher is trying to determine. In our case, these coefficients are the pass-through in addition to the effect the commodities have on the overall price index. Therefore, in order to compute the "correct" pass through, we have to add to the α_{ijk} coefficients, the coefficients of the impulse response of the aggregate regression (β_{jk}).

In that regression, we control for the disinflation (in that regression stochastic trends and the short term interest rates control for the disinflation effort).

$$\Delta \ln(P_t) = c_0 + \sum_{k=1}^{K}\sum_{j=0}^{L} \beta_{jk} \Delta \ln(c_{t-j,k}) + \varepsilon_t$$

Therefore, the actual impulse response is for item I until period l for commodity k (I_{ilk}) is given by

$$I_{ilk} = \sum_{j=0}^{l} \alpha_{ijk} + \beta_{jk}$$

One important point should be made. For countries with low and stable inflations running the regression on the item inflation as opposed to this two step procedure produces the same result. This procedure is advantages only if there is a disinflation process that adds noise to the standard pass-through regression. Having said this, our procedure will be used for all countries regardless of their inflation history. This will allow consistent comparisons across countries and items.

IV. Results

The first step is to describe the impulse responses for the pass-through estimates for every country in the data set, for some of the selected indexes that were constructed, and for the most relevant commodities. This first part of the section is mainly descriptive and therefore concentrates on the most salient features and common patterns in the data. The second step is to explain what drives some of the properties of the pass through. This section uses all the indexes and commodities and presents a regression analysis trying to identify the factors steering the differences across countries and sectors.

A. Impulse responses

We estimated the pass-through following the methodology described in the previous section. After the estimates are obtained we simulate a one percentage change in the price of the commodity (oil, wheat, etc) and depict the impulse response for each of the indexes we are interested.

This section is mostly descriptive and concentrates on three commodities: oil, wheat, and copper. Although we take the international prices as exogenous, it is important to clarify that the literature has said that in recent years, the first one is a very good measure of the demand for energy in the world, the second one is a very good measure of the growth of the demand in emerging markets, and the third one is a very good measure of the world aggregate demand. So, in the end when we compute the impulse responses we could be just computing how the economies react to these underlying shocks.

For presentation purposes, we split the countries in either four groups: Europe (which are all the countries in Western Europe plus the USA), Emerging Europe which are mostly countries from Easter Europe, Latin America, and Asia (that includes from Israel, India, China, to Japan); or into two groups Developed economies (which the figures still identify as Europe) and the rest of the world.

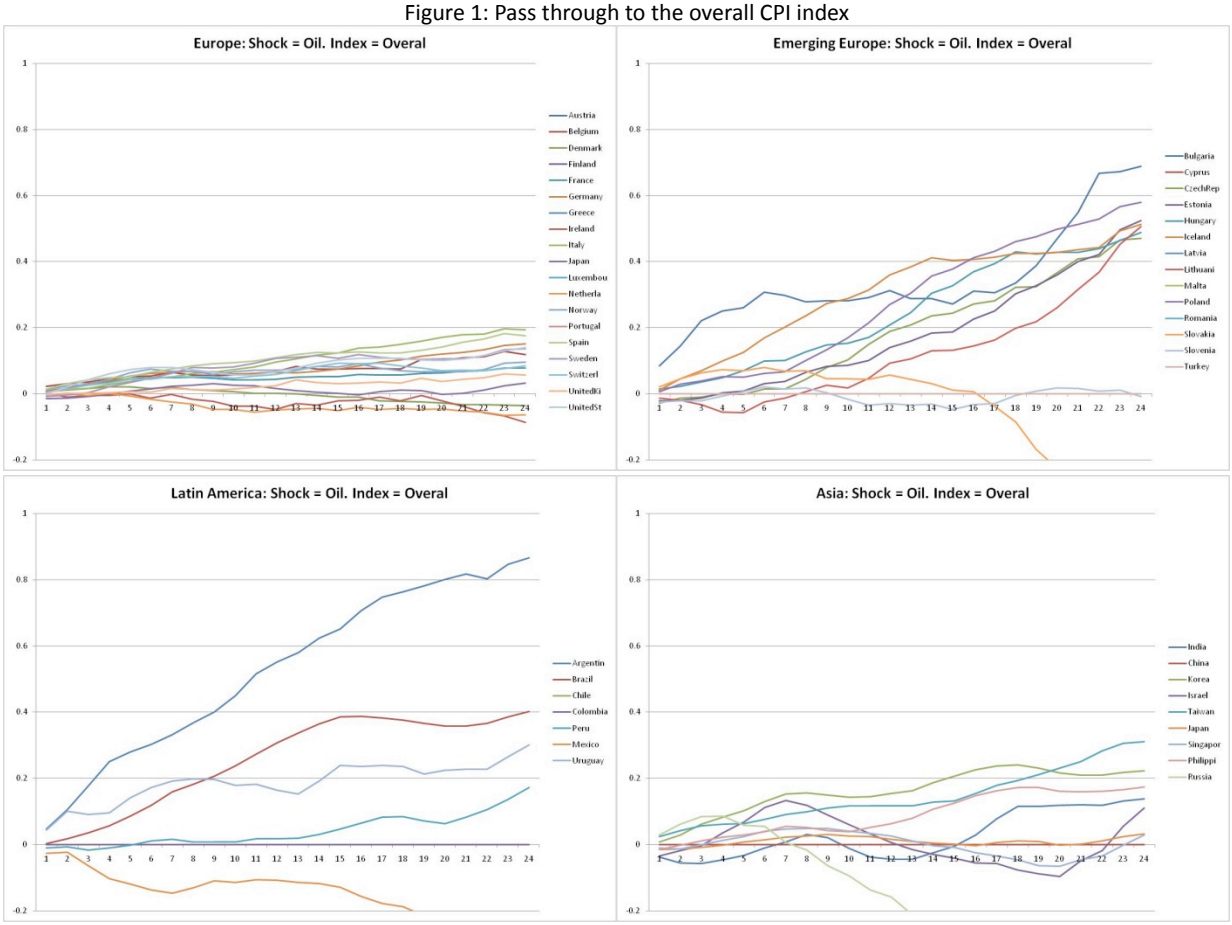
Finally, on the horizontal axis reflect the months in the impulse responses. We estimated the pass-through with 24 and 36 lags and the results are virtually identical. We are presenting here the estimated for the 24 lags specification. The impulse responses are estimated by accumulating the individual estimates.

1. Impact of Oil Price Shocks

The first step is to analyze the pass-through from oil prices to the overall aggregate price index. Remember that the price indexes have been detrended to take into account the disinflation efforts that have been underway in the past decade in Easter Europe. If the stochastic trend is not removed then an increase in oil prices implies a decline in the price level for countries such as Romania and Hungary.

In figure 1 we present the results from the estimation for the four possible groups. All the figures we present have the exact same vertical scale (from -0.2 to 1) meaning a -20 percent pass through to a maximum of 100 percent. We only present point estimates, and we present the path for each country within the groups. The title of every figure indicates the group of countries considered in the estimation, the shock, and the index.

Figure 1: Pass through to the overall CPI index



Several patterns arise from the figures that are worth highlighting. First, developed economies have a much smaller pass through and stable than other countries in the sample. All the pass-through estimates in the long run are below 20 percent, and are around 10 percent on average. Compare these estimates with Emerging Europe or Latin America, where the impulse responses usually reach long run pass-through much larger than 20 percent. Asia is in the middle where the average would be indeed 20 percent. Just for clarification, the interpretation of these coefficients is as follows. Assume there is a permanent increase in the price of oil of 10 percent, then the CPI in most developed economies will increase by roughly one percent 2 years ahead, by 2 percent on most Asian economies, and by more than that in the rest of the world.

Second, the speed of convergence to the long run pass-through is very different. Assume that we define the half life of the impulse response as the first time the impulse responses crosses half of the value of the long run pass-through. This is the equivalent of the half life estimated for AR decaying processes, except that here the decay is toward the long run pass-through. Notice that the developed economies are very slow. After one year, of the shock they are still not reaching half the long run effect. On the other hand, Latin America is the fastest.

The long run pass-through sometimes is badly estimated – because is the estimate of 24 lags. And it is always the case that estimates in the midpoint are of better quality. An interesting statistic to compute in

the impulse responses is the maximum of the impulse response; which sometimes occurs on month 24, but likely occurs before that. For the maximum we can compute the pass-through and its half life as well. In the appendix we present tables with the estimates of the maximum pass-through and the half lives country by country. For the CPI there is no difference, but as we will discuss in the subsequent indexes, it does make a difference for some of them.

Having analyzed the impact of oil prices on the overall index, the next step is to compute the impact of oil on the average price of gasoline, or fuels (whatever was provided).

Figure 2: Impact of oil prices on gasoline

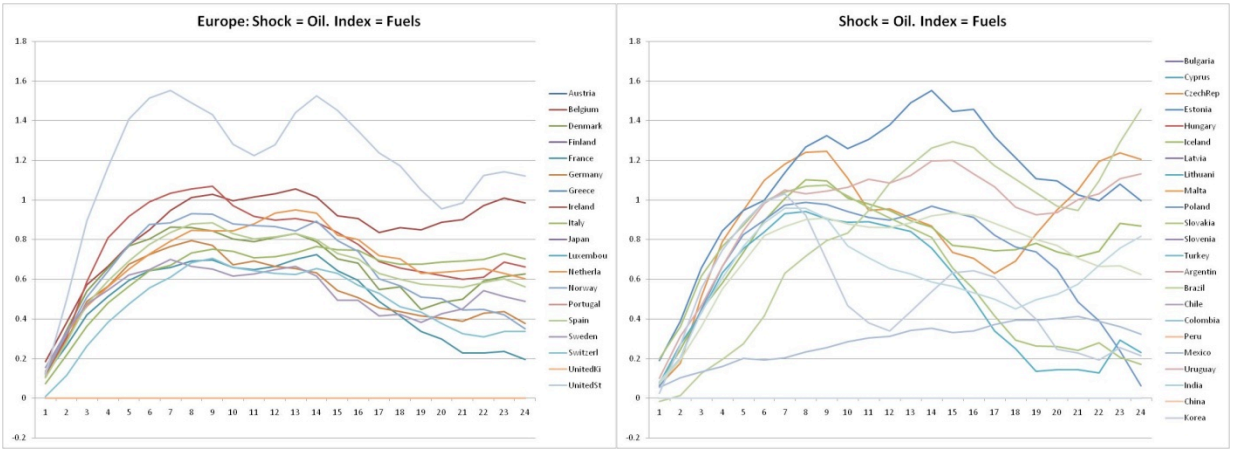
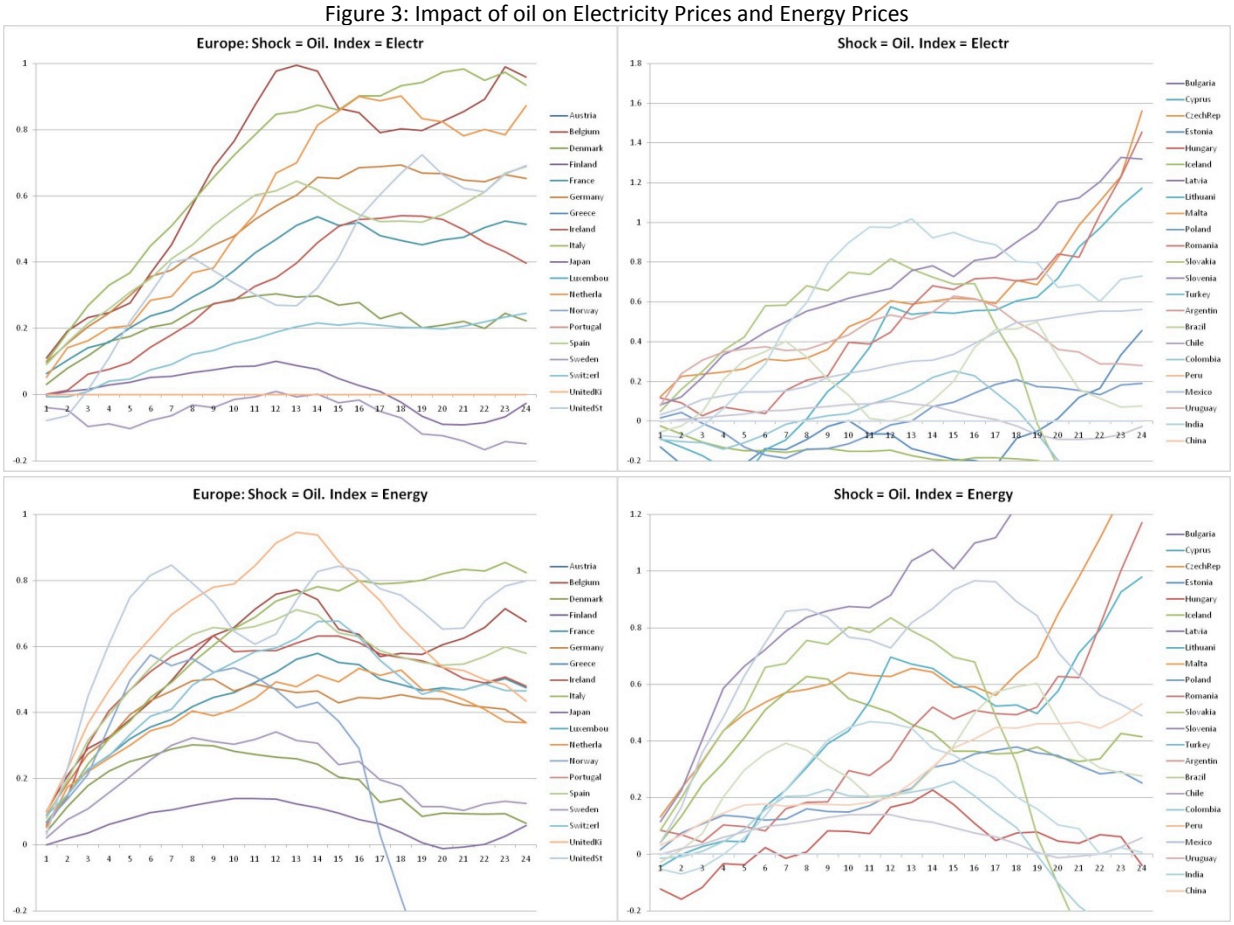


Figure 2 presents two panels, the developed economies (mostly Europe) and the developing ones. The pass-through to gasoline is remarkably stable across countries in developed economies. The pass through always picks around 9 to 12 months, and then stabilizes or declines. Also, the overall impact is very similar across countries. And importantly, the impact is very large. At the pick the pass-through ranges from 60 percent to 100 percent: which means a 10 percent increase in the price of oil implies a 6 to 10 percent increase in the price of fuels at the pump.

Emerging markets have a much noisier estimate, but the pattern is very similar to the developed economies. Part of the noise is the outcome that in developed economies the de-trending plays no role, while in most emerging markets the de-trending of the overall index does play a role in the estimates of the individual pass-through. Nevertheless, the messages are similar. The pass-through picks at 9 to 12 months, it stabilizes or comes down since that point, and it is around 100 percent pass-through. There are exceptions, of course, but the similarities are striking. These are countries with very different market structures for the distribution of gasoline, extremely different tax systems for gasoline, some are importers and some are exporters, and the weight on gasoline consumption is extremely different across countries. Still, after going through all the filters, the impulse responses convey similar messages.

Here it can be appreciated the different conclusions that would arise if we were to concentrate on long run pass-through as opposed to the maximum.

Figure 3: Impact of oil on Electricity Prices and Energy Prices



The next step is to look at the price of an energy index. We first look at the relationship between the price of oil and the price of electricity, and then we construct an index that includes all energy sources – gasoline, fuels, electricity, coal, etc. any item that is energy related was included in the energy index.

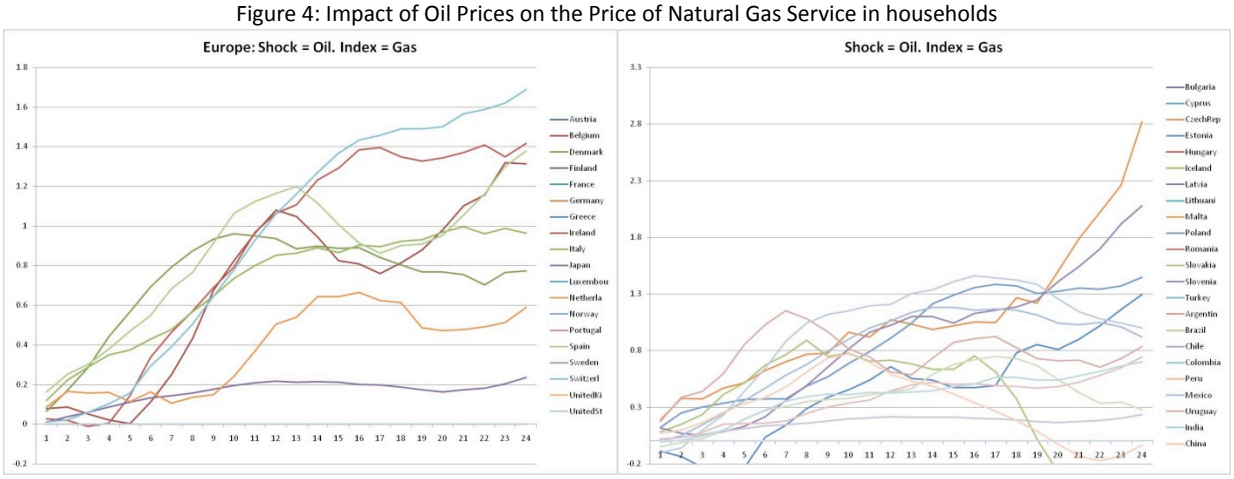
The impact of oil on electricity has less clear patterns than the ones we found before. Notice that, for example for developed economies, in some countries the pass-through is extremely large – one to one – while in others is small – 20 percent or less. The speed of convergence seems to be similar across countries but the long run pass-through is very different. One explanation for this patter is that electricity regulation might be very different across countries, and also the alternative sources of electricity might also be very different. In other words, oil and other fuels might be the marginal kilowatt of electricity is some countries, but not in others. The fact that there are different substitutes, and degrees of substitubility, across countries implies that the long run pass-through is likely to be also different.

For the rest of the world two patterns can be detected. For some countries the pass through is a "version" of the developed economies, but for others the price of electricity continues increasing for a long time. Interestingly the four countries experiencing long run divergence paths are Czech Republic,

Lithuania, Romania and Slovenia. These countries have very few observations for electricity and energy and it is possible that this is the outcome of small sample biases. Nevertheless, if the pattern continues it might be interesting to understand what is the market structure and regulation in those countries that is producing such large and persistent pass-through.

The second set of panels in Figure 3 show the impulse response path of the energy index. As can be seen, it is very close to the price of electricity. It is not identical, of course, but the same patterns arise. There are long run differences that probably indicate the market structure and the type of substitutes that exist.

Figure 4: Impact of Oil Prices on the Price of Natural Gas Service in households

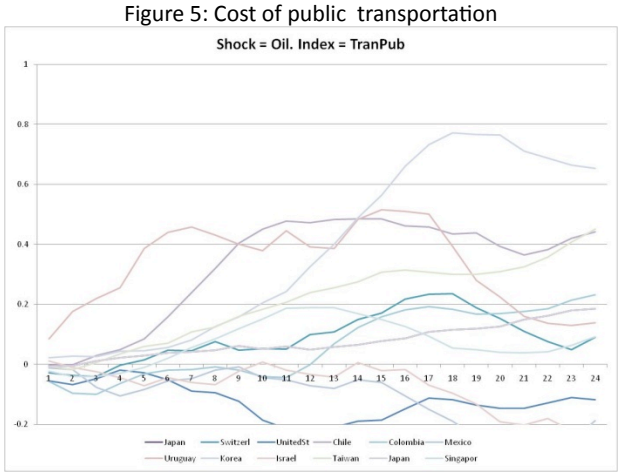


One ingredient of the energy index is the price of natural gas service to households. There is always the perception that oil price increases drive the price of household services up. Although the price of this item was not reported for all countries, some of them do have information.

In Figure 4 we present the impulse responses of the natural gas service to oil price shocks. The developed economies have relatively long data series, while the rest of the world is very short – hence, not a lot of weight should be put on the second panel responses. Nevertheless, the pass-through from oil to gas services is very large. The median maximum response in all the economies is more than 100 percent. The response is also very slow, and most countries achieve the pick after a year and a half of the shock; indicating that it takes quite some time to the price of oil to trickle down to the price of natural gas service.

In Figure 5 we present the cost of public transportation. Very few countries actually report these prices and therefore very few were included. In any case, every country that has some information was included in the regression.

Figure 5: Cost of public transportation



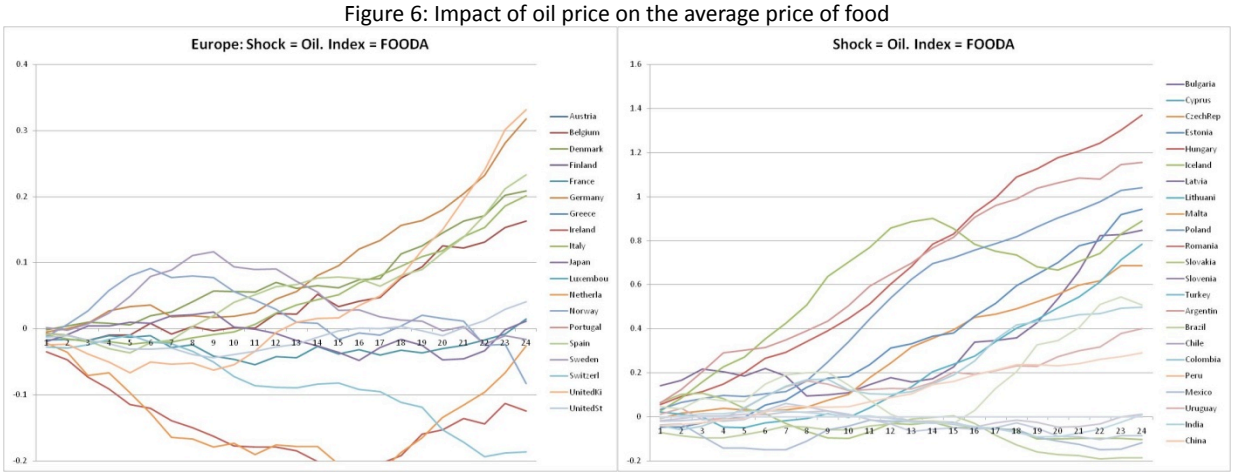
Notice that the pass through is slow and relatively large for the countries reporting. It is possible that the countries reporting transportation prices are those in which transportation prices are very sensitive in general – hence the authorities tend to pay more attention to them. In any case, it is interesting that the typical maximum pass through is about 40 percent for most countries.

Another dimension that is commonly argued on how oil prices affect inflation is through food prices. The intuition is that oil prices increase the price of transportation and therefore the price of food at retails. As we highlighted above the price of public transportation is rarely disclosed (at least to me) by the statistical offices and the price of private transportation is even less reported. However, the price of food is reported by all. So, we compute the impulse response from oil to food prices to evaluate the inflation "caused" by oil affecting transportation and everything else.

The results are presented in Figure 6. Let's start by discussing the emerging markets first. The pattern of the pass-through is certainly very interesting. All countries exhibit an almost straight line – which also looks very similar even when 36 lags are introduced. Countries have different long run pass-through, however. In this case, long run is probably a misnomer. We cannot use more than 36 lags in the regression. However, the "final" effect is very different across nations. Interestingly, the pass-through is very large for some countries. Again, this is likely to be determined by the use of oil and fuel in the transportation of food, as well as on the types of alternative sources of transportation.

For the developed economies, Belgium, Denmark, Germany, Italy, Spain, and UK have relatively large pass-through (around 20 percent), while the rest of the countries it is close to zero. It is important to mention that in this case the estimates are not statistically different from zero, therefore, nothing huge should be raised about the patter.

Figure 6: Impact of oil price on the average price of food



In any case, the important point is that emerging markets suffer a significant pass-through, while developed economies have no impact, and for the few that have some, the effect is rather small.

So far we have used the price of oil in domestic currency. In other words, in all the previous regressions we have used the price of oil internationally times the exchange rate. This implies that we are measuring the destabilizing and stabilizing role of the exchange rate already in the prices. Although this is not the aim of the present paper, we thought it was illustrative to show at least some estimates when the exchange rate is excluded from the analysis. Instead of repeating all the previous figures (that can be provided if desired) we only present the CPI responses

Figure 7 presents the response of the CPI to the dollar price of oil. Compare these responses to the responses in Figure 1. First, the long run pass-through is much more different across countries and large for developed economies. Before the average pass through was below 10 percent, and all responses were relatively small, here now we have countries experiencing pass-through above 50 percent. The same can be said about the responses of emerging markets.

Second, the impulse responses are much noisier and the half lives much shorter, indicating faster convergence rates toward the long run pass-through. In the empirical analysis in the following section we spend some time studying the impulse responses from the dollar prices – in general the reactions are always noisier and larger. In other words, for most countries the exchange rate in general offers some stabilization to the external shock.

Figure 7: Impact of oil prices on the CPI when the exchange rate is not taken into account

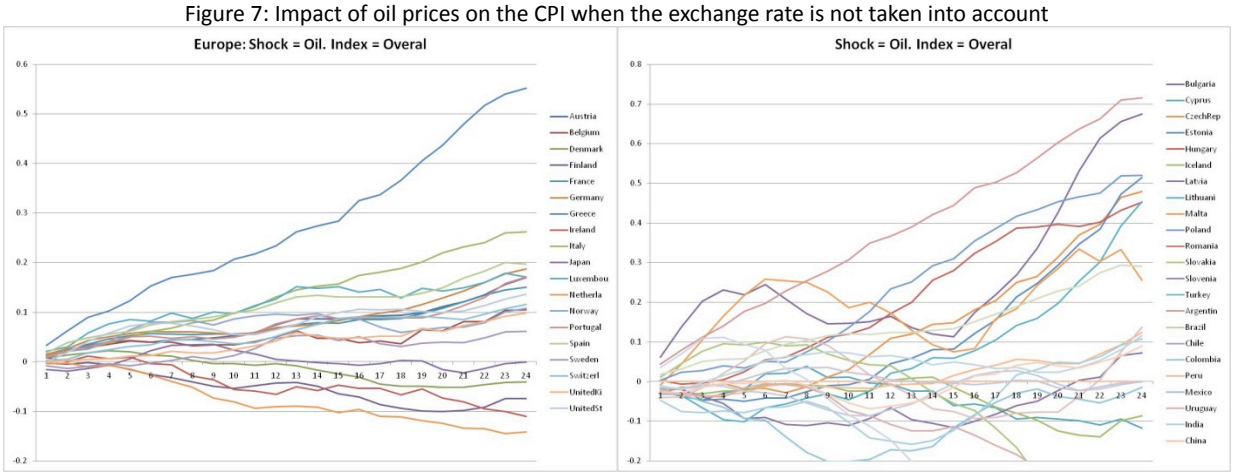
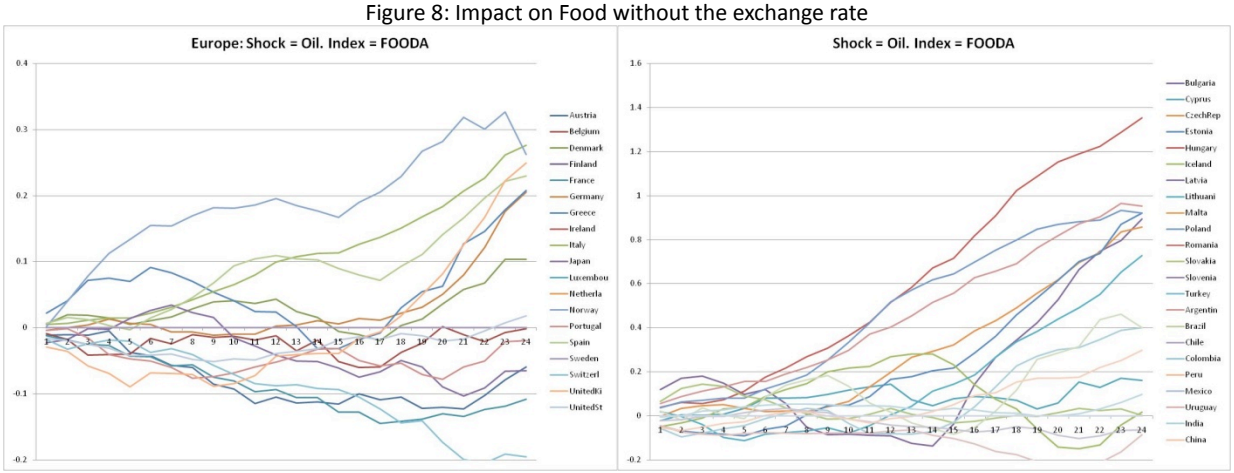


Figure 8 presents the impact on the average price of food. The exact same observations can be made in that index as well.

Figure 8: Impact on Food without the exchange rate



2. Impact of Wheat Price Shocks

Having spent the first subsection on oil, this section devotes its attention to the price of wheat. We will not present as many figures as in the case of oil, and mostly concentrate on a different set of indexes. This subsection has several messages worth highlighting at the onset. First, contrary to the case of oil in the case of wheat, running the regressions using the dollar price or the domestic price produce very similar results. The intuition is very simple if we understand that oil prices have a significant effect on the exchange rate, while wheat has a negligible effect on the exchange rate. Except, of course, for a couple of countries that are heavy wheat producers. In the right hand side of the pass-through regression we have the log price inflation rate of the commodity price. If the exchange rate is independent of the price of wheat then including or not the exchange rate on the right hand side is like including or not an orthogonal regressor. In the end, the impact is independent. The second point we present is the very slow moving effect that wheat has on everything in the economy – from the average price of food, to the price of bread.

Figure 9: Impact of Wheat prices on CPI

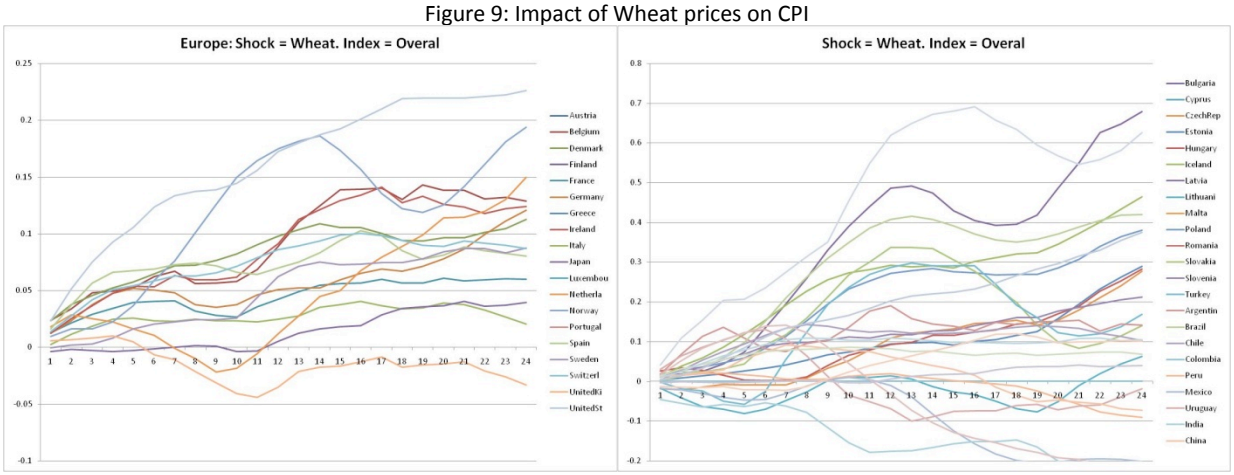


Figure 9 and Figure 10 present the impulse responses of CPI to a permanent price increase of wheat. Figure 9 is the pass-through when the price of wheat is computed in domestic currency, while Figure 10 is the pass-through for the dollar price.

It is very easy to realize the similarities in the two figures. In fact, the point estimates almost look identical – except for some minor exceptions.

The long run pass-through is very significant for developed economies – in the range of 10 to 20 percent. This implies that the price of wheat is not only capturing supply disruptions in wheat but also price increases due to aggregate demand. In other words, an increase in the world demand of wheat, increases its price and the price of all items.

Another interesting aspect is the delay in the pass-through. It takes 1 ½ to 2 years for almost all countries to incorporate the price effect into the CPI.

Finally, estimates for emerging markets are noisier, but in the end the message is similar: slow incorporating pass-through, and very large pass-through. Again, this second effect might be the outcome of partially capturing the demand effect. The next section we will discuss the case of copper. During this sample copper prices reach tremendous highs, mainly driven by demand increases. We will see in those environments that the pass-through is very large, and can only be explained by increases in the aggregate demand.

A note on solving the problem of endogeneity in commodity prices: this is a long and standing question in the literature – how to disentangle supply disruptions with demand push. Oil has had several supply disruptions that are easily seen and reported by news outlets – and in fact, as Hamilton has shown in several papers it is almost always the case that hi pick increases are due to supply disruptions. Wheat, in recent years had a combination of the two. Certainly there where important weather patterns in the mid 2000's that created less supply of wheat in the world, but clearly the increase in prices was due to a heavy demand – especially coming from emerging markets. Copper, has had very few supply disruptions

in the last 15 years – and therefore, that explains why the movement in prices have been associated with changes in the demand. This problem is extremely difficult to solve and is beyond the scope of the present paper. The purpose is to present the reduced form estimates and try to make sense of them, leaving the questions of disentangling the sources of shocks and channels to future research.

Figure 10: Impact of Wheat prices on CPI without the exchange rate effect

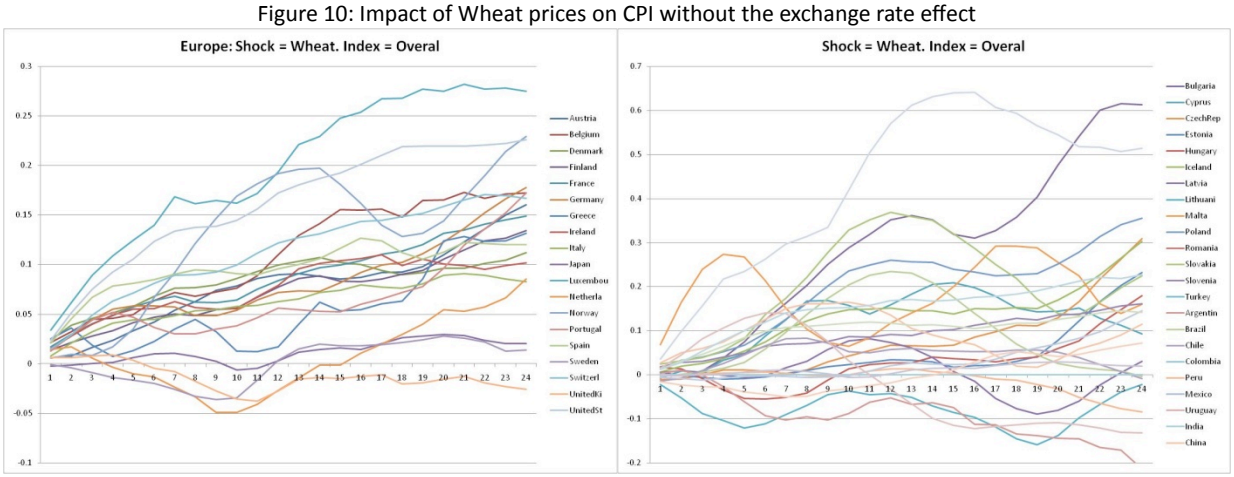


Figure 10 presents the estimates using the dollar price. Notice the tremendous similarities with the previous figure.

Wheat is a significant component of food, and also is associated with the demand for food. Hence, evaluating the pass-through from wheat prices to the food index reflects the strength of these channels. Figure 11 presents the results of the pass-through from wheat to food. We use the local price of Wheat in these regressions.

First, there is a relatively large pass-through in developed economies, and a very large long run pass through for emerging markets. One is close to 20 percent, while the other is close to 100 percent. It is hard to rationalize these estimates if we are thinking about a supply shock to wheat. These numbers have to take into account that an increase in the demand for food increases all food prices, and by transitivity increasing the price of wheat.

Second, the pass-through is very slow moving – again as in the case of the CPI it takes almost the whole sample to reach the long run pass-through. As in the case of Oil, the estimates of the half lives and maximum pass-through are presented in the tables in the appendix.

Figure 11: Impact of Wheat Prices on the Average price of food

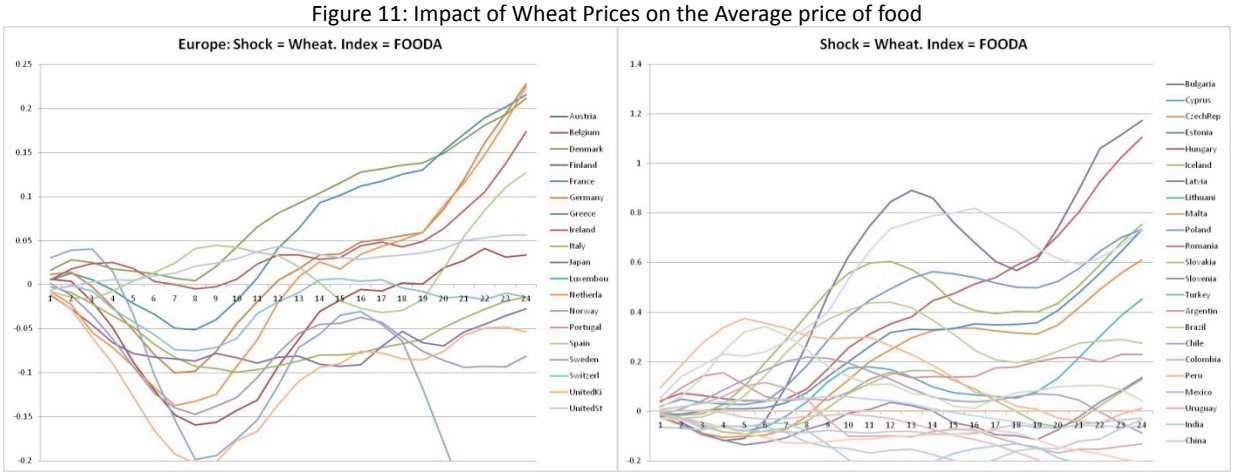
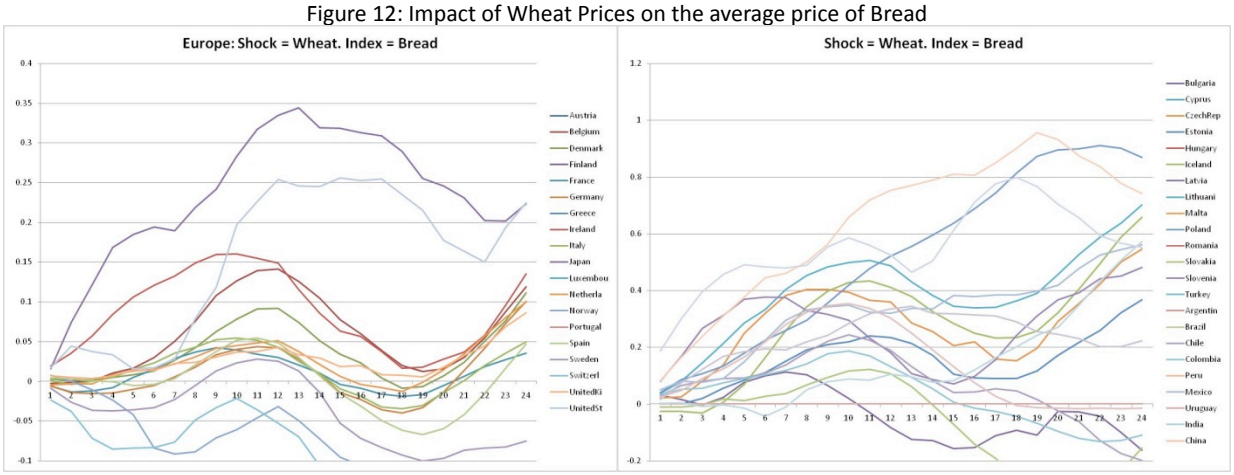


Figure 12: Impact of Wheat Prices on the average price of Bread



Instead of looking at the price of food we can concentrate on the price of bread, cereals and flour. Not all countries report the price of bread, but combining bread cereals and flour in a single index we were able to include several countries in the analysis.

The pass-through results are presented in Figure 12. Notice that the pass-through moves much faster than CPI or food. In fact, for developed economies the pass-through are much smaller – the maximum for all countries except 2 is 15 percent. Similarly for emerging markets, the maximum is around 60 percent (except for 4 or 5 countries).

Second, the maximum occurs much sooner than food and CPI. In fact, in most cases, the price reaches its maximum in month 8 to 12, with half-lives of less than 6 for almost all of them. In other words, prices of bread are reacting very fast in comparison to food and the CPI in general.

3. Impact of Copper Prices Shocks

Having discussed the case of oil and wheat, we decided to devote some time to the case of copper. The reason is that the price of copper can be interpreted as world demand, as opposed to supply disruptions

in copper. So, even though we will run the regression using the copper price we can interpret these impulse responses as consumer demand increasing.

Figure 13 presents the impact of copper on the CPI. We also present the impact on Energy, Clothing, Communications, Electricity and other household services, and Housing. These are figures 14 to 18 (all presented below).

Figure 13: Impact of Copper on the CPI.

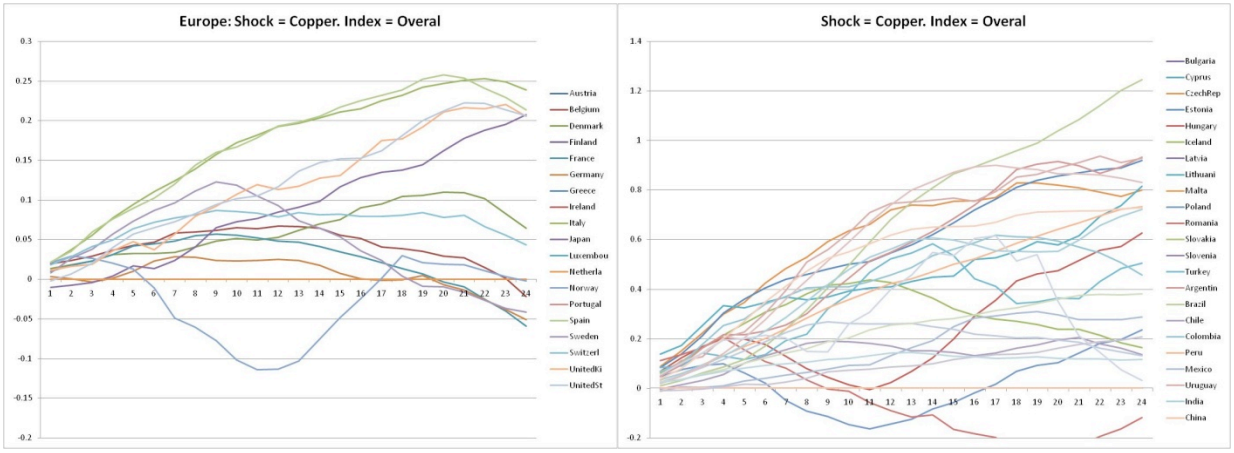


Figure 14: Energy

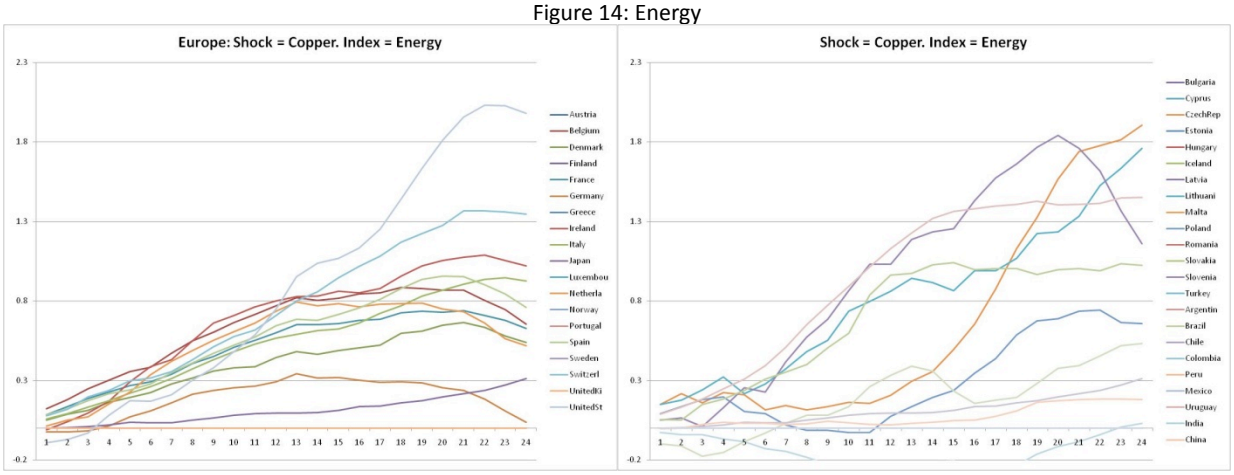


Figure 15: Clothing

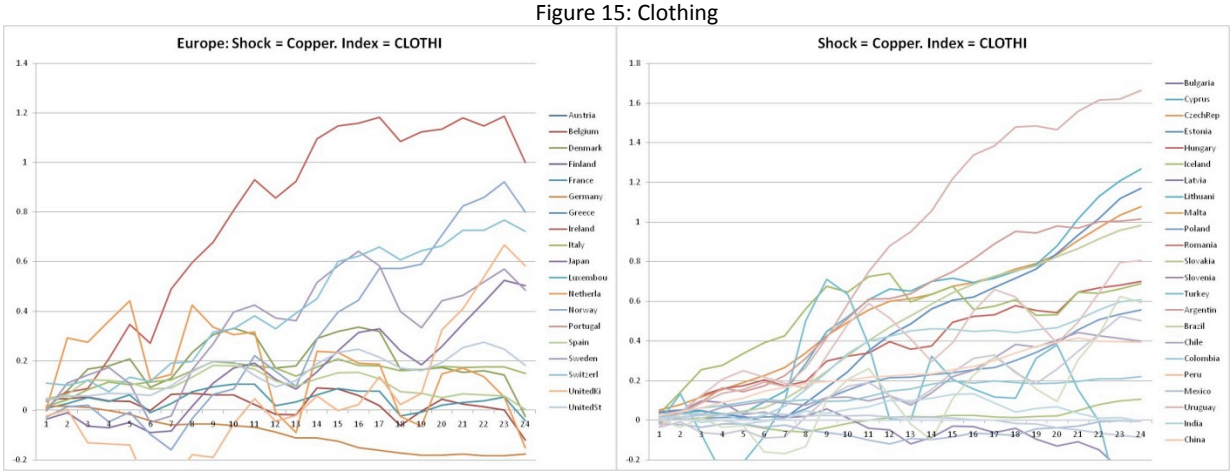


Figure 16: Communications

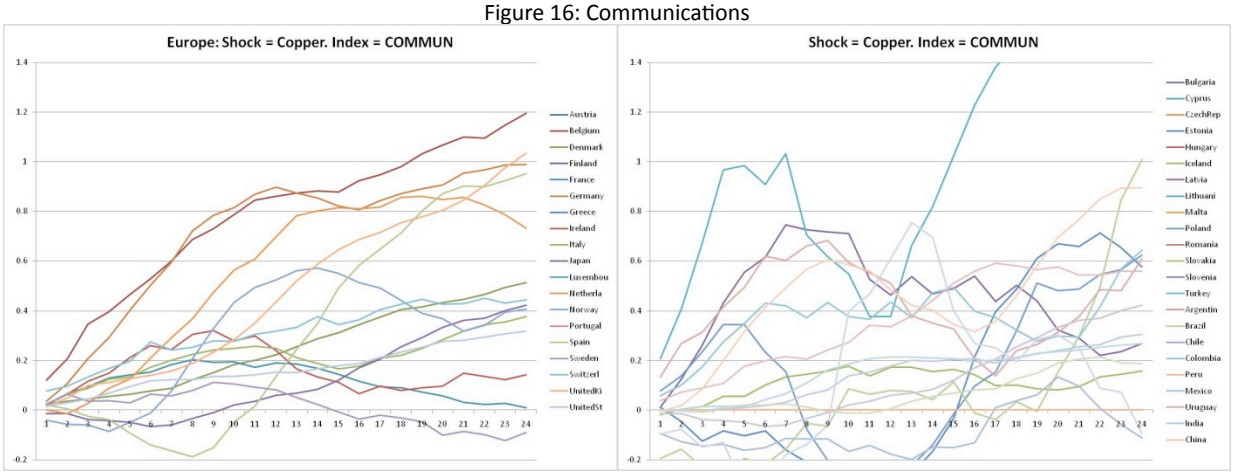


Figure 17: Electricity

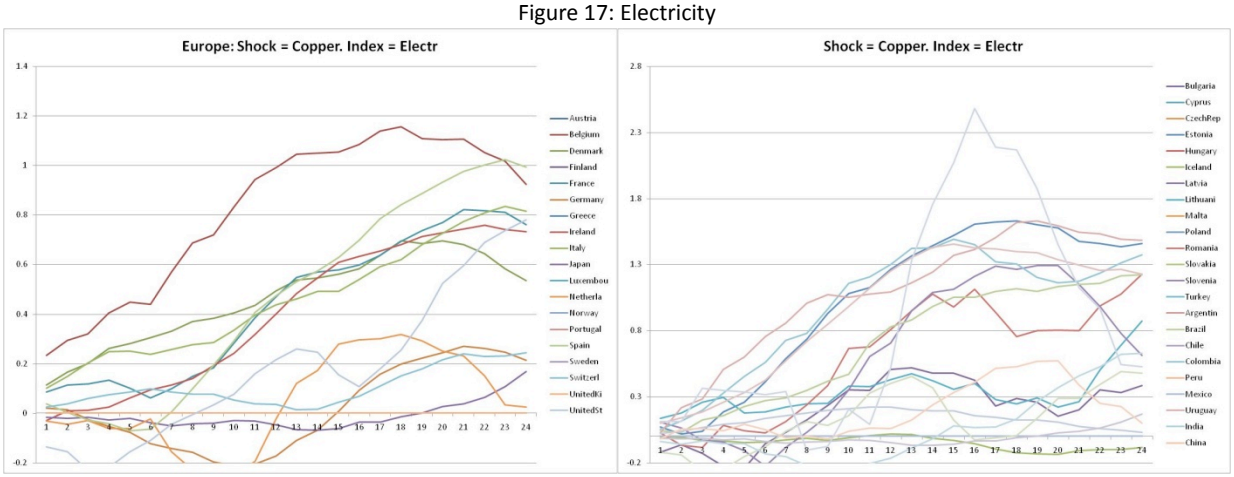
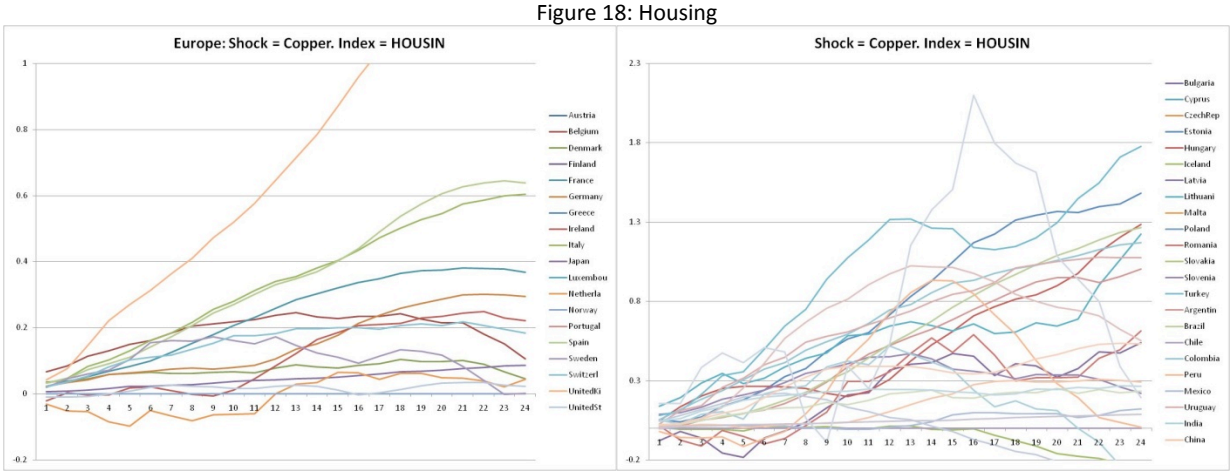


Figure 18: Housing



Independently of the index chosen we can detect several interesting patterns. In developed economies pass-through estimates are very slow. This is similar to the implications we would have obtained from estimating monetary policy shocks in these economies. Prices always tend to move slowly reaching the long run equilibrium two years later. All the figures show the same characteristics, or convey the same message.

A demand shock (copper) to these economies implies an increase in prices that takes roughly 20 to 24 months to be incorporated fully. From all the sectors, energy moves the fastest, while housing and communications move the slowest.

Emerging markets have much noisier estimates – again a product of the "cleaning" of the disinflation effort – but they seem to move faster than the developed economies. The same pattern arises: energy is the fastest and housing the slowest.

The second dimension is the level of the pass-through. As has been a common theme in this discussion, the pass-through to developed economies is much lower than developing economies.

For developed countries, the pass-through to the CPI is about 20 percent (the maximum), while it is 80 percent for energy, 60 percent for clothing, and 40 percent for housing. For emerging markets the all move about 100 percent!

B. Regression Analysis and Variance Decomposition

The previous section has described the impulse responses in the data. It highlights some of the interesting features and cross country comparisons. However, it is mostly a description of what occurs. In this section we want to go further and try to understand the factors determining the cross country similarities and differences.

In this section we would like to perform a variance decomposition trying to understand which factors describe the responses. For example, is it country characteristics or sectoral properties what drive the

impulse responses we observe. In order to do so we proceed in the following manner. We describe the impulse responses by four statistics. The first two are related to the pass through: The level of the pass-through in the long run, and the maximum pass-through in the impulse response. The other two are related to the speed at which the pass-through is achieved: the half life to the maximum and the long run pass-through.

The exact definitions are the following. For each impulse response, the long run pass-through is the level of the pass through that prevails in period 24 (which is the longest lag we computed in the previous section). Of course, there is a confidence interval for the estimate and we also compute it. The half life for the long run pass through is computed as the number of months that take the impulse response to reach half of the long run pass-through level. We look at the first time the impulse responses crosses the threshold. This is a measure of how fast the economy converges to the long run. Of course, there is also a confidence interval in the estimation of the half life – which needs to be computed by bootstrapping the residuals (more on this below). The other measures instead of computing the long run pass-through compute the maximum of the impulse response. The maximum usually occurs before month 24 and in general it is much better estimated – in the sense that the confidence interval is tighter. Finally, the half life to the maximum is computed in a similar fashion as the long run half life: we find in which month the impulse response reaches half of the maximum for the first time.

The computation of the confidence intervals requires the use of bootstrapping. To simplify the description of the methodology let's assume there is no aggregate disinflation. The idea is the following: Estimating the MA specification

$$\Delta \ln\left(P_t\right) = c_0 + \sum_{k=1}^{K}\sum_{j=0}^{L}\beta_{jk}\Delta \ln\left(c_{t-j,k}\right) + \varepsilon_t$$

Provides estimates of c_0 and β_{jk}. From this estimates we compute the impulse response as a simple sum of the β_{jk} for a given *k*. In that impulse response we compute the long-run pass through, its half life, the maximum and its half life. Because the residuals are supposed to be i.i.d., we bootstrap the residuals and using the original estimates of the coefficients we create a new series of $\Delta \ln\left(P_t\right)$. We re-estimate the coefficients using the constructed series – which provides another long run pass-through, maximum, and half lives. We repeat the procedure 500 times and obtain a distribution of our four statistics. We do that for each series, each country, and each commodity shock.

In practice we have another layer of estimation – which is the aggregate index – but the intuition is similar. The idea is to get a series of estimates for the aggregate and each relative price and construct our four statistics on the impulse responses.

Having estimated the statistics and their respective confidence intervals, we are ready to run a simple regression in which we disentangle the country and sectoral explanatory power. Because countries and sectors are not independent variables – they are not orthogonal in the data – the variance

decomposition cannot proceed in the usual manner. To clarify the estimation lets concentrate on the maximum pass through.

Assume we are have the estimates of the maximum for country *c* and sector or index *I* (denote them by) for an oil shock. In other words, are the estimates for every country and every sector that has valid data to an oil shock. For each one of these estimates we have their distribution – whose standard deviation we use to correct the estimation. The first step is to compute how much the country fixed effect explains. We estimate a simple regression of on country dummies.

$$m_{ci} = c_c + \varepsilon_{ci}$$

Where c_c are the country dummies. In the estimation we use the standard deviation of the estimates of m_{ci} to correct for the heteroskedasticity. In other words, if one m_{ci} is extremely badly estimated we want to put very little weight on that observation. The Rsquare of this regression is actually the explanatory power of the country dummies. In fact, this is the highest possible explanatory power we can give the countries.

In the second step, we add to the regression the sectoral dummies

$$m_{ci} = c_c + c_i + \varepsilon_{ci}$$

Where c_i are the sectoral dummies (we leave the aggregate index without a constant). Notice that now the R-square of this regression is the explanatory power that both the sectors and countries have. By subtracting the previous R-square from this one we obtain the contribution of the sectoral effects. Obviously, this procedure maximizes the explanatory power of the country effects. Doing the reverse order would have maximized the sectors effect. The results are different, but the qualitative message is the same – in the end the sectoral effects are quite significant. We will highlight this general message, and therefore, in this presentation only the results from the procedure that maximizes the country effect is presented – that is the most negative one for the point that is emphasized.

In the next table the variance decomposition for the impulse responses from the commodities in local prices is presented. Several commodities are analyzed: oil, rice, maize, wheat and copper. For each statistic, maximum pass through, maximum half life, long run pass through, and long run half life, we present the contribution of the country fixed effects (first column), the sectoral fixed effect (second column) and the total. For each commodity we run a separate regression.

TABLE 2
Variance Decomposition of Country fixed effect, and Sector fixed effects.
Commodity prices in local prices

Commodities in Local Prices						
	Max Pass Through			Max Half Life		
Shock	Country	Sector	Total	Country	Sector	Total
Oil	36.2%	25.4%	61.6%	33.9%	16.8%	50.7%
Rice	21.8%	32.1%	53.9%	8.3%	21.9%	30.2%

Maize	47.9%	15.5%	63.4%	20.2%	14.4%	34.6%
Wheat	49.4%	15.4%	64.8%	20.1%	14.8%	34.9%
Copper	16.5%	41.0%	57.5%	10.9%	27.8%	38.7%
		LR Pass Through			LR Half Life	
Oil	22.7%	29.1%	51.8%	32.5%	17.5%	50.0%
Rice	22.0%	27.5%	49.5%	7.8%	18.5%	26.2%
Maize	40.1%	13.6%	53.7%	24.2%	18.8%	42.9%
Wheat	39.1%	15.2%	54.3%	23.8%	19.7%	43.5%
Copper	8.5%	37.9%	46.4%	11.1%	29.0%	40.1%

We first study the impact of the commodity in local currency – hence the effect of the exchange rate is included – and in the following table we present the results for the dollar price of the commodities.

Several points are worth highlighting. First, the overall explanatory power of the fixed effects is quite significant for pass through. Roughly 50 to 60 percent of the variation is accounted for the fixed effects. For the half lives, however, the average explanatory power is about 30 to 40 percent.

Second, sectoral fixed effects explain a significant proportion of the variation. My prior was that country effects was going to swamp all the variation. My intuition was that the pass-through depended on monetary and fiscal policy reactions, as well as degree of competition, institutions, credibility, degree of stickiness, etc. Most of the literature has highlighted how different these effects are across countries, and how different the pass through estimates are. Hence, I was expecting a very small percentage of the variation to depend on sectoral characteristics – after taking country effects out of the picture. The results prove wrong this intuition. Even after controlling for country effects the sector effect is more than 15 percent – which means that 1/3 of the explained variation is at least explained by the sectoral effect. For copper and oil the effects are even larger – for these commodities the sectoral effect on the pass-through is at least half of the total explained variation.

Third, even more surprising is the fact that for all commodities the sectoral effect is almost always ½ of the explanation for the half lives. In other words, irrespectively of how we measure the speed of the pass through – long run or maximum – the sectoral effect is about ½ of the total explained variation. In fact, in the decomposition for the long run it is always more than half the explained variation.

What is the interpretation? My reading of the evidence is that the dispersion of pass through within an economy is mostly explained by characteristics that are “natural” to the sectors; use of the commodity in the production, procedures and channels of distribution, “natural” markups of the sector, “natural” substitubility of the items, etc. These factors are constant across countries. In general, we assign a significant proportion of the pass-through behavior to country characteristics – inflation, monetary policy, fiscal policy, degree of competition, taxes, etc. certainly these factors are important. By no means am I dismissing their role. But this cross country comparison is allowing us to have a different view of the problem and realize that several important determinants of pass-through have not being considered enough in the literature – and policy and practical work.

TABLE 3
Variance Decomposition of Country fixed effect, and Sector fixed effects.
Commodity prices in Dollars

Commodities in Dollars						
	Max Pass Through			Max Half Life		
Shock	Country	Sector	Total	Country	Sector	Total
Oil	27.0%	26.8%	53.7%	32.3%	17.0%	49.3%
Rice	24.7%	22.8%	47.5%	8.3%	19.1%	27.4%
Maize	55.4%	11.4%	66.7%	19.7%	18.0%	37.7%
Wheat	56.5%	11.8%	68.3%	19.6%	16.3%	35.8%
Copper	26.3%	27.1%	53.4%	29.8%	10.8%	40.6%
	LR Pass Through			LR Half Life		
Oil	18.4%	27.5%	46.0%	33.4%	18.8%	52.2%
Rice	23.4%	19.0%	42.5%	6.1%	20.8%	27.0%
Maize	50.8%	10.8%	61.5%	19.3%	20.1%	39.3%
Wheat	51.4%	11.3%	62.7%	20.5%	18.0%	38.6%
Copper	23.1%	23.8%	46.8%	24.4%	11.3%	35.7%

One interesting exercise is to leave the exchange rate out of the pass-through analysis. In other words, let's re-compute all impulse responses from the dollar price of the commodity and perform the same variance decomposition. The results are presented ion Table 3.

Notice that now the country fixed effect is much more important than the sectoral fixed effect. For some commodities, the country effect is above 50 percent of the va4riation, while the sectors explain about 10 percent. In fact, ion this exercise the sector effect is always less than 30 percent and for almost all the cases is between 10 to 20 percent. A much smaller percentage of the total variation, and a smaller share of the total explained variation.

This makes sense because indeed the reaction of the exchange rate – that for some countries is a stabilizing force, while for others is a destabilizing force – is clearly country specific. The variation is reflecting this very simple aspect. As a reminder, for some countries, a price increase in the commodity implies a depreciation, making the local price of the commodity to increase beyond the dollar shock – for other countries, the increase in the commodity price produce an appreciation (for most of the commodity producers) and hence, the local price increases by less than the international price.

One final point in this section is to justify why we used fixed effects as opposed to other variables. First, our exercise is entirely cross-sectional (cross-sectoral); hence, time variation plays no role. Second, it was impossible to find country variables that remotely approximate the explanatory power of the fixed effects. We tried several country variables – such as GDP, average inflation, financial development, quality of institutions, etc. in the end, the one that performed the best was GDP per capita. The results are presented in the following table.

TABLE 4
Variance decomposition for GDP per capita
Proportion of variance explained by income.

Commodities in Local Prices			Commodities in Dollars		
	Max PT	Max HL		Max PT	Max HL
Shock					
Oil	7.0%	4.0%	Oil	3.9%	4.3%
Rice	10.9%	0.3%	Rice	6.6%	0.6%
Maize	2.6%	0.0%	Maize	0.7%	0.0%
Wheat	2.4%	0.0%	Wheat	0.1%	0.1%
Copper	14.5%	1.8%	Copper	7.1%	0.1%
	LR PT	LR HL		LR PT	LR HL
Oil	6.0%	3.1%	Oil	2.4%	4.9%
Rice	8.7%	0.0%	Rice	4.3%	0.3%
Maize	1.3%	0.0%	Maize	0.0%	0.0%
Wheat	1.2%	0.0%	Wheat	0.1%	0.1%
Copper	12.1%	0.6%	Copper	3.6%	0.4%

Notice the tiny explanatory power of this variable. This is the maximum that GDP per capita can explain and it is a small fraction from what the fixed effects are explaining. This means that there are important country differences that are not captured – and not even correlated – with GDP per capita. And inflation, institutions, etc. It is not clear which variables should be included, but clearly, the ones used – even in tandem – are not enough.

Table 5 and 6 present a similar decomposition when a measure of the quality of democracy, and a measure of the quality of institutions (as represented by the index for the Rule of Law) is used instead of income.

Again, we are only presenting the variance explained by the variable of interest. Consistent with the results from the variance decomposition of income, the explanatory power of the institutional variables is very small. As in the previous case, the fact that country fixed effects explain so much, and it drops significantly to numbers well below 10 percent is an interesting finding that should motivate further research.

On the one hand, the fact that income is a much better proxy for the country fixed effects than institutional variables is an indication that the differences in pass-through are not related to contract enforcement or democratic institutions – obviously these are important variables in general, they are just not important enough in explaining pass-through behavior. Clearly further research should evaluate the monetary and exchange rate regimes, as well as other forms of regulation and trade practices.

Table 5
Variance decomposition
Proportion of variance explained by the Democracy Measure.

	Commodities in Local Prices		Commodities in Dollars	
Shock	Max PT	Max HL	Max PT	Max HL
Oil	0.1%	0.3%	0.1%	0.1%
Rice	2.0%	0.6%	1.4%	1.0%
Maize	0.1%	0.0%	0.4%	0.2%
Wheat	0.2%	0.0%	0.4%	0.0%
Copper	0.2%	1.4%	0.8%	0.6%
	LR PT	LR HL	LR PT	LR HL
Oil	0.2%	0.0%	0.0%	1.8%
Rice	2.1%	1.3%	1.2%	1.8%
Maize	0.2%	0.0%	0.8%	0.1%
Wheat	0.5%	0.0%	0.8%	0.1%
Copper	0.2%	0.3%	0.5%	0.0%

Table 6
Variance decomposition
Proportion of variance explained by the Rule of Law Measure.

	Commodities in Local Prices		Commodities in Dollars	
Shock	Max PT	Max HL	Max PT	Max HL
Oil	2.0%	2.2%	0.3%	2.0%
Rice	3.6%	0.3%	3.7%	0.0%
Maize	0.3%	0.6%	0.0%	0.0%
Wheat	0.2%	0.2%	0.0%	0.0%
Copper	5.4%	0.7%	1.7%	0.0%
	LR PT	LR HL	LR PT	LR HL
Oil	2.4%	0.5%	0.3%	4.5%
Rice	3.6%	0.5%	3.0%	0.3%
Maize	0.3%	0.1%	0.0%	0.0%
Wheat	0.3%	0.1%	0.0%	0.0%
Copper	4.5%	0.0%	1.2%	1.7%

V. Conclusions

The present paper has used unique micro price data to estimate the pass-through from commodity prices to items and indexes for several countries. This paper is mainly reporting some stylized facts found in the data regarding the type of impulse responses and argues that sectoral characteristics are a significant source of the observed variation in the data.

It should have been expected that countries respond differently to the different shocks; and that sectors respond differently across countries and commodities. Nevertheless, a third of all the explained variation is driven by sectoral characteristics. Most of the literature has disregarded this dimension. This is due to several reasons: first, for a given country it is rare to compute pass-through to different sectors. Second, rarely, we compare pass-through across two countries, and when that has been done it has been performed on the aggregate CPI. Therefore, the decomposition presented here could have not been performed. Because the analysis in the literature has been either one country at a time, or several countries but one sector at a time, the implication has been that country differences is what dominates the discussion. The results presented in this paper are challenging this common approach. This is a first step and certainly future research should continue to look into this decomposition further.

The second innovation in this paper is that instead of using exchange rates as the source of shock we have used commodity prices. This is interesting by itself, but the reason is that for most of these countries the movements in commodity prices is exogenous to local characteristics.

Although this is advantageous, there is one important challenge that commodity prices entail. It is difficult to understand how much of the shock is due to supply disruptions of the commodity and how much due to world demand. We study three commodities that clearly have different degrees in this mixture. Oil, although it has a strong demand component, supply disruptions are very frequent and important short run movement is due to clashes in Venezuela, Nigeria, and the war in Iraq. Wheat, has had some supply disruptions in the last 10 years due to important weather patterns, however, the price of wheat increased considerably due to excess demand in emerging markets. Finally, copper is perhaps the commodity that has suffered less supply problems in the last 15 years and therefore, its price can be considered mostly world demand. The distinction between wheat and copper in terms of demand, is that wheat is mostly demanded in food or processed food – something likely to increase by India and China increasing its consumption – while copper is lead by electronics and high end manufacturing products – something likely to be driven by excess demand in rich nations.

In this paper we have not disentangle the sources of the commodity price movements. Indeed, solving the problem of endogeneity is not trivial at all. Future research should look into this and incorporate the disentangling of the supply versus demand shocks into the present pass-through analysis.

VI. Tables

TABLE A1
Estimates for Oil Shocks on CPI Index
Oil in local currency

	Max	HL (max)		Max	HL (max)
Belgium	13%	7	Iceland	51%	9
Denmark	2%	2	Lithuania	51%	20
France	8%	5	Poland	58%	13
Germany	15%	16	Slovakia	8%	2
Ireland	0%	1	Slovenia	2%	6
Italy	20%	13	Argentina	87%	10
Japan	3%	7	Brazil	40%	9
Netherlands	0%	2	Peru	17%	22
Norway	10%	5	Uruguay	30%	6
Spain	18%	10	India	14%	17
Sweden	14%	8	Korea	24%	6
Switzerland	9%	7	Israel	13%	5
UK	6%	13	Taiwan	31%	17
USA	14%	5	Japan	3%	7
Bulgaria	69%	19	Singapore	5%	5
Czech Republic	47%	14	Philippines	17%	14
Estonia	52%	18	Russia	9%	2
Hungary	49%	13			

TABLE A2
Estimates for Oil Shocks on Energy Index
Oil in local currency

	Max	HL (max)		Max	HL (max)
Belgium	77%	6	Czech Republic	146%	20
Denmark	30%	3	Hungary	23%	12
France	58%	5	Iceland	63%	4
Germany	50%	3	Lithuania	98%	11
Ireland	63%	4	Poland	38%	12
Italy	85%	6	Romania	117%	20
Japan	14%	5	Slovakia	83%	4
Netherlands	53%	5	Slovenia	181%	12
Norway	57%	4	India	26%	6
Spain	71%	4	Korea	97%	4
Sweden	34%	5	Taiwan	60%	6

Switzerland	68%	6	Japan	14%	5
UK	95%	5	Singapore	47%	8
USA	85%	3	Philippines	53%	14

TABLE A3
Estimates for Oil Shocks on Gasoline Average Prices
Oil in local currency

	Max	HL (max)		Max	HL (max)
Belgium	105%	3	Estonia	155%	4
Denmark	86%	3	Iceland	110%	4
France	72%	3	Lithuania	94%	4
Germany	79%	3	Poland	99%	4
Ireland	107%	3	Romania	29%	4
Italy	77%	4	Slovakia	107%	3
Netherlands	95%	4	Brazil	146%	9
Norway	93%	3	Mexico	41%	8
Spain	89%	3	Uruguay	120%	4
Sweden	70%	3	Korea	103%	3
Switzerland	70%	4	Taiwan	93%	4
USA	155%	3	Singapore	96%	4
Czech Republic	125%	4	Philippines	94%	3

TABLE A4
Estimates for Oil Shocks on Natural Gas Average Prices
Oil in local currency

	Max	HL (max)		Max	HL (max)
Belgium	132%	9	Slovakia	89%	5
Denmark	96%	5	Slovenia	208%	13
Ireland	142%	10	Mexico	118%	8
Italy	100%	8	Uruguay	115%	4
Japan	24%	6	Korea	146%	7
Netherlands	66%	11	Israel	74%	12
Spain	138%	8	Taiwan	75%	10
Switzerland	169%	11	Japan	24%	6
Czech Republic	282%	20	Singapore	70%	7
Estonia	129%	12	Philippines	77%	7
Poland	144%	11			

TABLE A5
Estimates for Wheat Shocks on CPI Index
Wheat in local currency

	Max	HL (max)		Max	HL (max)
Belgium	14%	12	Lithuania	6%	23
Denmark	11%	5	Poland	38%	9
France	6%	4	Slovakia	34%	9
Germany	12%	16	Slovenia	21%	10
Ireland	14%	11	Turkey	30%	9
Italy	4%	4	Argentina	19%	3
Japan	4%	17	Brazil	42%	8
Netherlands	15%	17	Chile	14%	4
Norway	19%	8	Peru	2%	2
Spain	10%	3	Mexico	1%	10
Sweden	9%	12	Uruguay	13%	3
Switzerland	10%	4	China	9%	5
UK	1%	1	Korea	37%	12
USA	23%	6	Israel	14%	3
Bulgaria	68%	10	Taiwan	9%	4
Czech Republic	28%	16	Japan	4%	17
Estonia	29%	20	Singapore	11%	4
Hungary	28%	18	Philippines	12%	13
Iceland	46%	9	Russia	69%	9

TABLE A6
Estimates for Wheat Shocks on CPI Index
Wheat in DOLLARS

	Max	HL (max)		Max	HL (max)
Austria	16%	11	Czech Republic	31%	21
Belgium	17%	11	Estonia	23%	21
Denmark	11%	5	Hungary	18%	22
Finland	13%	12	Iceland	30%	18
France	15%	11	Latvia	8%	9
Germany	18%	16	Malta	29%	2
Greece	13%	19	Poland	36%	9
Ireland	11%	5	Slovakia	37%	8
Italy	9%	7	Slovenia	16%	10
Japan	3%	15	Argentina	1%	2
Luxembourg	28%	7	Brazil	23%	8
Netherlands	9%	20	Chile	8%	5
Norway	23%	8	Peru	1%	11
Portugal	17%	20	China	17%	5
Spain	13%	3	Korea	14%	21
Sweden	3%	13	Israel	14%	3

Switzerland	17%	7	Taiwan	14%	5
UK	1%	1	Japan	3%	15
USA	23%	6	Singapore	23%	6
Bulgaria	62%	11	Philippines	7%	17
Cyprus	21%	7	Russia	64%	9

TABLE A7
Estimates for Wheat Shocks on Bread Average Prices
Wheat in local currency

	Max	HL (max)		Max	HL (max)
Belgium	8%	9	Iceland	94%	9
Denmark	3%	10	Lithuania	14%	6
France	4%	7	Poland	89%	13
Germany	3%	24	Slovenia	49%	4
Ireland	17%	5	Chile	94%	7
Italy	2%	9	Colombia	29%	6
Japan	24%	5	Israel	58%	6
Netherlands	9%	23	Japan	24%	5
USA	8%	12	Singapore	117%	18
Bulgaria	70%	5	Philippines	39%	9
Czech Republic	60%	21	Russia	34%	2
Estonia	28%	21			

TABLE A8
Estimates for Wheat Shocks on Food Index
Wheat in local currency

	Max	HL (max)		Max	HL (max)
Belgium	4%	21	Iceland	76%	8
Denmark	21%	15	Lithuania	45%	22
France	22%	16	Poland	74%	10
Germany	23%	21	Slovakia	16%	11
Ireland	17%	22	Slovenia	14%	23
Netherlands	22%	21	Argentina	23%	3
Spain	13%	22	Brazil	44%	7
Switzerland	1%	14	Chile	22%	5
USA	6%	10	Peru	37%	3
Bulgaria	117%	10	Uruguay	12%	4
Czech Republic	61%	14	Taiwan	34%	4
Estonia	73%	20	Singapore	6%	3
Hungary	111%	18	Russia	82%	10

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