Brazil's Commodity Price Index

Alisson Curátola de Melo[1]

1. Introduction

The pass-through of commodity prices to consumer inflation is a topic of large interest in monetary policy studies, as a result of frequent inflationary pressures caused by these products price shocks. Understanding the pass-through mechanism enables the monetary authority to respond in a timely manner and in an appropriate intensity to commodity price shocks, smoothing the inflationary impact of such shocks and the economic cost of central bank actions.

Since 2007, in particular, the occurrence of two strong commodity price shocks has increased the uncertainty about the development of commodity prices and, therefore, the importance of monitoring these prices. Considering this outlook, this paper introduces the methodology used by the Banco Central do Brasil (BCB) to build the Brazil's Commodity Price Index (IC-Br) that aims to identify the share of international commodity price changes which is significant to the Brazilian Consumer Price Index (CPI). This indicator has been published monthly since January 2011 and its series begins on January 1998.

The reason behind the creation of a new commodity price index was the absence of an indicator with an appropriate weighting structure to measure the impact of those price changes on Brazilian consumer inflation, as the weights adopted by the available indexes did not reflect the relative share of each commodity in the domestic consumption basket. Thus, the IC-Br was built employing the Vector Autoregressive (VAR) methodology to estimate the pass-through coefficients of each commodity to CPI inflation, setting the weighting structure based on these estimations. The study provides evidence that IC-Br has a better adherence to the Brazilian CPI compared to other commodity price indexes.

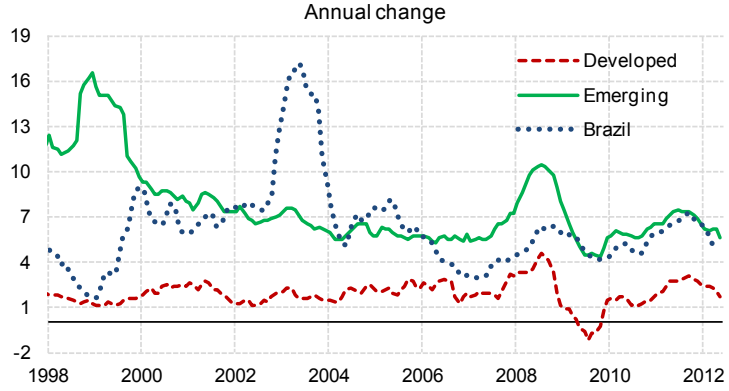
Besides this introduction, the paper also includes four other sections. Section 2 provides a brief summary of the main aspects related to recent commodity price shocks and their implications on global inflation; Section 3 presents the theoretical background about the pass-through of changes in international commodity prices to inflation; Section 4 presents the methodology used to build the IC-Br, as well as some exercises designed to evaluate the index efficiency; and Section 5 concludes this study.

2. Commodity prices and global inflation

Since mid-2007, inflation rates around the world have been increasingly synchronized, showing strong increases up to the third quarter of 2008, intense declines amid the international financial crisis, a resumption between late 2009 and early 2011 and another drop as of the second half of 2011 (Graph 1).

[1] Banco Central do Brasil, Department of Economics, alisson.melo@bcb.gov.br.

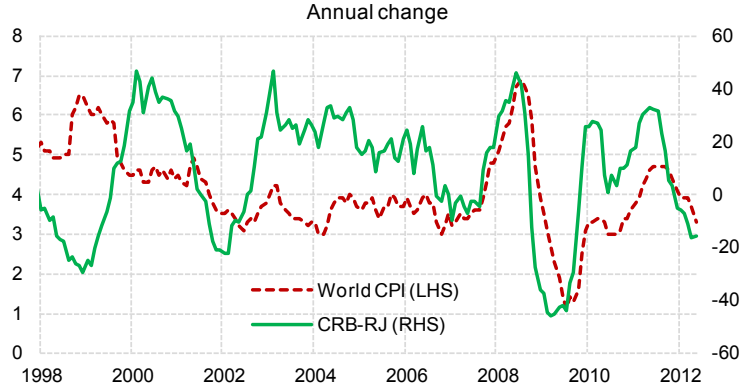
Graph 1 - Consumer inflation
Annual change



Source: IMF and IBGE

Regardless of country-specific factors, the more synchronized behavior of global inflation in recent years suggests the predominant influence of a common factor. Indeed, the economic cycle observed during this period and particularly its effects on commodity prices had an enormous influence on global inflation developments. The underlying hypothesis is supported by the analysis of Graph 2, which shows the symmetry between global inflation and international commodity prices since 2007.[2]

Graph 2 - Inflation and commodities
Annual change



Source: IMF and Reuters Jefferies

Notably, the two most recent periods of world inflation hikes, 2007/2008 and 2010/2011, occurred in an environment of apparent change in long-term trend of real commodity prices. Until late 1990s, international commodity prices had a clear downward trend in real terms[3] (Graph 3), as a result of productivity gains that enabled the expansion of supply at a faster pace than demand. However, since the end of 2002, international commodity prices have reversed this trend, beginning a period of strong rise, as a result of several factors.

---

[2] For inflation, we used the annual change of World CPI, calculated by the International Monetary Fund (IMF), on which each country weight is proportional to its share of world Gross Domestic Product (GDP), considering the Purchasing Power Parity (PPP). The international commodity prices were represented by the annual change of CRB index, calculated by Reuters Jefferies, which aggregates the prices of agricultural, metal and energy commodities, totalling nineteen products.

[3] According to Cashin and McDermott (2002), commodities presented an average 1.3% real depreciation per year during the period of 1862 to 1999.

In this context, it should be highlighted the role of emerging economies, with emphasis on China, where the strong economic growth and current level of development – more intensive in natural resources – have led to a significant increase in demand for commodities, thus becoming an important component of the apparent changing trend of commodity prices. Regarding food consumption, the higher purchasing power has enabled these economies to adopt a richer protein diet, which has been sustaining strong growth in global demand for agricultural commodities, especially meat and grains.[4] Similarly, the massive investments in infrastructure and construction sectors in these economies, together with fast expansion of consumer durables production, boosted the demand for industrial inputs and contributed to higher prices in this segment. Additionally, it should be noted that the increased allocation of agricultural commodities for biofuel production, in this case concentrated in developed countries, also contributed to the change in the long-term price trend.

Graph 3 - CRB Index

Deflated by U.S. CPI (Jan/1951=100)

Source: Commodity Research Bureau and Bureau of Labor Statistics. BCB elaboration

Although the change in commodity long-term price trend has been an important component of recent periods of inflation hikes, trends usually do not cause price movements as intense as those seen in 2007/2008 and 2010/2011. Indeed, these two periods of significant commodity price increases were more related to short-run supply shocks rather than the change in long-term trend of prices. The world's supply of many agricultural commodities suffered significant impacts of adverse weather events, while the supply of oil was affected by disruptions, with emphasis to the production shutdown in Libya in the context of geopolitical tensions in North Africa and the Middle East in early 2011. In both cases the boom was intensified by agents in financial and physical markets, who increased the resources allocation in future contracts of these products – anticipating further price hikes – or increased precautionary inventories attempting to hedge from a possible continued price rise.

In Brazil, the most recent periods of international commodity price hikes were also followed by domestic inflation increase, which required a cautious monitoring of such prices by policymakers. However, as Brazil is a major exporter of commodities, those events have also been associated with increased capital inflows, exchange rate appreciation and aggregate demand strengthening. Therefore, for the Brazilian economy, those commodity price shocks have not represented a traditional supply shock.

[4] Increased demand for grain has been related not only to direct human consumption, but mainly to the higher allocation of these products for feed production, reflecting the rise of meat consumption.

3. The theory reference on commodity pass-through

The pass-through of commodity price changes to inflation is not a stable relationship, which, according to Malliaris (2006), reflects constant changes in the economic environment and the materialization of new inflation causes. In addition to the direct impact related to the pass-through of rising costs, Furlong e Ingenito (1996) point out that the statistical interaction between commodity prices and inflation is influenced by similar impacts, although with different lags, that a demand shock has on these variables.

Similarly, Bower, Geis and Winkler (2007) explain three channels through which commodity prices affect inflation in oil-exporting African countries. In addition to the direct pass-through to retail prices as a result of rising production costs, the authors argue that the rise in commodity prices may influence the level of domestic prices through increased private and public sectors spending, reflecting the positive income effect, or by the increase in banking sector liquidity as a result of the expansion of foreign exchange inflows.

It is important to note that commodity markets cover a wide range of products that can be segmented into agricultural, metal and energy, with different impacts on retail price level. JP Morgan Chase Bank (2009) notes that although metal prices are the most affected by economic growth, this segment has the less significant impact on inflation. According to the report, price changes of agricultural and energy commodities quickly affect the retail costs of food and transportation, while price fluctuations of base metals are smoothed along the usually large production chains. But Hobijn (2008) asserted that while a rise in oil prices affects gasoline price in about a month in the United States, rising prices of agricultural commodities can last up to a year to have an effect on consumer prices, due to slow pass-through of this supply chain.

The pass-through of the commodity price changes may also be different for increases or decreases, as shown by Brown and Yücel (2000) for the impact of oil prices on gasoline in the United States. While rising oil prices affects the U.S. fuel cost in four weeks, the fall requires several months to be reflected in prices paid by consumers.

Economic growth and the size of changes in commodity prices are also factors that can affect the degree of pass-through. According to JP Morgan Chase Bank (2008), although core inflation measures tend not to suffer a strong influence from changes in commodity prices, 39% of the rise in core inflation rates in developed countries from 2006 to 2008 could be explained by oil prices increases. The high level of capacity utilization in the period and the strength of commodity price hikes are the explanations provided by the report to the change in the pattern.

The commodity pass-through to inflation also tends to diverge from country to country according to the consumption basket, the productive efficiency and the energy matrix. Emerging countries, for instance, tend to suffer from greater inflationary impact of commodity prices, since food has a higher share in the average consumption basket and production is usually less energy efficient. According to Hobijn (2008), the influence of commodity prices on U.S. consumer spending is restricted to a few types of products and therefore the average annual increase of 40% in prices of agricultural and energy commodities from 2006 to 2008 was responsible for only 1.5 percentage point of the average consumer inflation of 3.2% in the period.

In countries where revenues from commodity exports accounts for a significant share of the exchange flow, the inflationary impact of a commodity price shock tends to be offset by the resulting currency appreciation. Bloch, Dockery and Sapsford (2006) found evidence of positive impact of international commodity prices on price level in Australia and Canada between 1970 and 2001, but also found that inflation in these countries has some resilience to shocks in these products value, as the resulting exchange rate appreciation offsets the direct effect of commodity prices on production costs.

Chen (2008) estimated that the pass-through of oil prices to inflation in nineteen industrialized countries was on average 17% between 1970 and 2006. The study also found evidence that the pass-through had been declining during the period, which, according to the author, can be attributed to the appreciation of these countries' currencies, more active monetary policy and increased trade liberalization.

In summary, the degree of pass-through of commodity prices to inflation of a given country is positively influenced by the pace of economic growth, the intensity of changes in commodity prices, the share of these products in the average basket consumption and the relative importance of fossil fuels and biofuels in the energy matrix. On the other hand, both the size of production chain and the productive efficiency lead to a smaller pass-through.

4. Brazil's Commodity Price Index

Seeking a better understanding of commodity price pass-through to consumer inflation in the Brazilian economy, the BCB developed the Brazil's Commodity Price Index (IC-Br). The main motivation for creating a new commodity price index was the absence of an indicator with an appropriate weighting structure to measure the impact of those price changes on Brazilian consumer inflation, since the weights adopted by the available indexes do not reflect the relative share of each commodity in domestic consumption basket. However, the definition of a more appropriate weighting is not easy, since the weights of these products in the Brazilian CPI are not directly observable, as commodities are mostly inputs to production of goods effectively weighted in the reference basket. Wheat is a classic example of this difficulty, since it has no direct participation in the reference basket, but is an important input for the production of flour, pasta and bread.

Given this difficulty, the IC-Br was built employing the Vector Autoregressive (VAR) methodology to estimate the pass-through coefficients of each commodity to CPI, and by using these coefficients, define each product weight as proportional to its estimated pass-through.

An initial step of developing a price index is the definition of price aggregation method. In the first version of the IC-Br,[5] the structure of weights determined by the VAR model was maintained constant throughout the series, not considering, therefore, the effect of a particular commodity price change on the income share destined to its consumption. Underlying this methodology is the hypothesis of adjusting the amount consumed of those products that register different variations of the basket average price. In contrast, the methodology used by the Brazilian Institute of Geography and Statistics (IBGE) to calculate the monthly CPI updates the weighting according to the price changes occurred in the previous month. In this methodology, the quantities consumed of each product remain constant in relative terms, implying change in the share of income destined for consumption of each good proportionately to price changes.

Disregarding any judgment about the most appropriate method for a price index, the methodology used by the IBGE to calculate the consumer inflation in Brazil is more appropriate for IC-Br, since the goal of this indicator is to identify the influence of international commodity prices on CPI. Indeed, the implementation of CPI methodology in IC-Br computation resulted in significant increase in the correlation between IC-Br and CPI.

[5] IC-Br aggregation methodology and weighting structure were revised in December 2011, resulting in the index series update.

Thus, the IC-Br current calculation methodology, based on Laspeyres index formula used by the IBGE, updates the weights monthly. Considering the weights estimated by the VAR model as for the month m, the weight of commodity i in month m+1 is:

$$w_{m+1}^{i} = \frac{w_m^i \times \frac{p_m^i}{p_{m-1}^i}}{\sum_{i=1}^{n} w_m^i \times \frac{p_m^i}{p_{m-1}^i}} \qquad \text{(eq. 1)}$$

Where:

w_m^i is the weight of the commodity i, in month m ($\sum_{i=1}^{n} w_m^i = 1$);

p_m^i is the average price of commodity i, in month m.

Once the weights are determined, the calculation of IC-Br on day d, of month m is:

$$I_d^{ICBr} = I_{d-1}^{ICBr} \times \left(\sum_{i=1}^{n} w_m^i \times \frac{p_d^i}{p_{d-1}^i}\right), I_0^{ICBr} = 100 \qquad \text{(eq. 2)}$$

Thus, the index published in a given month m is defined:

$$I_m^{ICBr} = \frac{\sum_{d_m=1}^{u_m} I_{d_m}^{ICBr}}{u_m} \qquad \text{(eq. 3)}$$

Where:

u_m is the number of working days in the month m.

In order to estimate the weights, we used monthly data covering the period between January 2004 and November 2011. The beginning of the sample was chosen to avoid the period before 2004, because of significant structural breaks in the Brazilian economy from 1994 to 1999 and the turmoil in the exchange market in 1999 and 2003. The variables used in VAR models estimations were: the monthly changes of commodity prices measured in reais, a measure of economic activity (IBC-Br), a monetary policy variable (Selic interest rate), the monthly change of exchange rate and CPI inflation. The adoption of reais to measure commodity prices in IC-Br is justified by the fact that these products are actually traded by using the domestic currency within an economy.

The first step in setting the weights consisted in building a price index for each sector: agriculture, metals and energy. In order to do so, we estimated a VAR model for each product and, using impulse responses, it was possible to obtain individual pass-through coefficients of each commodity to CPI, accumulated in twelve months.[6] After that, the weights were calculated dividing each individual pass-through coefficient by the sum of all coefficients of the segment, in a way that the weight of each commodity should be proportional to its pass-through (Equation 4).

$$w_0^{i,j} = \frac{\emptyset^{i,j}}{\sum_{i=1}^{n_j} \emptyset^{i,j}} \qquad \text{(eq. 4)}$$

[6] The choice of estimating a model for each product is justified by the enormous loss of degrees of freedom resulting from the inclusion of all products in the same model.

Where:

$w_0^{i,j}$ is the reference weight of the commodity i, component of segment j ($\sum_{i=1}^{n_j} w_0^{i,j} = 1$);

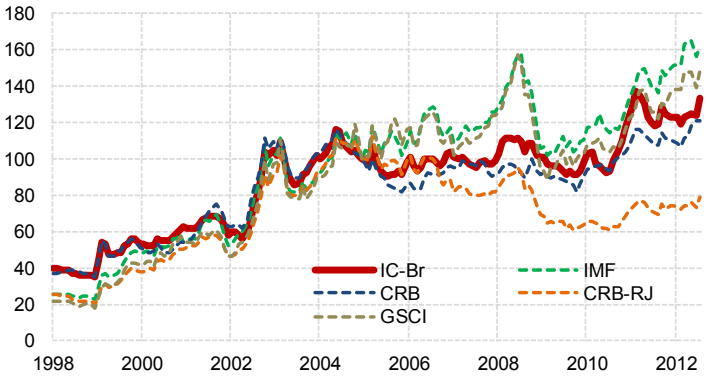
$\emptyset^{i,j}$ is the impulse response accumulated after twelve months of a 1% shock in the price of commodity i, component of segment j, on CPI;

n_j is the number of the commodities in segment j.

Once the three indexes were built, the second step consisted in repeating the procedure of estimating the VAR model and the impulse responses, but this time using the price series of the three segments, in order to establish the weight of each segment and thus achieve the composite index. Differently from the initial step, when a VAR model was estimated for each commodity, the second step included the three segments in the same model, since the loss of degrees of freedom would not be so significant.

Graph 4 compares the resulting index, the IC-Br, with other commodity indexes often used in macroeconomic analysis. As up to 2004 the volatility of Brazilian exchange rate was higher than international commodity prices, the fluctuations of all commodity indexes measured in reais were very similar until this year, reflecting the exchange rate movements rather than commodity prices. Since 2005, however, the indexes developments have been different, as the increased volatility in commodity prices exposed the differences of composition and methodology between the indexes. It should be noted that the indexes presented in Graph 4 are measured in reais in order to be comparable to IC-Br, which is conceptually measured in Brazilian currency.

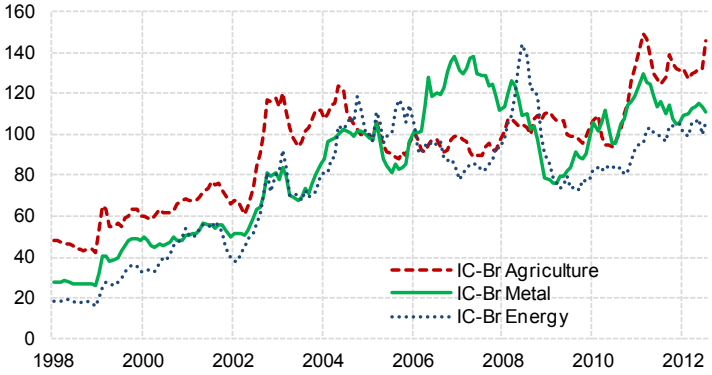
Graph 4 - IC-Br and other indexes
measured in R$ - Dec/04=100



Source: Commodity Research Bureau, Reuters Jefferies, S&P GSCI, IMF and BCB.

The segmentation of the IC-Br is presented in Graph 5. For the Agricultural index, prices of live cattle, cotton, soybean, wheat, rice, sugar, corn, coffee and lean hogs were considered. The Metal segment gathers aluminum, iron ore, copper, tin, zinc, lead and nickel, while the Energy index includes Brent oil, natural gas and coal.

Graph 5 - IC-Br segments
measured in R$ - Dec/04=100

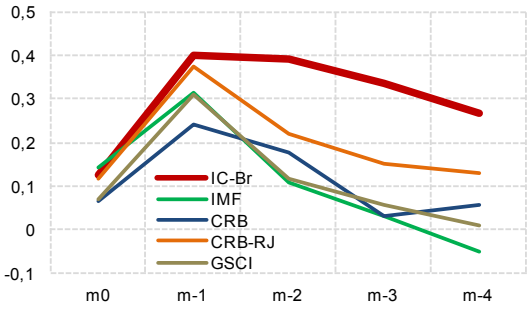


Source: BCB.

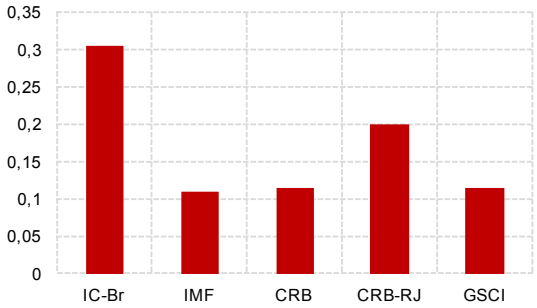
4.1 Index efficiency

In order to evaluate the IC-Br efficiency in identifying the share of changes in commodity prices significant to domestic inflation, we calculated the correlations of some commodities indexes[7] with the monthly CPI, covering the contemporary relationship and four months of lag for commodities.

Graph 6a - Correlation with IPCA
By month of lag



Graph 6b - Average correlations



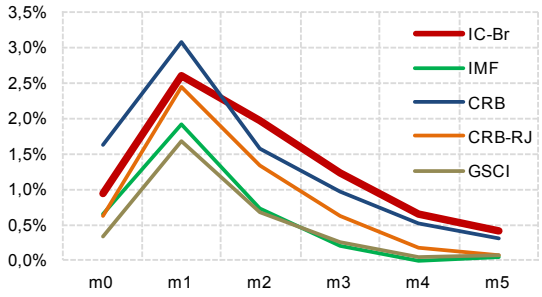
Source: BCB, IBGE, Reuters Jefferies, Commodity Research Bureau, Standard & Poor's/Goldman Sachs and IMF. BCB elaboration.

As demonstrated in Graph 6a, the IC-Br contemporary coefficient is situated at a similar level to those of other indexes, but its correlations with lags are always at a higher level, resulting in higher average correlation (Graph 6b). These results are a good indication that the IC-Br is more efficient in identifying the relevant changes in commodity prices, regarding their impact on CPI.

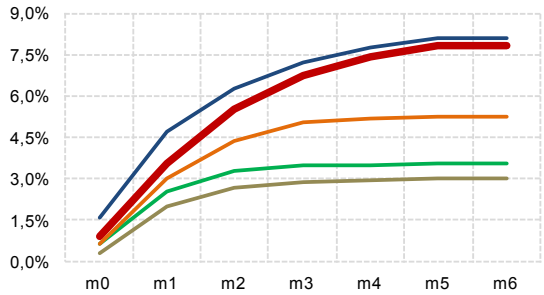
Alternatively, the index efficiency can be evaluated from its capacity of measuring the monthly impact, in percentage points, that changes in commodity prices have on CPI. Considering this goal, we have estimated a monthly pass-through structure for each index using the same VAR methodology used in determining the weights. The results are compared in the graphs below:

[7] CRB: Index computed by Commodity Research Bureau; CRB-RJ: Index computed by Reuters Jefferies; GSCI: index computed by Standard & Poor's together with Goldman Sachs; IMF: index computed by International Monetary Fund.

Graph 7a - Pass-through from commodities to IPCA
By month of lag



Graph 7b - Pass-through from commodities to IPCA
Accumulated - By month of lag

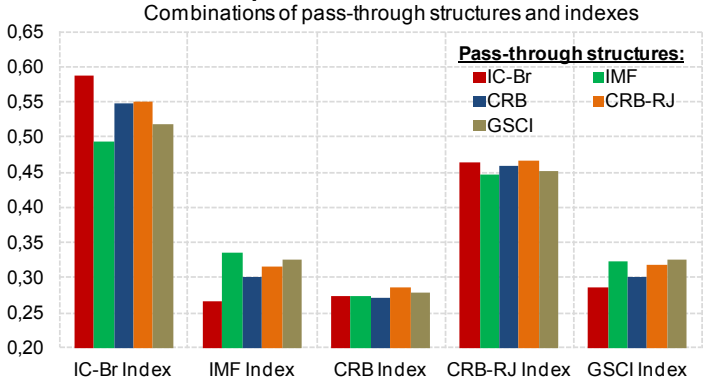


Source: BCB, IBGE, Reuters Jefferies, Commodity Research Bureau, Standard & Poor's/Goldman Sachs and IMF. BCB elaboration.

The five structures shown in Graph 7 indicates that, for the period under consideration, a commodity price shock affects CPI in the first month in which the average price of these products increase (m0), reaching the highest impact in the following month (m1) and losing strength from then, almost exhausting the pass-through in the sixth month (m5). Although the accumulated pass-through estimated with IC-Br is slightly smaller than the one estimated with CRB, it seems that the IC-Br pass-through is better distributed in time. The IC-Br structure provides a larger weight to more persistent shocks, which tends to avoid an overestimation of the impact of a transitory shock on inflation. It should be noted that the estimated structures reflect the average economic context of the sample used on estimation. Thus the effective pass-through in a given month depends on several factors.

After that, the five pass-through structures were used to estimate twenty-five monthly series of commodity prices impact on CPI, combining those structures with the five indexes. The resulting series were used to calculate the correlation coefficients with monthly CPI (Graph 8), which revealed that regardless of the structure used, IC-Br provides a better estimate of commodity price impact on inflation. Additionally, the monthly impact series calculated with IC-Br and its associated pass-through structure has the highest correlation with Brazilian consumer inflation among all the twenty-five coefficients calculated, which confirms the superior performance of the IC-Br compared to other indexes.

Graph 8 - Correlations with CPI
Combinations of pass-through structures and indexes



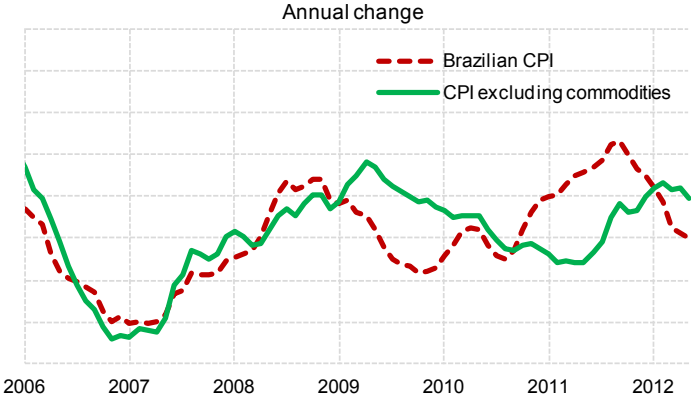
Source: BCB, IBGE, Reuters Jefferies, Commodity Research Bureau, Standard & Poor's/Goldman Sachs and IMF. BCB elaboration.

4.2 CPI excluding commodities

Finally, once the IC-Br efficiency was confirmed, the index and its pass-through structure were used to gauge the CPI with exclusion of commodity price influence. It should be noted that the exclusion of commodity prices using the estimations provided by the VAR model removes not only the direct impact of higher production costs. Such procedure also removes possible second-round effects and the impact of demand pressures related to the income

effect of a commodity shock, opposing, therefore, to a simple removal of a component as in traditional core measures.

Graph 9 - Consumer inflation
Annual change



Source: IBGE and BCB.

The developments of headline inflation and the CPI excluding commodity effects are compared in Graph 9. After showing variations similar to the CPI from 2006 to 2008, the exclusion measure has disclosed a different behavior since 2009, reflecting the influence of higher commodity prices volatility on consumer inflation in Brazil. Although during the 2007/2008 shock the exchange rate appreciation helped to keep the exclusion measure near the headline inflation, the commodity prices collapse that followed the intensification of the global financial crisis in late 2008 and early 2009 enabled the decline of consumer inflation in Brazil, which is confirmed by the exclusion measure at a higher level than the CPI in 2009. A new period of detachment began in the second half of 2010, when CPI registered a sharp increase, moving away from the exclusion measure, a behavior consistent with the strong rise in international prices of major agricultural, metal and energy commodities. Recently, the worsening of the fiscal crisis in Europe in the second half of 2011 resulted in new decreases in commodity prices, which has contributed to the downward trend of the headline inflation that is below the exclusion measure.

5. Conclusion

Commodity price fluctuations demand constant monitoring by central banks around the world given frequent inflationary pressures arising from increases in these prices. In particular, given the higher volatility of commodity prices in recent years, understanding the pass-through mechanism has become even more important, as it helps the monetary authority to react in a timely manner and in an appropriate intensity to shocks in commodity prices, smoothing the inflationary impact of those shocks and the economic cost of central bank actions.

In this context, seeking a better understanding of this matter, this paper introduced the methodology used by the BCB to develop the IC-Br, which is more appropriate to identify the impact of changes in international commodity prices on consumer inflation in Brazil. The IC-Br was built employing the VAR methodology to estimate the pass-through coefficients of each commodity to CPI, setting the weighting structure based on these estimates.

This paper showed some evidence that the IC-Br efficiency is notably superior to other indexes in identifying the impacts which changes in commodity prices have on the CPI dynamics.

References

Bloch, H., A.M. Dockery and D. Sapsford (2006), ***Commodity Prices and the Dynamics of Inflation in Commodity-Exporting Nations: Evidence from Australia and Canada***, The Economic Record, 82: S97-S109, 09.

Böwer, Uwe; Geis, André and Winkler, Adalbert, ***Commodity Price Fluctuations and Their Impact on Monetary and Fiscal Policies in Western and Central Africa*** (April 2007). ECB Occasional Paper No. 60.

Brown, Stephen A. and Yücel, Mine. ***Gasoline and Crude Oil Prices: Why the Asymmetry?*** Federal Reserve Bank of Dallas Economic and Financial Review (Third Quarter 2000).

Cashin, P. e C.J. McDermott ***The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability***. IMF Staff Papers, Vol. 49, 175-99-2002.

Chen, Shiu-Sheng ***Oil price pass through into inflation***. Working Paper Series National Taiwan University Jan 2008, Department of Economics, Taipei. (January 2008)

Furlong, F. and R. Ingenito. ***Commodity Prices and Inflation***. Federal Reserve Bank of San Francisco Economic Review (2): 27–47. 1996.

Hobijn, Bart, ***Commodity Price Movements and PCE Inflation*** (November 2008). Current Issues in Economics and Finance, Vol. 14, No. 8, November 2008.

JP Morgan Chase Bank (2008), ***Global deflation delusion***. Economic Research – Global Data Watch (November 21, 2008)

JP Morgan Chase Bank (2009), ***Commodities are a wild card in the outlook for disinflation***. Economic Research – Global Data Watch (March 27, 2009)

Malliaris, A. G. ***U.S. Inflation and Commodity Prices: Analytical and Empirical Issues***. Journal of Macroeconomics, Vol. 28, pp. 267–271, 2006.