

COMMODITY PRICES IN ARGENTINA: WHAT DOES MOVE THE WIND?*

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Abstract

The increase in the international commodity prices exported by Argentina are usually presented as a tail wind that explains the strong growth and the good external conditions that have benefited this country since 2004. This paper investigates which are the drivers of an index of the real prices of the eight main commodities of Argentina. We discuss different theoretical approaches and present a VECM in order to make a multivariate empirical analysis. Our estimations indicate that effective real exchange rate of US, the real interest rate, the international liquidity, and the factors that represent industrial demand for raw materials are significant determinants of Argentinean commodities in the long run. The key conclusion of the paper is that the factors that explain the behaviour of commodity prices are very similar to those that affect capital account movements. This could help to understand why we observe a positive correlation between nominal and real shocks in emerging markets in general and, particularly, in Argentina.

JEL Codes: C32, F42, Q11

Keywords: commodity prices, international liquidity, VEC models,

Palavras-chave: preco de commodities, liquidez internacional, modelos VEC

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Commodity Prices in Argentina. What does move the wind?

1. Introduction

There is a widespread feeling that favorable winds are blowing in the direction of many emerging economies in the last years. This “tail wind” has essentially two components: low interest rate environment, and high prices of various primary commodities. But in contrast to the 90s, the emphasis is now more on the second component at least in South America and, particularly, in Argentina. In the later case, much of the recent growth performance is usually attributed to an unusual situation of commodity prices and the terms of trade.

Commodity prices shocks are an important source of growth, volatility and uncertainty in a small and open economy like Argentina. Economic intuition tells us that the degree of exportable sector diversification is inversely linked to the macroeconomic importance of specific commodity prices. According to 2007 data¹ approximately one-third of Argentinean exports are primary products, and a similar percentage corresponds to agricultural manufactures like vegetable oils, soybean meal, beef, dairy products, oil, or metals like copper or aluminum. This means about sixty-five percent of Argentinean export basket depends directly or indirectly on international commodity markets.

High commodity dependence influences almost every policy stance in a small and open economy. Volatile prices impose not only macroeconomic restrictions over fiscal, monetary, and exchange rate policies, but also influence consumers purchasing power, private and public savings, commercial policies and openness strategies, agricultural policies, natural resources utilization, and investment allocation among economic sectors.

From the Argentinean perspective, commodity prices influence the economy through a variety of channels. We could think in four main channels.

Firstly, high commodity prices were, historically, the basic way to obtain external liquidity to enhance economic growth. That is why much of the economic analysis until the financial openness of the seventies rested on the behavior of commodity prices to explain cyclical patterns and external constraints. This channel lost preeminence once the economy opened to financial markets at least from a theoretical standpoint². However, it continues to be relevant in practice since crisis were recurrent in the last thirty years, and consequently international financial restrictions were frequent.

Secondly, the incidence of commodity prices over the fiscal stance is direct. Even when tax structure have changed in Argentina, high external prices were historically a source of direct (exports taxes) or indirect (income taxes) revenues for the public sector.

Thirdly, in contrast with other commodity producer economies, the Argentinean domestic consumption basket contains large numbers of products that are part of the export basket. For this reason, the ups and downs of commodity prices create important distributive effects and directly affect poverty line calculations. This fact also differentiates Argentina from developed countries where volatile price of food and energy are partially ignored in monetary policy formulation based on the analysis of core CPI inflation³. Argentinean

¹Preliminary figures based on 2007 first quarter data of INDEC.

²In open countries there is also an indirect effect of commodity prices over external finance. In a primary producer country, commodity prices affect agents' expectations of future wealth changing debt sustainability analysis. Therefore, current prices could affect both the cost (sovereign spread) and the availability of finance, and result a important element in building expectations.

³See D' Amato et. al (2006) for a recent review of core inflation indexes published by different Central Banks.

monetary policy formulation could not easily ignore these items since their direct and indirect weights in CPI is extremely high.

Finally, commodity prices and terms of trade could impact the real exchange rate (RER). Carrera and Restout (2007) have recently shown that an increase in the terms of trade leads to a real exchange rate appreciation in South America.

Despite of its importance, the academic interest in the subject of commodity prices has changed over time. Following seminal papers of Prebisch (1950) and Singer (1950), a series of works have tried to assert the existence of trends and/or structural breaks in commodity prices data. But only recently the subject has recover part of it past strength. In Frankel (2006) words “commodities prices are back with a vengeance”. The recent historical nominal records of many commodity prices such as cooper, nickel or crude oil has motivated additional research on this field focusing on both the consequences for developed countries and the effects in commodity producers economies.

In this regard, there is well documented evidence of the importance of commodity prices and terms of trade shocks over long run growth⁴ and macroeconomic volatility⁵ in the international economic literature. Many scholars have analyzed commodity dependence highlighting that is something not too different to a curse. The so called “resource curse” in the growth literature (Sachs and Wagner, 1995) establishes that countries with abundant natural resources tend to grow slower than resource-scarce economies. Economic theory has proposed no less than three channels of transmission. In the fist place, high commodity prices could lead to Dutch Disease effects through the previously mentioned real exchange rate link. In the second place, countries with more natural resources are probably more exposed to volatility which, in turns, impacts on growth⁶. Finally, commodity dependence could have adverse effects on governance⁷.

Commodity prices could also influence growth from a political economy point of view. In a period of price booms policymakers could think that the economic situation is so good as to alter it, but during depressions there are no means as to change primary products dependence even when policymakers have the purpose to do it.

Even good luck has been mentioned as a main factor driving economic performance of primary producers countries. Diaz Alejandro (1984) proposed the “commodity lottery” idea which emphasized that, from a historical perspective, the exportable resources of each country were basically determined by geography and previous experience with global integration. But later economic development was a result of the economic, political and institutional attributes of each commodity. In fact, the long run temporal behavior of commodities is far from being homogeneous. To take some quick examples of heterogeneity in commodity prices, consider the following growth rates⁸ over the period 1900-2000 according to Ocampo and Parra (2003): lamb 399%; beef 135%; tobacco 100%; cotton -66%; rice -67%; and rubber -94%.

All the above mentioned reasons partially explain why the study of both the stochastic properties of commodity prices, i.e. trends, volatility and cyclical properties, and their economic determinants has been a mayor issue for many economists for the last sixty years. In addition, this also helps to appreciate why

⁴Harberger (1950) and Laursen and Metzler (1950) pioneering works suggested that a fall in the terms of trade will reduce national income and consequently decrease savings in order to smooth consumption. Later on this effect became know as the Harberger-Laursen-Metzler effect. Subsequent works of Obstfeld (1982) and Kent and Cashin (2003) extended the idea, and demonstrated that longer persistence and duration of negative terms of trade shocks result in lower investment rates and higher saving.

⁵Deaton (1999) for instance, documents a strong comovement between commodity prices and growth rates in Africa, while Mendoza (1997) describes the links between terms of trade uncertainty and economic growth. Moreover, Bastourre and Carrera (2004) find that terms of trade volatility increases output volatility using a panel data approach.

⁶See Ramey and Ramey (1995).

⁷Lane and Tornell (1996) and Tornell and Lane (1999).

explaining and forecasting commodity prices continues being a relevant concern from a policymaker point of view.

From this introduction we hope to have convinced the reader that commodity prices, i.e. the wind, are a key factor affecting a small open economy similar to Argentina. Since we are aware of the central role of commodity prices, our next step will be trying to answer a related question: What moves this wind?

Thus, this paper aims at identifying global macroeconomic determinants of commodity prices of Argentinean export basket. To this end it has been employed a vector error correcting model (VECM) to explore the links between of variable of interest and its drives.

The structure of this study is as follows. In the next section we describe macroeconomic determinants of price movements. We also briefly survey empirical work done in this area. In the second section we analyze time series properties of argentinean terms of trade and commodity prices. Following this, we present the empirical model to be estimated and the empirical results. Our focus will be posed on both the economic long run relationships among the considered variables and the short run responses of commodity prices to various types of macroeconomic shocks. We also extend our basic empirical model to study the relationship of Argentinean export prices and its terms of trade with macroeconomic global factors. The paper ends discussing conclusions and policy recommendations.

2. Drivers of Commodity Prices.

In one of the most controversial thesis in the field of international economics of the past century, Prebisch (1950) and Singer (1950) claimed that, contrary to classical view, primary products would fall relative to industrial products⁹. Since productivity had tended to growth faster in industry than in agricultural or mining sectors during 1876-1947, Prebisch argued that there existed a fundamental asymmetry in the international division of labor: while center countries would had kept all the gains of its productivity increases, “the periphery” would had conceded the benefits of it own technological progress.

For a developing country with a non-diversified and traditional export structure it is quite obvious that exists a positive link between terms of trade and commodity prices. That is why much of the empirical research on the Prebisch-Singer hypothesis is not a direct test over terms of trends per se, but instead a test over falling commodity prices over time in nominal and/or real terms. By and large, this has been the common way to empirically approach to commodity prices¹⁰.

Other important branch of this literature states that it is incorrect to discuss long run trends since in the short and medium term volatility dominates by far the behavior of commodity prices. According to Deaton (1999), what commodity prices lack in trend, they make up for in variance. In this respect, Cashin and McDermott (2002) find that volatility of commodity prices has increased notably since Bretton Woods breakdown at the beginning of the seventies.

But contrary to focus on time properties of prices series as such, a smaller group of scholars has raised a different question: Are there some accepted macroeconomic determinants of commodity prices?

⁸All these commodity price figures are deflated by the Manufacturing Unit Value (MUV) index developed by the United Nations.

⁹The classic wisdom due to Ricardo and Mill was that because of diminishing returns of land the relative price of agricultural products was bound to rise in the long run.

¹⁰There are many papers that analyzed long run behavior of commodity prices. Grilli and Yang (1988) devised several series for the period 1900-1986, and found that non-fuel primary commodities prices had fell 0.6% *p.a.* relative to manufactures. Among others, the works of Cuddington and Urzúa (1989); Powell (1991); Bleaney and Greenaway (1993); Lutz (1999), Cashing and McDermott (2002); and Ocampo and Parra (2003) had tried to confirm or reject Grilli and Yang (1988) results. The general picture that emerges from these papers is that negative growth rates tend to prevail in the very long run. However there is not a clear consensus. While some works argue in favor of a trend that moves at a constant pace, other papers find that more important factors are structural negative shifts that are not fully recovered during the upward phase of commodity prices cycles.

The clearest message that has emerged from this literature is that fluctuations in the value of the dollar have implications on the real value of primary commodities. The pioneering model of Ridler and Yandle (1972) uses comparative static analysis in a single-good model to demonstrate that an increase in the value of the dollar (i.e. a real appreciation) should result in a fall in dollar commodity prices. Moreover, the magnitude of this negative elasticity should be less than one in absolute value since a 100% general appreciation will cause a $100 * (1 - v_i)\%$ change in commodity i , where v_i measures the relative significance of US as a producer and consumer of this good¹¹. This is the so called “denomination effect” that have been discussed many times since then.

A second intuitive driver of commodity prices proposed by literature is world income. Dornbusch (1985) for instance sets out a two country market clearing model to describe external influences on relative commodity prices. Market clearing equilibrium requires that the sum of domestic (U.S.) and foreign demand (D and D^*) equals global supply (S) which is assumed exogenous. In turns, each demand depends on both relative domestic prices measured in its respective currency ($\frac{P_c}{P}$ and $\frac{P_c^*}{P^*}$) and income levels (Y and Y^*).

$$(1) \quad S = D\left(\frac{P_c}{P}, Y\right) + D^*\left(\frac{P_c^*}{P^*}, Y^*\right)$$

Due to full arbitrage in commodity markets, the general solution for our variable of interest is:

$$(2) \quad \frac{P_c}{P} = H\left(Y, Y^*, \frac{P}{eP^*}; S\right); \quad H_1, H_2 > 0; \quad H_3 < 0$$

This means real commodity prices in dollars are positive related to domestic (U.S.) and foreign activity and negatively influenced by the U.S. effective real exchange rate $\left(\frac{P}{eP^*}\right)^{12}$.

Apart from real exchange rate and industrial production, a third variable has been suggested as a determinant of commodity prices namely the real interest rate. In explaining the excess of co-movement among commodity prices with respect to fundamentals, Pindyck and Rotemberg (1987) have considered that these movements are the result of herd behavior in financial markets since its participants could have the belief that all commodities tend to move together. As storable assets, commodities are affected by expectations. Interest

¹¹It could be argued that it is not consistent to use a partial equilibrium model for each good without considering all possible commodity prices interactions. It would not be correct to compute, for instance, the effect of real exchange rate of the dollar on the price of copper holding the price of aluminum constant, and then to calculate the effect of the same change on the price of aluminum holding the price of copper constant (Gilbert, 1989). This led Chambers and Just (1979) to a multi-commodity generalization of Ridler and Yandle (1972) model. In this context, the assumption of gross substitutability in production and consumption is sufficient to assure that the dollar exchange rate to commodity prices elasticity remain within the unit interval.

¹²As in the case of the Ridler and Yandle (1972) model it could be showed that the elasticity of commodity prices to real exchange rate would be less than one in absolute value. To reach such result take the partial derivative of expression (1) with respect to the real exchange rate to have:

$$(2') \quad \frac{\partial \ln\left(\frac{P_c}{P}\right)}{\partial \ln\left(\frac{P}{eP^*}\right)} = -\frac{\beta^*}{\left(\frac{\beta\eta}{\eta^*} + \beta^*\right)}$$

where η and η^* are the domestic and foreign price elasticities of commodity demand and β and β^* are the shares of home country and the rest of the world in total demand. As it is clear from (2') the left side elasticity should be a fraction. Moreover, if demand elasticities are the same commodity price response to U.S. real exchange rate is proportional to the importance of U.S as global buyer in that good.

rates might affect the rates of investment or harvest in a number of commodities changing future supplies and so current prices. It could also affect expectations about future economic activity and then future commodity demands which, again, impacts on current prices.

As part of a general model of North-South interdependence, Beenstock (1988) pointed out two components of commodity demand, a flow element that reflects consumption of raw materials in the production process, and a stock element related to speculative activity. Supply of commodities negatively depends on the price of oil since energy is required in the production process. Therefore, in theory relative commodity prices are a positive function of total demand and the price of oil and a negative function of the change in the nominal interest rate.

According to Frankel (2006) rising interest rates are transmitted to commodity prices through for three channels: i) by increasing the incentive for extraction (or production) today rather than tomorrow; ii) by decreasing the desire of firms to carry inventories; and iii) by encouraging speculators to shift out of commodity contracts and into treasury bills. The three channels of transmission work to reduce spot prices of commodities. This means it would be expected a negative relationship between commodity prices and real interest rates from an theoretical point of view. In fact, Frankel (2006) point out that recent nominal records in some commodities could be a signal that monetary policy has been loose.

2.1. The empirical evidence. Where we stand?

Considering the models previously reviewed, the conclusion about commodity prices determinants is straightforward. They should rise with global income, and fall with real exchange rate appreciation of the dollar and with real interest rates. However, this simple picture that emerges from theory has not been easily mirrored in empirical studies.

Several caveats make hard to survey the available empirical research. In the first place, the number of estimations is not too large and the majority of them are from the eighties, where these literature had its momentum. In the second place, the available calculations are methodologically not totally comparable. Finally, both the dependent variables and the explanatory variables are often dissimilar.

The most puzzling result up to now refers to the value of the real exchange rate elasticity of commodity prices. Most of the empirical studies found a negative coefficient as theory predict, but its absolute value is higher than one. Several explanations have been hypothesized to explain this result, particularly Dornbusch (1985) pointed out that there could be measurement problems with the real exchange rate. Particularly Gilbert (1989) suggested that the widely used IMF MERM index is inappropriate since it gives disproportionate weight to the Canadian Dollar. More recently, De Gregorio et al. (2005) have found that RER elasticity of copper price also overshoots its theoretical value, but they have not proposed a full explanation to this fact.

Both the demand and supply sides of the model have also been problematic. It is clear that in a general equilibrium setting prices and quantities should be modeled simultaneously. However, this is not an easy task and the empirical literature have follow basically two strategies. The first one is to estimate pure demand side empirical models. In this case, industrial production of developed countries have been the preferred proxy. Alternatively, some authors have augmented this demand side benchmark using supply side proxies. Borenstein and Reinhart (1994) for instance, have assumed an exogenous supply of commodities in their theoretical model but they have incorporated two supply factors in the empirical specification: industrial

production of former Soviet Union, and a dummy variable for the debt crisis of the eighties. Also Gilbert (1989) has included debt services as a supply shift variable¹³.

Regarding real interest rates, Frankel (2006) shows fresh evidence that appears to confirm a negative coefficient of the real U.S interest rate representing global monetary policy according to this author. This result was established in previous works of Gilbert (1989) and De Gregorio et al. (2005). Pindyck and Rotemberg (1987) had found a negative link between nominal interest rates and various commodities prices.

In sum, there are not a great number of empirical studies and also their results are not totally comparable. To shed some light in this international literature is another reason to explore the empirical counterpart of the theory of commodity prices determinants in the particular case of Argentinean external prices.

3. The stylized facts of the external prices of Argentina

As part of a global tendency described in the introduction, the issue of terms of trade and commodity prices has recovered a central place in the economic debate in Argentina. However in many occasions, this debate starts with ideas that are not totally supported by the data. For instance, it has been occasionally said that current terms of trade are the highest in Argentinean history but this is not true from a long run view. Alternatively, some observers tend to study commodities as a homogenous market when there are clear disparities in the behavior of commodity groups. Moreover, short run analysis usually focus only on nominal prices making not connection with real prices, as if both variables were the same.

In order to clarify ideas it will be helpful to start the empirical analysis by describing both the general trends and the recent outcomes in commodity prices and the terms of trade. This is an important step in order to move to the analysis of the role of international drivers of Argentinean commodity prices.

In Graph 1 below we have drawn a long series for the Argentinean terms of trade. The first notable visual feature is its high volatility.

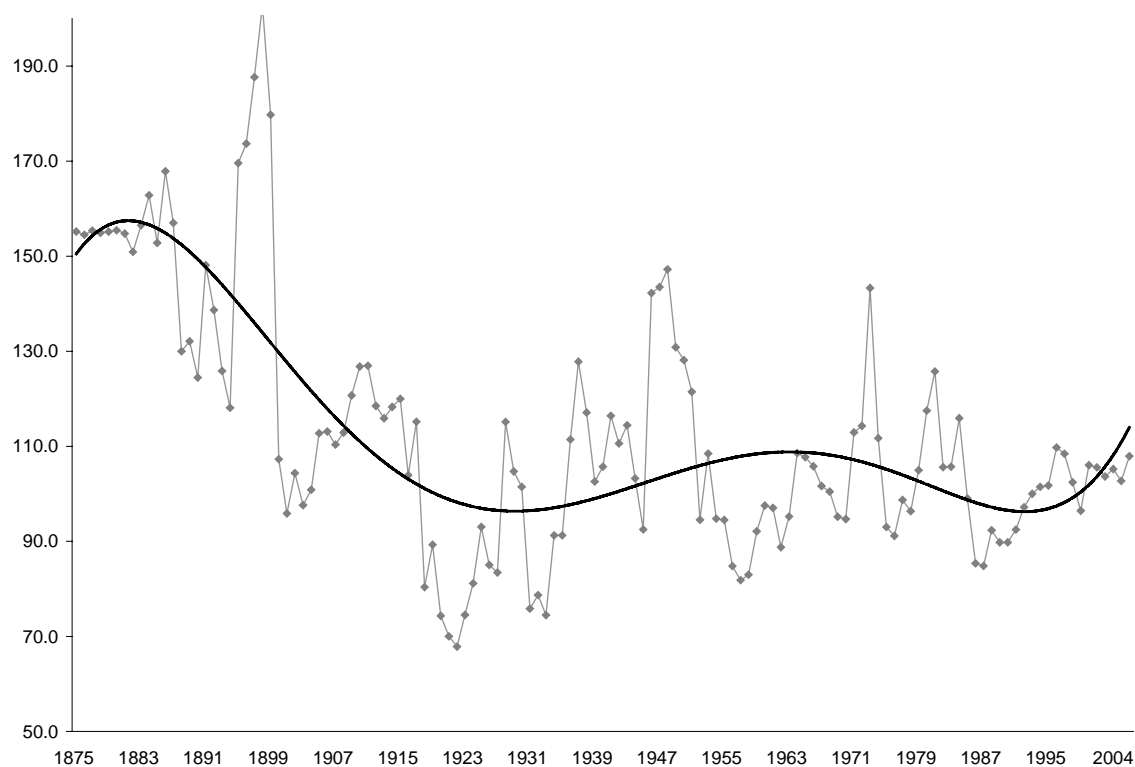
Regarding long run trends, we could see four phases. From the beginning of the series in 1875 to the crisis of the 30s approximately there is a period of decaying terms of trade. Around the Second World War period we observe a recovery of the terms of trade explained by sharp commodity prices increases. Then there is a period of low terms of trade from 1940 to approximately 1970. In the later years the terms of trade peaked as a consequence of the oil shocks. However, this event did not structurally alter the behavior of the series and so they acted more as a jump shift rather than as a step shift. Hence, from 1973 to 1986 volatility tended to prevail.

Only from 1987 on we detect an upward trend with some degree of persistence. This later period has raised an important debate among economists.

In this debate, some observers suggested that current terms of trade are in an extraordinary unique situation, while others said that around the years 2000-2001 there was a structural negative break in the terms of trade that jeopardized the convertibility plan. Nevertheless, when historical data is analyzed we conclude that recent fluctuations have been relatively small, and that stable and slightly rising terms of trade are not a novel characteristic in Argentinean economy but an outcome that has been taken place during the last twenty years.

¹³The idea is that debt crisis endogenously created incentives to increase commodity supply and so prices plummeted in 1982-85.

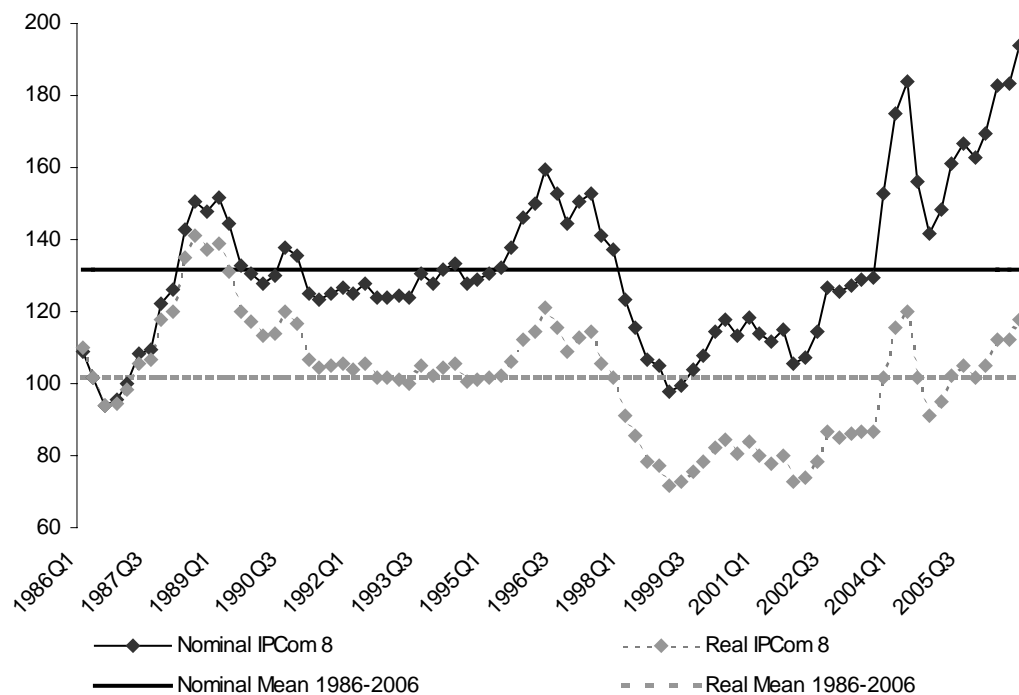
Graph 1. The very long run of Argentinean terms of trade



Source: ECLAC Office in Buenos Aires based on INDEC, Ministry of Finance and BCRA and others

As the most volatile component of the terms of trade series, commodity prices evolution is different to some extent. In the case of international prices we will focus in the last twenty years of data which is the rising terms of trade cycle previously identified. Our analysis of main commodity prices of Argentina will be conducted using the variable IPCom 8 which is a summary measure of the eight principal international commodities that Argentina exports. A full description of this variable will be giving in the section one of the appendix in conjunction with the rest of the variables that take part in the empirical model (section two of the appendix). For this moment we have draw two commodity series one in nominal terms and the other in real terms using in the later case the U.S GDP deflator.

Graph 2. Nominal and real indexes of Argentinean commodity prices, 1986-2006



Source: authors' calculations based on IMF and Central Bank of Argentina data

According to Graph 2 the commodity prices level of the 2004-2006 period are 28% higher in nominal terms compared with the average of the last twenty years. Moreover, in real terms the level of the last three years is only 4% higher to the twenty years mean. There is effectively a peak in the real prices during the last years, but this peak is not too different to those observed in 1995-1997, and clearly real commodity prices are lower to those that prevailed during 1988-1991. In the economic debate in Argentina this last fact tends to be ignored and short run analysis focus primary on nominal prices which partially resemble us the idea of money illusion.

Putting both series together we conclude that commodity prices are undoubtedly passing through a positive cycle, although the idea of a historical unique boom does not seem supported by the data.

We distinguish four phases in Graph 2. Firstly, a rising nominal and real prices cycle from 1986 to 1989. From 1989 on there is a second phase of relative steady nominal prices and slightly decaying real prices which ends with a new peak at the end of 1996.

The Asian crisis and the posterior period of financial turbulence produced a turning point and we observe a sharp decrease in both commodity series that start in the middle of 1997. As in the case of the debt crisis of the eighties it could be argued that international financial restrictions endogenously boosted supply of commodities. In the short run this supply increase could be fed by less domestic absorption in developing countries and a reduction in commodity stocks. In the medium term it is expected to observe rising levels of production.

In a third phase prices go down until the first quarter of 1999. From them on they remained below the historical means up to the second quarter of 2003.

The last cycle had two periods of sharp growth whit a short correction between the third and four quarters of 2004.

Thus, while terms of trade changed its trend in 1986, real commodity prices only took off in 2002 in a persistent fashion. This is an interesting fact since both series are expressed in real terms. It is possible that the explanation for this behaviour was due to a differentiated evolution in the denominators of both series. Particularly, it could be argued that Argentinean import prices have been influenced by a process of "commodification" of some manufactures. This idea originally introduced by Singer (1971) and Sakar and Singer (1991) is that manufactures are not immune to falling relative prices. Wood (1997), Kaplinsky (2005) and Kaplinsky and Santos-Paulino (2005) suggest that some categories of manufactures have experimented decaying prices, and these are predominantly manufactures in which China has become a mayor exporter.

This effect could help to explain the fact that Argentinean nominal import prices remains practically unchanged in the last ten years, a period in which China and other developing countries increased their share in Argentinean imports. Contrary to this effect, GDP deflator of the U.S has experimented an independent temporal evolution of steadily low growth.

4. The empirical model

The objective of this section is to evaluate the empirical validity of the models revisited in section 2. These models showed commodity price determination for Argentina's main exports during the 1986Q1-2003Q3 period.

Besides the determinants already studied by literature (interest rate, U.S real exchange rate, the world industrial production), we think it is also important to study the role of global liquidity.

Monetary conditions of international economy have not usually been taken into account in a direct way in the explanation of commodity price behaviour (see Graph A.2.2 in the Appendix). However, some studies, like HSBC (2007) and Dooley and Garber (2002) have pointed out that global liquidity is the key variable in order to explain the remarkable growth of world economy and the recent good performance in emerging markets financial assets. Because of these reasons, commodity values are expected to be influenced by the global liquidity level, beyond the effect captured by interest rate.

Regarding world demand, China's industrial production has been added to the developed countries industrial production with the objective of evaluating the role played by this new actor in raw materials markets.

As the objective of this paper are, on one hand, to establish if any long run relationships exist between commodity prices and the previously pointed out global factors, and on the other, to know commodity price short run dynamics in the presence of different shocks, we propose to estimate a vector error correcting model (VECM). Besides satisfying the objectives above, this methodology does not present the typical problems of univariate modelling.

We propose to estimate the model based on the following equation:

$$(3) \quad \Delta X_t = A_0 + \Pi X_{t-1} + \sum_{i=1}^{p-1} \Pi_i \Delta X_{t-i} + \varepsilon_t$$

Where the endogenous variables vector X_t is corresponds to the price index of eight main Argentinean commodities, the US real exchange rate, the financial return of the US treasury bond (one year), a global liquidity measure, and a developing countries plus china industrial production index. Details of data sources and time evolution of the variables are provided in section A.2 of the appendix.

In the long run equation we have added a time trend in order to control for the possibility of a Prebisch-Singer effect. As we have used a US GDP implicit price index to deflate commodity prices and this index has a high component of services and manufactures, the hypothesis would be that, given OECD demand, the pass-through of rising productivity to international prices has been more intense in commodity goods than in manufacture goods and tradable services.

5. The empirical results

The first methodological step in the VECM is to determine the order of integration of the series to be included in it. To this end, we have employed standard augmented unit root test of Dickey and Fuller (1979). In section A.3 of the appendix we show the results. As it could be inferred from them, it is not possible to reject the null hypothesis of a unit root in all the variables that enters in the VECM.

Since all the series are I(1), we proceed to estimate an unrestricted vector autoregressive model (VAR) in levels to determine the appropriate lag length and check the properties of the residuals. We follow the practical rule of considering the seasonal lag plus one, and so our unrestricted VAR is estimated whit five

lags. We next proceed to check the absence of serial autocorrelation and heteroskedasticity in the residuals. This results are shown in section A.4 of the appendix.

We following the Johansen (1991 and 1995) methodology in order to test the possibility of one or more cointegration relationships among our variables. In Table 1 we present the results of the trace (λ_{trace}) and maximum eigenvalues (λ_{max}) statistics. In this respect, it is important to remind that a deterministic trend has been included in the cointegration equation for the reasons presented in the previous section. In the first column of this table we place the number of cointegration equations under the null hypothesis. Following this, we can find the value of each statistic, the corresponding critical value, and finally the associated probability.

Table 1. Results of the cointegration tests

Trace Test			
Number of Cointegration Equations	Trace Statistic	5% Critical Value	Probability**
None*	0.3917	107.35	0.0012
At most 1*	0.2653	66.08	0.0322
At most 2	0.2164	40.49	0.0856
At most 3	0.1524	20.24	0.2138
At most 4	0.0754	6.51	0.3981
Maximun Eigenvalues Test			
Number of Cointegration Equations	Max-Eigen Statistic	5% Critical Value	Probability**
None*	0.3917	41.27	0.0223
At most 1	0.2653	25.59	0.2531
At most 2	0.2164	20.24	0.2292
At most 3	0.1524	13.73	0.2726
At most 4	0.0754	6.51	0.3981

*Denotes rejection of the null hypothesis at the 0.05 significance level

**P Values based on MacKinnon et. al (1999)

As we observe from the table both test produce different results. Trace test indicates the presence of two cointegration equations while maximum eigenvalues test suggests one equation. When the coefficients of the first cointegration equation are normalized we obtain the coefficients and the t statistics of the long run equation which are presented in Table 2. In this table, the left hand side variable is the commodity prices index.

Table 2. Long run relationship between commodity prices and its drivers

	Real exchange rate**	Interest rate*	International liquidity*	Industrial production*	Time trend*
Coefficient	0.4922	-5.5945	2.2011	-4.6324	-0.0189
t statistic	(-1.6744)	(2.7607)	(-5.1067)	(5.0944)	(2.8349)
p-value	0.100	0.008	0.000	0.000	0.006

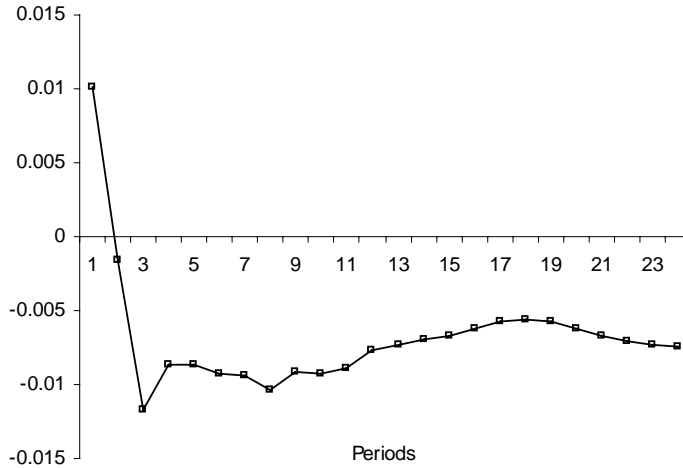
*Denotes rejection of the null hypothesis at the 0.05 significance level

**Denotes rejection of the null hypothesis at the 0.10 significance level

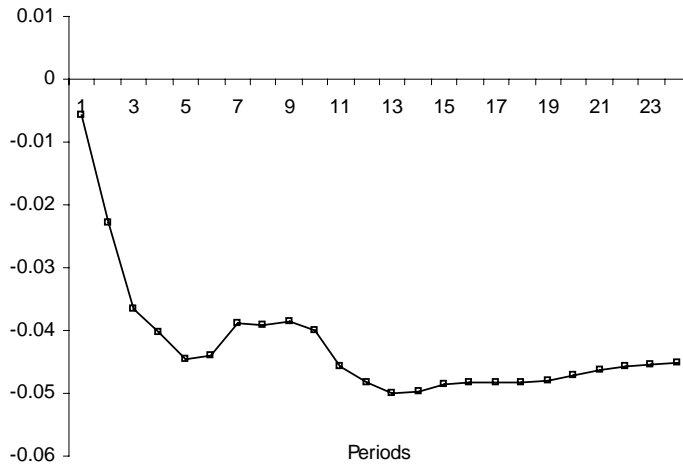
Previous to the analysis of the economic consequences of the econometric results showed in Table 2, we have opted to introduce the short run dynamics of the VECM. We then discuss simultaneously both long and short run implications of our model.

In the next sequence of graphs the results of the impulse-response analysis are presented. It is important to take into consideration two things. Firstly, these graphs make reference to accumulated impulse-response functions. Secondly and more important, in order to identify the structural innovations we have employed the Cholesky factorization based on some economic intuition regarding the order of the variables. We have assumed that liquidity shocks of the VECM in reduced form are identical to the structural shocks. Thus, liquidity is the most exogenous variable in the sense that its instantaneous impact over the remaining variables is no null. The remaining variables are put in the following order: real interest rate, real exchange rate, industrial production, and finally real commodity prices. As it is usual, results are measured as a percentage of change in the variable that receives the shock and the magnitude of it is one standard deviation of each variable.

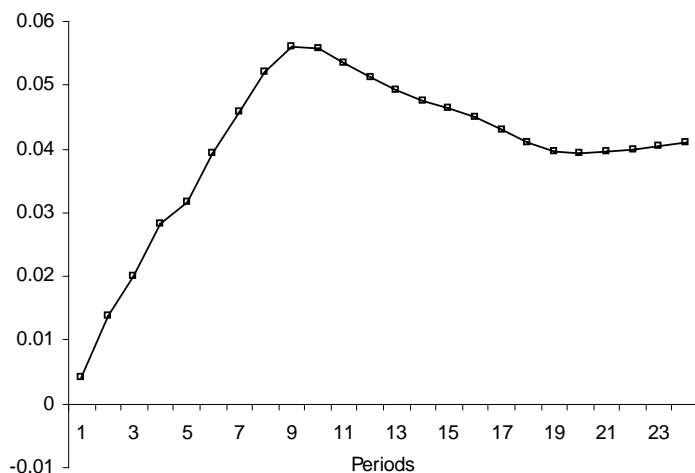
Graph 3. Accumulated responses of real commodity prices to a real exchange rate shock



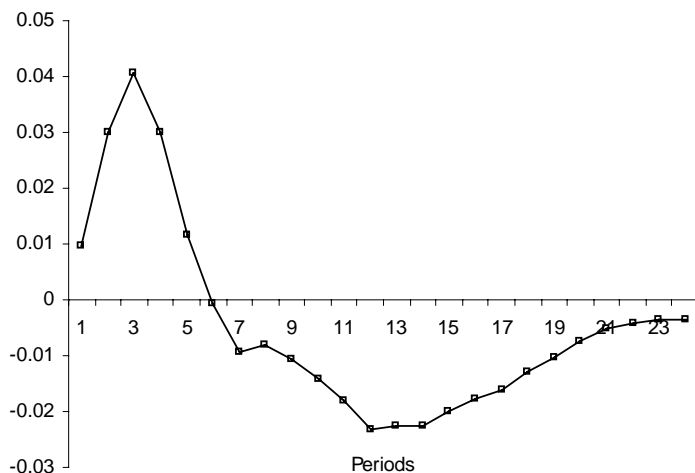
Graph 4. Accumulated responses of real commodity prices to a real interest rate shock



Graph 5. Accumulated responses of real commodity prices to a international liquidity shock



Graph 6. Accumulated responses of real commodity prices to a industrial production shock



From the analysis of Table 2 and Graphs 3 to 6 we see that the proposed variables are statistically significant and their signs in the long run relationship and in the impulse response analysis are the expected ones in almost every case.

Real effective exchange rate of the U.S shows a negative and significant relationship. This is consistent with previous empirical results and with anecdotal evidence which suggests that big dollar depreciations have been associated with rises in real prices and vice versa. This elasticity as is theoretically expected lies between zero and minus one. This is a novel feature of our empirical estimations since former works have systematically presented a value higher than one in absolute value. Regarding short run responses, we observe an overall negative response but its magnitude is small.

Real interest rate presents a negative sign in the long run equation. This would indicate that rising financial cost of inventories increased current supply and reduce prices. In the same way, the interest rate could work as a predictor of an economical slowdown which results in future supply excess that depresses current prices. Besides, the short run dynamic response of one standard innovation shock in the real interest rate cause a accumulated drop in commodity prices of approximately 4.5 percentage points.

International liquidity appears as a significant determinant of prices which would indicate that the remarkable rise in dollar liquidity has put some pressure on highly tradable and competitive goods markets, even when this liquidity increase is partially sterilized by reserve accumulators countries.

The later result could help to understand some of the most discussed elements in the global imbalances literature which are the effects of excessive liquidity on prices, and the importance of sterilization and the distribution of costs and benefits of imbalances across countries. Also impulse response functions behave as it was expected. A positive shock in liquidity generates a cumulative change of about 5%.

The demand for raw materials which was approximated by the industrial production index of OECD countries plus China, presents contradictory between short and long run. During the first five quarters the response to a shock in demand is positive as expected by theoretical models, but in the long run the sign reverts. Since the type of commodities that dominate our index are the agricultural ones, it is possible that this short run result represents the immediate reaction to an unexpected increase in demand and that flexible supply starts to adjust as time pass in order to fulfil the gap.

In fact, if we substitute the traditional variable of demand in levels for the same variable expressed as a difference regarding a time trend (a rough proxy for output gap) the sign in the long run relationship turns positive.

The variable appears significant but with a negative sign. This implies that in the last twenty years the rise in industrial production volume has been associated with low commodity prices. When we tried with alternative variables to the ones suggested by literature, for example, the variation of industrial production respect to a long run trend, the result has the expected positive sign.

Differently from what theoretical models assumed, supply would only be fixed in the short run, but quite flexible in the medium run (i.e. when the harvest is wider or new extractions are possible). This, added up with the Presbich-Singer effect i.e. a bigger transfer of productivity to commodity prices regard more elaborated manufactured goods, would explain the negative trend in prices.

This differentiated reaction between short and long run open a theoretical and methodological discussion regarding future extension of this type of research. Firstly, is necessary go further of the traditional demand determined models in order to build more complex dynamic models that allows for a medium run reaction of supply. The simple tentative of adding supply in Borenstein and Reinhart (1994) are a strand that needs to be developed with the capacity of agricultural supplier to react (or possible, overreact) to higher prices.

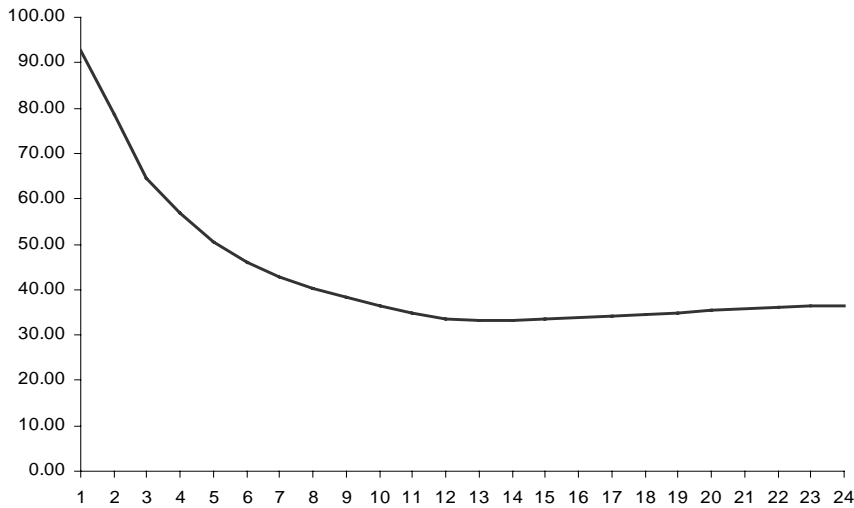
Regarding empirical investigation of supply issues Borenstein y Reinhart (1994) simplify the problem approximating annual world supply with imports of commodities from OECD countries because they are interested in the whole sample of commodities except oil. So to associate demand with industrial production of OECD and supply with commodity imports from OECD could be acceptable. But in the type of model like the one presented here, things are more difficult. We are interested in a specific weighted index then the assumption that we should made in a production index are non-neutrals. Additionally, there are not quarterly data of specific agricultural production.

In summary, the interaction between supply and demand would show that the trend in prices has been ruled by supply, but that strong or/and unexpected shifts en international demand rise or depress them cyclically. In this way, its left to see if the strong growth in our demand series because of China's additional demand, produces a permanent jump on commodity prices or a cyclical jump to witch supply will adjust in the medium term, returning to the negative trend. Regarding the actual phase of the prices, we can see that its degree of persistence will depend on the persistence of the shock in monetary variables, as well as the supply elasticity to new levels of demand.

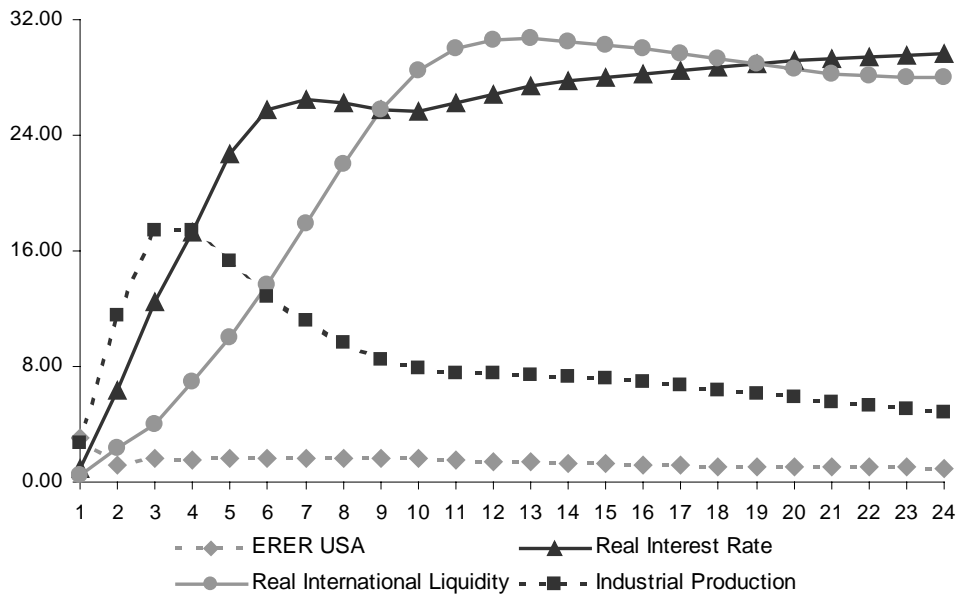
Other important instrument of the VECM is the variance decomposition analysis. In Graph 7 below we have draw the share of commodity prices variance due to its own shocks while in Graph 8 we present the decomposition due to the remaining shocks that take part of the system.

As we could see the more important source of shocks in this model are the financial variables related to international liquidity and the interest rate. This confirms that financial factors are not only important determinants of commodity prices long run values but also main drives of short run dynamics.

Graph 7. Accumulated responses of real commodity prices to a industrial production shock



Graph 8. Accumulated responses of real commodity prices to each type of shocks



6. Conclusions

High commodity prices have gained weight as an explanation of recent growth cycle in Argentina and Latin America. If we take an index that reflexes commodity price dynamics of Argentina’s main eight commodity exports, we could see that prices between 2005-2006 are 28% higher in nominal terms, than it’s average of 20 last years. In real terms, this figure is only a 5% increase. In real terms, commodity prices are today similar to those observed in 1995-1997 but inferior to those of the 1988-1991 phase. An analysis of the recent commodity prices cycle shows that after an abrupt fall provoked by the Asian crisis in 1997-8, prices have experimented a sustained recovery.

In this paper we have tried to deduce which are the main determinants of the prices of Argentina’s main commodities. For that, we have explored different theoretical explanations and constructed an empirical

multivariate model (VECM) that takes into account the interaction between the variables and also short and long run relationships.

Theoretical evidence indicates that commodity prices are mainly determined by the real effective exchange rate of the dollar (with a negative sign) and by the demand of raw materials by consumer countries (with a positive sign). In some models interest rate is added, basically because its effect on speculative demand: a lower rate of interest stimulates speculators to buy commodities as an alternative to financial assets. This phenomenon has grown in recent years and this could be reflecting what is called the "financialization" of commodity¹⁴. This implies that commodities have become an increasingly important part in investments fund portfolios. Most existing models are in general demand determined, where supply is assumed to be given and also perfect competition in international commodity markets.

However, from our perspective is relevant to complete theoretical ideas with the vision that emerges of the literature related to the deterioration trend of raw material prices regard industrial goods. The existence of auction markets for raw materials and customer markets for industrial goods and tradable services makes that productivity growth transfers to prices at different speeds.

In our empirical model we have taken into account the effect of time through a specific trend variable. Finally, we have also introduced a variable that represents real international liquidity in dollars, that complements interest rate as an indicator of global liquidity conditions.

The VECM model establishes that a cointegration relationship exists among the determinants previously mentioned and commodity prices. In this long run relationship, all variables are significant and adjust to equilibrium correctly while its signs are the expected in most cases.

In particular, the real exchange rate has a negative sign and its elasticity is lower than one as it is anticipated in the models.

The increases in global liquidity is associated with the higher prices of commodity, this could be highly for the last part of the sample.

Real interest rate represent the opportunity cost of stocking commodities, it presents the expected negative sign that an increase reduce the incentive to accumulate more commodities in the portfolio and by doing so, makes prices fall.

The global demand of raw material is captured by the level of industrial production index of OECD countries plus China. It is the only variable that shows an opposite sign between the short and the long run. The former is positive, as it is expected, and the later is negative which could indicate a reaction of supply to higher prices in the previous year.

Finally, the trend that represents the Presbich-Singer effects is significant and negative evidencing a faster velocity of transmission of productivity shocks to prices in commodity competitive markets than in manufactures customer markets.

As a general conclusion of our empirical model we have that most of the macroeconomic variables that determine commodity prices and perceived value for the exporting economy are the same that influence capital flows from the centre to the periphery. Such is the case of the U.S real exchange rate, the interest rate and the global liquidity. These variables, of a monetary nature, coordinate the exogenous cycle in countries like Argentina and act by two channels: the commercial and the financial channels (Carrera, Féliz and Panigo, 2000; Canova, 2005). This source of positive correlation between channel increase exogenous volatility received from the centre.

Hence, for a developing country more international liquidity, less interests rates and a dollar depreciation generate higher commodity prices, enhanced sustainability and risk perception, attract more capital flows and investment, and produce more growth alongside with inflationary and appreciatory pressures. When global economic conditions change in the centre, all of this effects reverted and it is possible to find overshooting in commodity prices fall (Frankel, 2006).

Since international variables that determine commercial and financial cycles in a open economy like Argentina overlap, it is difficult to cushion real commercial shocks using international financial markets. If the fall in prices were caused by monetary tightening and dollar appreciation it would be more difficult to finance the shortfall in domestic income with external finance. This suggests that a good domestic strategy

¹⁴ According to Domanski and Heat (2006) the number of outstanding contracts on gold and commodities in millions of dollars has more than doubled between 2003 y 2006.

should take into account developing domestic measures to smooth external cycles when prices are in high levels.

Regarding policy recommendations designated to such end, there are some that belong to the macroeconomic field and other that are structural measures.

Among the first ones, they should reduce cycle volatility smoothing transitory elements. We can list some of them: keeping a flexible exchange rate, accumulate international reserve, avoid real exchange rate overshooting respect to its long run equilibrium, implement a tax-subsidies system to exports accordingly the phase of external price cycle, establish fiscal funds to stabilize expenditure and adopt countercyclical regulations of short term capital flows. Other more innovative measures are the hedging proposals made by Caballero (2002) to create financial funds that take into account the correlation of commodities to other financial asset and Frankel's recommendation to use as a monetary policy target an export price index.

Structural policy measures should try to deal with the declining trend in prices. Thus, increasing diversification in commodity exports as well as enhancing production chains for each raw material through an industrialization process would help to reduce price volatility. Other fronts of policy should be posed in developing infrastructure and also stimulates local financial instruments intended to diminish future uncertainty. Finally, coordination between producer countries could collaborate to stabilize markets even though its implementation seem rather difficult.

The last paragraph is again devoted the current high prices phase. Accordingly to our analysis, is still valid to say that the force that moves the price wind is the great liquidity existing in the world, even when increasing demand of commodities from countries like China and India, and the long way that could take to this countries to catch up the developed world in terms of commodities consumption, are considered. As variables that represent liquidity had changed many times in the past, it is possible that they can do it once again. In other words, it is probable that an important part of the recent positive shock reflects transitory conditions. Countries like Argentina should profit this period to minimize the costs of future reversions.

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Appendix

A.1. Commodity prices index

We have constructed an index of the prices of the eight main commodities exported by Argentina (IPCom8). The following table shows the commodities considered as well as their shares in the total exports of Argentina in 2006. The weight of each commodity in the index is calculated according to these figures

Table A. 1. Construction of the Argentinean Commodity Price Index

Commodity	Share in Total Exports	Price Index Weight
Soybeans	3.8	13.3
Soybeans oil	6.0	20.9
Soybeans meal	9.3	32.6
Maize	2.7	9.5
Wheat	3.2	11.1
Aluminium	0.8	2.6
Metals	0.5	1.7
Beef	2.4	8.3
Total	28.7	100.0

Our index contains the same products included in Index of commodity prices published by the BCRA, but differently to that index we use fixed weights along the whole period considered, particularly those corresponding to the year 2006. The main justification of that is that BCRA index is a chained Laspeyres index where the weights are updated every year. Since part of the evolution of that index reflects changes in shares and we want to capture the pure price effect. But more important to this is the fact that we have excluded oil and cooper in comparison with the index of the BCRA. The reason is that we want to focus on highly consolidated export sectors that are related to the traditional comparative advantages, and has room to growth in the near future.

The nominal prices are taken from International Financial Statistics (IMF). In the econometric analysis the IPCom8 is deflated by the GDP implicit price deflator of USA (IFS-IMF).

A.2. Description of the international variables

In this part, construction and sources of global commodity price determinants are explained in detail. We use quarterly data for the period 1986-2006. All variables were seasonally adjusted (except for the interest rate and real global liquidity) by the X-12 Arima method and are expressed in logarithms.

US Multilateral Real Exchange Rate

The broad multilateral real exchange rate index series from the Federal Reserve Bank of New York was used.

Real Global Liquidity

This series is the result of the sum of the US monetary base and international reserves held by central banks all over the world. The seasonally adjusted monetary base from the Board of Governors of the Federal Reserve System and the world total reserve series from the International Financial Statistics (IFS-IMF) were used in its construction. “001.1..SZF...” To deflate the variable the USA GDP implicit price deflator was used (“11199BIRZF...” IFS series).

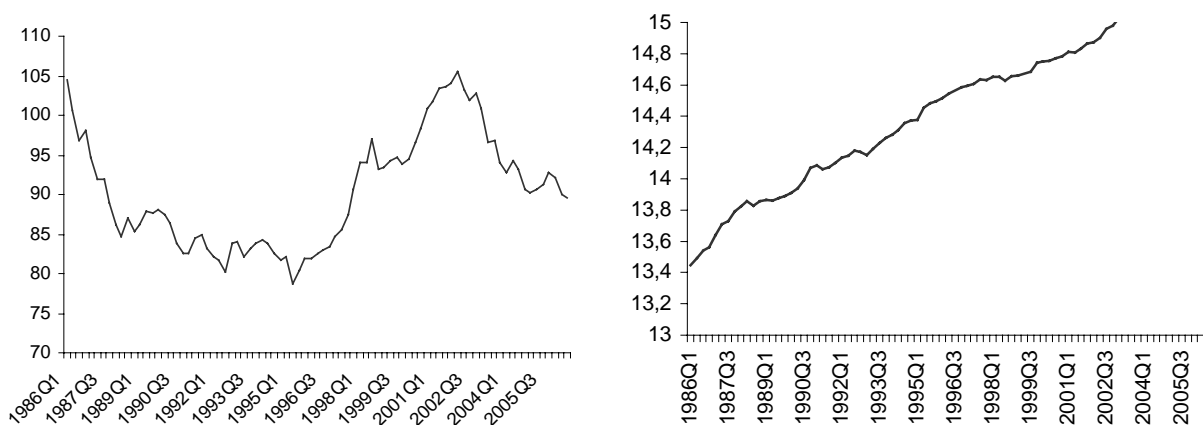
Real Interest Rate

The 1-Year Treasury Constant Maturity Rate from the Board of Governors of the Federal Reserve System was utilized and deflated by the USA GDP deflator.

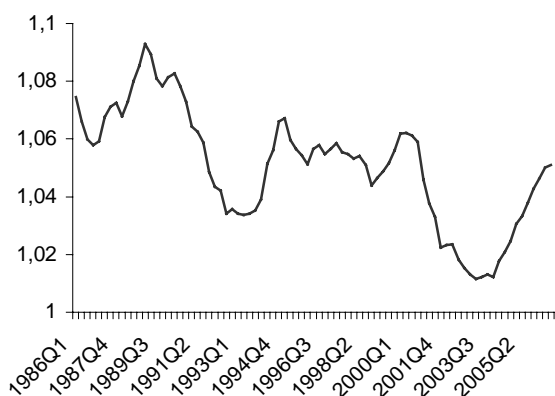
Industrial Production Index

A developed countries plus China industrial production index was built. As there is no industrial production index for the last country, we used the industrial added value employing IFS and World Development Indicators (World Bank) data as an approximate measure. For developed economies IFS IPI series (“11066..IZF...” series) was used. Both indexes were weighted by the respective industrial added value.

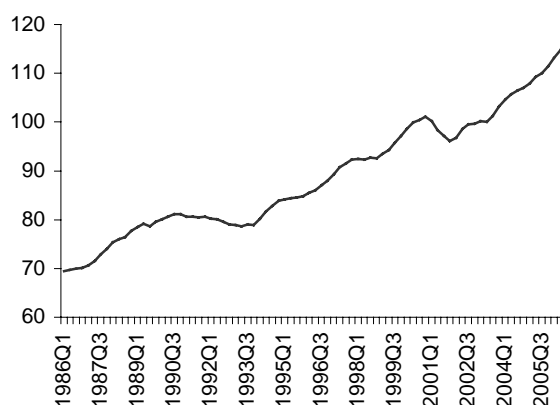
Graph A.2.1 Multilateral Real Exchange Rate Graph A.2.2 Real Global Liquidity (logarithmic scale)



Graph A.2.3 Real Interest Rate



Graph A.2.4 Industrial Production



A.3. Unit root tests

Table A.2. Summary of the Augmented Dickey-Fuller test

Variable	Deterministic regressors		
	None	Constant	Constant and trend
IPCom8	0.4602	0.1937	0.1168
MRER USA	0.7279	0.3954	0.6943
Real Global Liquidity	0.9999	0.9999	0.2687
Real Interest Rate	0.3093	0.2927	0.0336
Industrial Production Index	0.9994	0.9786	0.1736

A.4. Unrestricted VAR residuals

Table A.3. VAR Residual: Serial Correlation LM test

H0: no serial correlation at lag order h
 Sample: 1986Q1 2006Q4
 Included observations: 83

Lags	LM-Stat	Prob
1	32.90498	0.13346
2	32.27370	0.15024
3	34.15704	0.10459
4	37.07791	0.05676
5	19.66240	0.76430
6	34.25041	0.10266
7	31.09528	0.18588
8	22.77168	0.59089
9	24.23186	0.50601
10	17.95039	0.84449
11	31.10532	0.18555
12	30.49116	0.20642

Table A.4. VAR Residual: White Heteroskedasticity Test

H0: no heteroskedasticity
 Sample: 1986Q1 2006Q4
 Included observations: 83

Chi-sq	df	Prob.
726.62940	750	0.72326