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Inflation Determinants in Paraguay: Cost Push versus Demand Pull Factors

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Inflation Determinants in Paraguay: Cost Push versus Demand Pull Factors

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Abstract

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This article uses two analytical methodologies to understand the dynamics of inflation in Paraguay, the mark-up theory of inflation and the monetary theory of inflation. We also study the impact of different monetary aggregates. The results suggest that monetary factors, in particular currency in circulation, play a major role in determining long-run inflation, while foreign prices, in particular from Brazil, or some food products have a large impact on the short-term dynamics of inflation. Wage indexation may also contribute to locking up price increases.
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II. INTRODUCTION

Paraguay evaded the bouts of hyperinflation that affected most countries in Latin America over the post-war period, but, as inflation started to decline in neighboring countries, it remained afflicted with moderate inflation. In the region, it shares these characteristics of never experiencing three digit inflation over the past fifty years only with Colombia. However, inflation in Paraguay over the past ten years has been on average higher than in most other countries in the region, as if the experience of hyperinflation (and the institutional changes that resulted) had cured these countries even from moderate inflation.[2]

Over the recent past, inflation has also been highly volatile. The volatility reflects in part external factors related to the specific position of Paraguay as an exporter of primary commodities (subject to related supply shocks) located between two large neighbors, and exposed to the spillovers from regional financial crises. Paraguay has also been affected by the world increase of food and energy prices.[3] Nonetheless, the domestic component to inflation volatility should not be underestimated. For example in 2006-07, the sharp gyration of a few agricultural product prices led to year-long decoupling between headline and core inflation that left the general public puzzled.

This paper uses different methodologies to understand the dynamics of inflation since the early 1990s.[4] An obvious starting point consists in looking at the structure of the Consumer Price Index published by the Central Bank (BCP) and at its different component. Given the high volatility of headline inflation, the rest of the paper focuses on the determinants of core inflation indicators. Two different analytical points of view are used to assess the long-term determinants of inflation, before encompassing them to study the short-term dynamics of inflation. One of such approaches is the mark-up theory of inflation, where prices are modeled as a function of domestic costs and imported prices. In the other approach, inflation results from the deviation of real money demand from its long-term determinants. In particular, the paper evaluates the impact of different monetary aggregates, from currency in circulation to broad money, to assess which is the most robust. All econometric models are estimated using quarterly data for 1991-2007.

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[2] See Annex I, for a historical comparison of inflation in Paraguay versus Latin America. Paraguay only experienced two episodes of high inflation in the post-war period: in the early 1950s inflation briefly crossed over the one hundred percent threshold during the civil war period; in the early 1990s economic liberalization and the opening up of the economy sent inflation shooting up above forty percent.

[3] For an analysis for Latin America of the food and fuel price shocks, see IMF (2008).

[4] Inflation has been the focus of research at the Central Bank of Paraguay (BCP). For example, BCP (2005) study the pass-through and inflation determinants; and Rojas-Paez and Wenniger (2006) estimate money demand.

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The results suggest that monetary factors, in particular currency in circulation, have played a major role in determining long-run inflation, while foreign prices, in particular from Brazil, and some food products have had a large impact on the short-term dynamics of inflation. There is also an interesting dichotomy between the exchange rate with respect to the U.S., which matters for currency demand in the long-run, and the exchange rate with respect to Brazil which matters for cost-push inflation in the short-run. The evolution of some food prices matters beyond their already large share in the CPI basket, possibly because wage indexation—or expectations of continued moderate inflation going forward—tends to lock up price increases.

Section II discusses headline and core inflation indexes. Sections III and IV investigates the long-run determinants of inflation using respectively the analytical framework of the mark-up theory and of the monetary approach. Section V presents the short-term inflation dynamics while Section VI includes concluding remarks.

III. Measuring Inflation

Having an accurate and reliable measure of inflation appropriate for monetary policy is far from straightforward. Headline inflation, measured by the Consumer Price Index (CPI), is well known to present both some noise (due to the impact of its most volatile components), and some bias (due to substitution effects).[5] This section presents the characteristics of headline inflation and discusses the use of alternative inflation indicators.

A. Headline Inflation[6]

During the period under study, headline inflation was volatile and influenced by countless supply shocks (mostly food and, to a lesser extend, energy items) which do not reflect aggregate demand pressures nor imbalances in the money market.

Food items have experienced significant supply shocks over the recent period, contributing to overall inflation way beyond what would be expected from their share in the basket. Food

[5] For a discussion of inflation measurement and proposals for choosing different underlying inflation measures, see Cecchetti (1996), Marques et al. (2002), or Silver (2006). Heenan, Peter, and Roger (2006) in particular discuss the choice of the inflation indicator in the case of inflation targeting countries. Paraguay cannot be considered a full-fledged inflation targeting country as inflation is only one among many objectives. Since 2003, however, the Central bank has announced an end-year target for inflation with a broad band of +/- 2.5 percentage points.

[6] Inflation in the sample period (1991-2007) is measured by a consumer price index (CPI) based on the 1992 household budget survey that is considered obsolete. Since January 2008, the BCP started publishing a new CPI based on the 2005 household budget survey. The new basket gives less weight to food items, which have been one of the main reasons of price increases over the past two years. Had the weights of the new index been used in 2007, headline inflation could have been 1½ percent lower on average. See Annex III on the new index.

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items can be classified in three main components, each having its own dynamics independent of the others:

- *Fruits and vegetables*. They represent 6 ¼ percent of the CPI basket (reduced to 5 percent in the new index). This is by far the most volatile component of the basket, with a coefficient of variation about 5 times larger than that of the index in general. Fresh food is naturally influenced by changing weather conditions, but political interference has played an important role since 2006[7]. In particular, the wide variations in the price of tomatoes, which represent only about one percent of the CPI, could move year-on-year headline CPI by 2-3 percent.[8] The wide fluctuations of tomato price and their impact on headline CPI illustrate to the extreme the substitution bias of headline CPI.

- *Meat products*. They represent 10¾ percent of the CPI basket (relatively unchanged in the new index). The category is largely dominated by beef products, which represent about 4/5 of meat products. The domestic price of meat has been influenced not just by the international price of beef, but also the impact of foot-and-mouth diseases (FMD), either at home or in neighboring competing producers[9]. Beef prices contributed on average by 2 percent to annual inflation between 2003 and 2006.

- *Other food items*. They represent 18.4 percent of the basket (against 16.5 in the new basket). Historically, they have tended to evolve in line with non-food prices. Starting in mid-2007, however, milk and bread products have increased worldwide. These products represent about 8-10 percent of the basket and have increased by around 30 percent between June 2007 and June 2008. In the case of milk, the increase in the

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[7] For instance, the periodic imposition or removal of sanitary controls of imported fresh food products, in order to protect domestic producers, led to a year-on-year increase of up to 110 percent of fruits and vegetables in August 2007, followed by a collapse three months later, with a monthly decline of 30 percent in November. Reduced political interference in 2008 has led to a decrease of the volatility of this category.

[8] To give an idea of the volatility of tomato prices: between August and December 2006 the price of tomatoes increased by 350 percent, before being reduced by half until July 2007; in November 2007, after having gained 68 percent in the previous three months, the price collapsed by 72 percent before rebounding by 69 percent in December.

[9] The evolution of beef prices has followed the chronology of FMD episodes in the region:
- Starting in 2000, regional outbreak hit Paraguayan beef producers and domestic price started to decouple from the international price. In 2002, several outbreaks of FMD led to the closure of Paraguayan export markets.
- In 2005, Paraguay recovered its status of "FMD-free with vaccination" from the World Organization of Animal Health while some provinces in Brazil and later in Argentina were deprived of this status. This provided a major boost for Paraguayan beef, further enhanced by export restrictions from Argentina. Between July 2002 and July 2006, beef components of the CPI index increases by 140 percent.
- In 2007, the reopening of Brazilian markets led beef importers to shift away from Paraguay and contributed to a decline of beef prices in early 2007, although they recovered in the second part of the year. In 2008, they have increased in line with overall inflation.

price responded more to a supply effect due to a severe drought in the Chaco region of Argentina and Paraguay, affecting milk production.

Another source of supply shocks come from energy products, which represent about 3½ percent of the basket (increased to 5¾ percent in the new basket). While the international price of oil was relatively stable in nominal terms for most of the 1990's, it fell in real terms, with a significant fall in 1997-98, since then the international price of oil has been on an upward trend. There is no government interference in the market for gasoline and natural gas and their domestic prices follow closely international trends with a lag. However, the government tries to stabilize the domestic price of diesel, resulting in occasional subsidies. This adds an additional source of uncertainty as diesel prices tends to move in sharp steps. The impact of energy prices is also captured partly by administrated prices because of the role of oil as an input for public transport. Recently and until mid-2007, both energy and administrated prices have contributed to lower headline inflation. Since then, they have administrated prices have increased in line with overall inflation, while fuel products increased by twice as much.

Figure 1c presents several indicators of inflation stance. An analytically interesting slicing of the CPI index consists in distinguishing between tradable and non-tradable goods. For clarity, we present tradable goods excluding impact of fruits and vegetables (all tradable goods):

- *Non-tradable goods*. During the first half of the sample, non-tradable inflation has tended to be consistently higher than average core inflation; this result stand for all categories of non-tradable (administrated prices, education or health, other services). By contrast, since 2002, non-tradable have been consistently lower, even if one excludes administrated prices.[10] This may reflect the impact of lower real wages in the public sector since 2001, as evidenced by the lower inflation rate of education or health, but also more broadly a less inflationary environment, also reflected in the trend decline in unit labor costs.

- *Tradable goods*. The spikes in inflation, in 1998, 2003, and 2006, are driven primarily by tradable goods. Paraguay experienced significant depreciation with respect to the U.S. dollar in 1998 and 2003. By contrast, in 2006, the depreciation with respect to the U.S. dollar was relatively mild (and following a period of appreciation), but the *guarani* depreciated with respect to the *real*. In addition, higher fuel prices seem to have contributed to this last episode of inflation.

[10] Administrated prices cover utilities (water and electricity), phone, and public transport. The slow growth of administrated prices reflects in part productivity improvement in the state-owned utility sector, leading to a stability of users' fees, and in part the moderation of fuel prices measured in local currency affecting public transport.

Panel Figures 1: Indicators of inflation stance

Fig. 1a : Headline and core inflations and contribution of fruits and vegetables

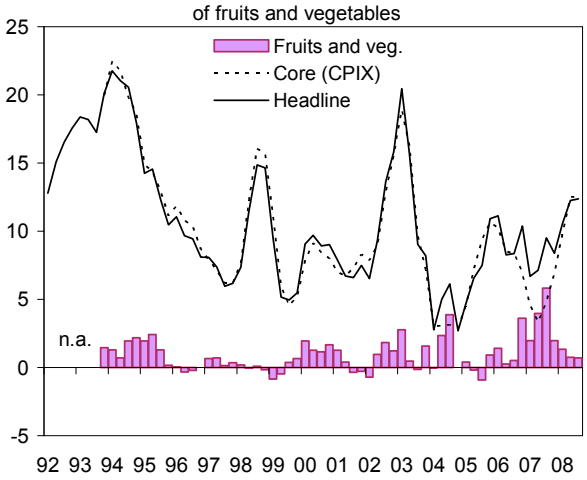


Fig. 1b: Contribution of food components to headline inflation and non food inflation

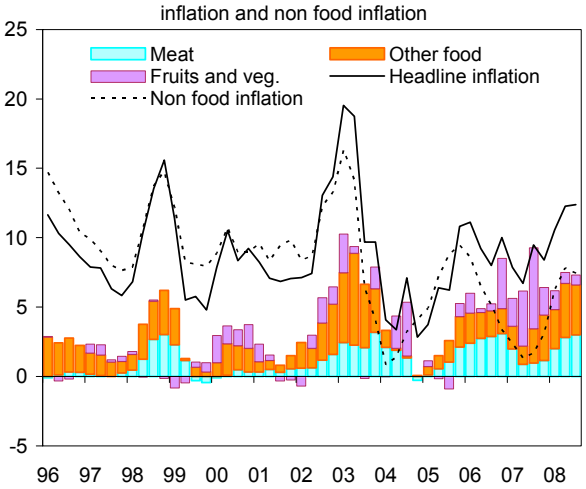


Fig. 1c : Headline, tradable and non-tradable inflation

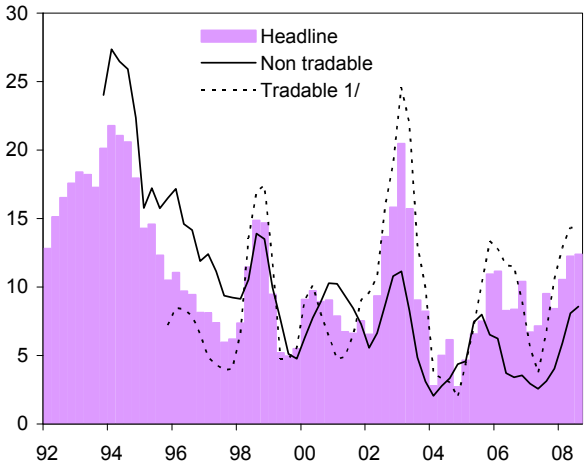
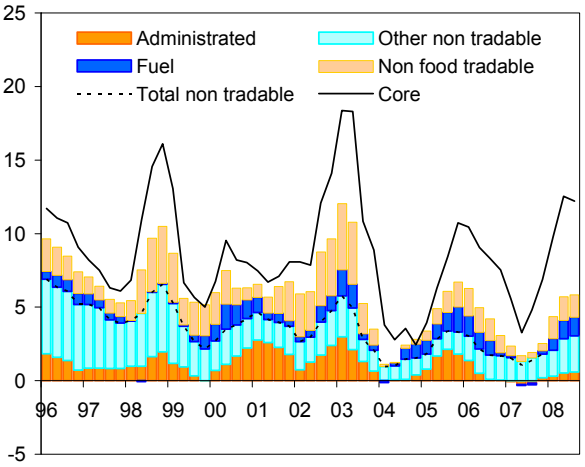


Fig. 1d: Contribution to core inflation



1/ Excluding fruits and vegetables from tradables.

Fig. 1e: Indicators of inflationary stance in 2004-07

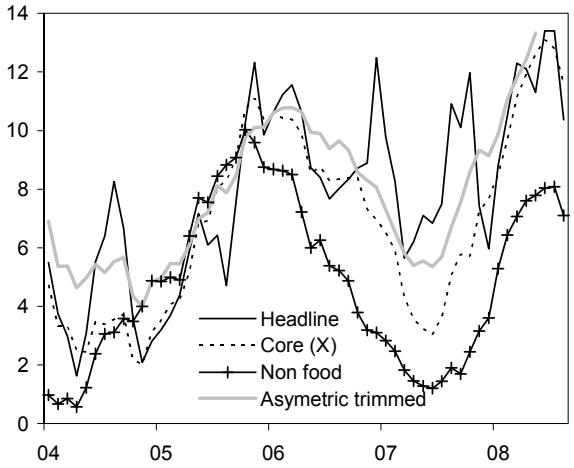
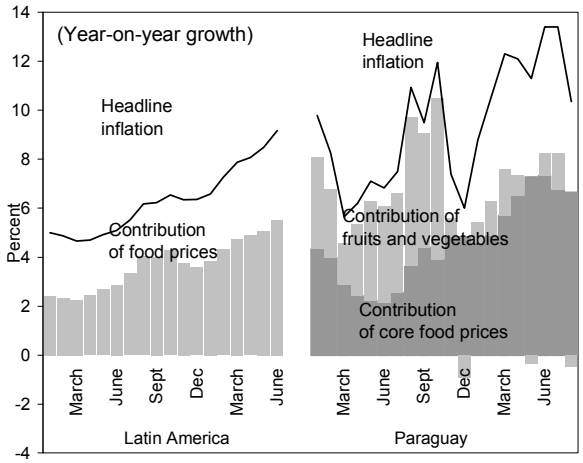


Fig. 1f: Headline inflation and food contribution in 2007-08



Sources: authors' estimates.

B. Core Inflation Measures

Indexes of core or underlying inflation allow to abstract from transitory factors and aim at identifying the permanent component of inflation. The Central Bank produces two exclusion-based core inflation indicators, "CPIX" which is headline inflation excluding fruits and vegetables, and "CPIX1" which also excludes fuel items and products subject to administrated prices. In addition, we suggest two alternative indexes of core inflation, a simple non-food inflation index and a trimmed index. The properties of the different core inflation indexes are analyzed in the following subsection.

An alternative core inflation index could exclude all food products as in done in some advanced economies. While one may consider that, food items are beyond the control of monetary policy as they are driven mostly by supply shocks, such exclusion would appear radical, given that food represent between 35-40 percent of the CPI.

Finally, a core inflation indicator could be created with a trimmed index by excluding items according to their volatility in a given month rather than being related to a specific category of goods. A trimmed index excludes a fixed portion of the items with the largest decline and with the largest increase. Trimmed index thus allow to exclude on-off large adjustment, for example a spike in one item's price because of supply disruptions. They tend to give a sense of the general direction of inflation. Trimmed indexes with symmetric exclusion of the largest and the smallest changes tend to be systematically biased downward because of the tendency of prices to increase sharply but to moderate gradually (Silver, 2006). By contrast, asymmetric index may reflect better the underlying inflationary trend. We constructed four different trimmed indicators,[11] two excluding symmetrically 10 and 20 percent of the most volatile components, and two asymmetric excluding ⅓ are the most volatile and ⅔ are the least volatile.

C. Properties of Inflation Indicators

The choice between different core inflation indexes depends on their intended use, that is, whether the index is used to identify current inflation trends, measure inflation produced by excess aggregate demand, or provide an indication of future inflation. To assess the properties of the core inflation indexes discussed above, Table 1 presents a set of different indicators measuring the desirable properties of the core inflation indexes:

- *Benchmark*. The standard deviation measures the volatility of the index. Similarly, bias measures the deviation of the index from headline inflation. Although headline inflation may be more volatile than core inflation indexes, it remains the most comprehensive index and as such is taken as the benchmark for calculating the bias.

[11] We thank Jorge Canales Kriljenko for sharing with us a template to compute trimmed inflation indexes.

- *Volatility*. The root mean square error (RMSE) measures the deviation of the indexes with the moving average (over 18 or 36 months) of headline inflation. This gives an idea whether the indexes reflect medium-term inflation.

- *Attraction*. By contrast, the measure of attraction proposed by Marques et al. (2000) is more forward looking. It measures the coefficient of the regression of the difference of inflation *h* period ahead and current inflation with the difference between current headline and core values.[12]

- *Causality*. Granger causality tests also provide some indications on the forward looking properties of the core index. The test indicates whether lagged values of core inflation have a predictive power for headline inflation. We do not report in the table the predictive power of headline inflation for the core index considered.

Over the sample period, all exclusion based-core indexes show a slightly higher volatility than headline inflation. These indexes are also biased downward, the bias being greater for the CPIX1 because of the significant larger increase of administrated prices and fuel prices compared to other prices.[13] By contrast and as expected trimmed mean indexes show a much lower volatility, but at the price a significant bias for symmetric indexes. The asymmetric index excluding only 10 percent of the items of the basket has both a lower volatility and a small (positive) bias.

Regarding which index offers a better proxy of average inflation over the medium-term, non-food inflation and the asymmetric index at 10 percent have the lower RMSE for inflation measured as a moving average of 36 months. If the medium-term inflation is measured over a moving average of 18 months, only the asymmetric indexes have significant lower RMSE.

Concerning the forecasting properties of the core inflation indexes, the asymmetric indexes also present the absolute value of the coefficient closer to unity. The symmetric indexes tend to underestimate future headline inflation, while exclusion based index tend to overestimate future headline inflation and by more than the asymmetric index. Granger causality tests show that most variables tend to Granger-cause headline inflation at longer horizons (3 to 6 months), with the exception of CPIX1 and non-food inflation.

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[12] Specifically, the equation estimated is the following: $\pi_{t+h} - \pi_t = \alpha_h + \beta_h(\pi_t - \pi_t^c) + \varepsilon_{t+h}$ where π_t is headline and π_t^c is core inflation. As π_t - π_t^c measures the short-lived inflation components, one expects the coefficient β_h to be negative and close to -1. In addition, if the absolute value of the coefficient is higher (lower) unity, the core measure tends to underestimate (overestimate) the inflation rate.

[13] They increased by 11.5 and 16.3 percent respectively, against 7.8 percent for other prices.

Table 1. Properties of inflation indicators (year-on-year change over 1995-2007) 1/

	Mean	Median	Std. dev	Bias	RMSE with avg. over (months): 2/		Attractor property with horizon of (months): 3/			Granger causality with lags of (months): 4/		
					36	18	1	3	6	1	3	6
Headline	8.8	8.2	3.6	0.0	3.6	2.4	...	...	...	...	...	...
CPIX	8.5	8.0	3.7	-0.3	3.5	2.3	0.17	0.58	0.53	0.07	0.00*	0.00*
CPIX1	7.8	7.4	3.7	-1.0	3.7	2.5	0.06	0.34	0.38	0.71	0.03*	0.05
Non-food	8.3	8.6	3.9	-0.5	3.2	2.5	0.12	0.39	0.62	0.02*	0.04*	0.05
Symmetric trimmed index												
At 10 %	6.1	5.5	3.1	-2.7	3.8	3.0	0.22	0.87	1.38	0.05	0.00*	0.00*
At 20%	4.9	4.4	2.8	-3.9	4.6	4.0	0.23	0.90	1.44	0.03*	0.00*	0.00*
Asymmetric trimmed index												
At 10 %	9.0	8.2	3.4	0.2	3.2	2.0	0.19	0.74	0.80	0.16	0.00*	0.00*
At 20%	7.4	6.9	3.3	-1.4	3.3	2.2	0.20	0.78	1.13	0.04*	0.00*	0.00*

1/ Detailed data for all items of the CPI are only available from Dec. 1994 onwards, although the main categories have been backdated by the BCP up to 1992.
2/ Root mean square error of inflation indicator with moving average inflation over 36 or 18 months.
3/ Opposite of coefficient beta.
4/ Probability of test rejecting the hypothesis that core inflation does not Granger-cause headline inflation.

To summarize, this section shows that an asymmetric trimmed index, preferably with a lower cutoff (of 10 percent of the basket) could usefully complement the core inflation indicators currently used by the BCP. Of the exclusion-based core indexes used by the BCP, CPIX presents better statistical properties than the narrower CPIX1. By contrast, non-food inflation tends to be a relatively poorer core inflation index, because it tends to present higher volatility, a larger bias than CPIX, or has less predictive power for future inflation at large horizon.[14, 15]

[14] In addition, a cross-country analysis in Annex IV confirms that food inflation does matter in Paraguay, somehow more than in other Latin American economies. We return to the role of food inflation in section IV, by integrating a term for food inflation in a structural error-correction model of inflation.

[15] Silver (2006) cautioned that the properties of the indicators vary with the time period chosen. Although subject to large temporary shocks which may distort the results, Paraguay did not experienced any major change of the monetary policy framework over the period.

IV. Analytical and Empirical Set-Up

This section presents the analytical and empirical framework used to assess the determinants of inflation. The determinants of inflation are based on two different theoretical frameworks: (i) the markup theory of inflation; and (ii) the monetary theory of inflation. Given that most variables are non stationary, the equations of interest are estimated using cointegration techniques.

A. Inflation as a Mark-Up over Costs

In the mark-up theory of inflation, domestic consumer prices (P) are assumed to be a mark-up over total producer's costs. Domestic costs are measured by the unit labor costs (ULC) and other domestic inputs (P_a), such as fuel or administrated prices, whereas external costs are proxied by the prices of different trade partners (P_m). This relationship can be written as:

$$(1)\ P = e^{\mu} \cdot ULC^{\alpha} \cdot P_m^{\beta} \cdot P_a^{\gamma}$$

where e^{μ}-1 is the mark up of consumer prices over producer's costs. The basic model can be expressed in loglinear form with lower case letters denoting the logarithm of the variable:

$$(2)\ \ p = \mu + \alpha\, ulc + \beta\, p_m + \gamma\, p_a$$

If the restriction $\alpha + \beta + \gamma = 1$ (linear homogeneity) is accepted, prices are a weighted average of unit labor cost, other domestic inputs, and foreign prices. Including fuel and administrated prices as separate cost factors allow to measure both their direct (via their components in the CPI basket) and indirect effect (via the spillover of, say, a fuel shock to other prices).[16]

B. Inflation as the Result of Excess Money Supply

In the monetary theory of inflation, inflation is driven by excess money supply over money demand. The equilibrium in the money market entails that real money supply $(M/P)^s$ equals real money demand $(M/P)^d$:

$$(3)\ (M/P)^{s} = (M/P)^{d}$$

This equilibrium condition can be written in loglinear form:

[16] The relation of the estimated coefficient of Pa in equation (2) to the weight of these prices in the CPI is ambiguous. In the case of oil prices, for example, one could expect the effect to be larger than the weight, because fuel is used as an input for other products (e.g. public transport) or because of its spillover impact on other prices. However, substitution effects (not captured in the fixed weight CPI index) may reduce the impact of an oil shock.

(4) $m^s - p = m^d(y, i)$,

where m^s is the log of money supply, p the log of the price level, and the demand for real money balances, m^d, is a positive function of the log of real income, *y*, and a negative function of the opportunity cost of holding money, *i*. Real income captures the transaction motive for holding money, while the opportunity cost captures some portfolio arbitrage effect (precautionary and speculative motives).

Assuming that money demand is linear in its determinants and normalizing for the coefficient of price, the testable long-run money demand relation derived from equation (2) has the following form:

(5) $p_t = \beta_1 m_t + \beta_2 y_t + \beta_3 i_t + \nu_t$

where ν_t is a constant ($\nu_t = \nu_0$) or a constant and a trend ($\nu_t = \nu_1 t + \nu_0$) if the specification incorporates the effect of long-run parameter shifts. A number of restrictions can be tested on the functional form of the money demand relationship:

- *Money illusion*. The case where m_t and p_t are cointegrated with $\beta_1 = 1$ implies long run price homogeneity: money and prices are moving together in the long-run (i.e., no money illusion).

- *Constant velocity*. The case where money, prices, and income are cointegrated with $\beta_1 = -\beta_2 = 1$ and ν_t is a constant implies that the money velocity is stationary: this implies common movements of money, prices and income (i.e., no money illusion and a unitary income elasticity in money demand). In this case, the resulting model is comparable to the quantitative theory of money, augmented by a term for opportunity cost.

C. Econometric Methodology

As the variables of interest are non-stationary,[17] we use cointegration techniques for the estimation. The cointegrated VAR approach (or VECM) of Johansen (1991)[18] allows to determine the existence and number of cointegration relations, distinguishing between stochastic trends and cointegration relationships. It also allows to encompass both the long-

[17] Annex Table V.1 describes the variables used in the regression and Annex Table V.2 presents the results of the ADF and Schmidt-Phillips stationarity tests; the variables of interest are generally non stationary in levels but stationary in first differences.

[18] See also Juselius (2005) for a step-by-step textbook discussion of the cointegration technique and its application to a money demand model for Denmark.

run and the short term dynamics. However, the estimated coefficients may be unstable in small samples. To check the robustness of the coefficients, we also use the Dynamic OLS (DOLS) methodology of Stock and Watson (1991). The DOLS methodology gives consistent estimates of the coefficient of a cointegration relation but, unlike the Johansen procedure, it does not test the existence of a cointegration relation.

In the short run, prices are influenced by the deviation from the long run equilibrium and by short term shocks. The long run relations are provided by equation (1) and (3) above. The short run equation is the following:

$$(6)\ \Delta x_t = \Gamma_1 \Delta x_{t-1} + \ldots + \Gamma_{k-1} \Delta x_{t-k+1} + \alpha\beta' x_{t-1} + \nu_t + \varepsilon_t$$

where x_t is the vector of endogenous variables and ν_t is a vector capturing the short-run or long run constants or trends. A lag structure of $k = 2$ implies a single term in difference for the short term dynamics. The long run error-correction relation is given by $\beta' x_{t-1}$, while α represents the loading coefficient to the cointegrating vector, which gives an idea of the speed of adjustment following a deviation from the equilibrium relation. In addition to the endogenous variables, the short run dynamics may also be influenced by some exogenous variables (not represented in equation (3) above). If weak exogeneity of other variables beyond prices holds, the dynamics of inflation can be estimated in a simple univariate setting mixing variables in differences with the long-term cointegrating relationship.

The loading coefficient is particularly important for stability. Assuming that the coefficient of price is normalized to 1 in the cointegration vector, a negative and significant loading coefficient α in the short term price dynamics means that the relation can be interpreted as an error-correction relation: a deviation of price from its long-run relation in a given period leads to a contraction of prices in the following period and thus to a return to the long-term value. By contrast, a positive coefficient means that the dynamics of inflation is explosive and that deviations from the long-term relation are self-reinforcing.

The model is estimated on quarterly data over 1991Q1 to 2007Q3 using a two-stage estimation strategy. The two long run relationships (2) and (5) are estimated independently in a cointegrating setting before being combined to study the short-term dynamics. This two step approach has been successfully adopted in other countries.[19] Although less efficient from the econometric point of view, this approach allow to find estimates closer to the theoretical assumptions.

[19] On the two-stage approach, see for example Sekine (2001) on Japan, Oomes and Ohnsorge (2005) on Russia, Sacerdoti and Xiao (2001) on Madagascar.

V. MARK-UP THEORY OF INFLATION

A summary of the results for the mark-up equation is presented in Tables 2 and 3 (while Annex Table VI.2 reports the full detail of the regression as well as alternative modeling). The results are reported with a lag structure of 3 quarters for the VAR, although we tested the robustness of the results with different lag structures.[20] Results for different inflation indexes are presented in Annex. In the preferred set-up presented below, inflation is measured by the core inflation index CPIX1.

Unit labor cost is strongly significant and it is the main determinant of domestic prices. The value of the coefficient is rather stable in different specifications (between ¾ to 0.9) and robust to different assumptions regarding the lag structure of the VECM (or to the inclusion of other variables). However, the coefficient of ULC is on the high side compared to other studies.[21]

To proxy imported inflation, we use the exchange rates of the main trading partners (U.S., Brazil, Argentina), with or without correction for inflation. Consumer prices in Brazil are found to influence inflation in Paraguay more than any other indicator of imported inflation. The U.S. dollar exchange rate is not significant, nor is the nominal effective exchange rate. By contrast, Brazil CPI is significant and its coefficient is stable around ¼--⅓. The non-significance of the U.S. dollar exchange rate is somewhat surprising, given the high pass-through coefficient from exchange rate to price found in a VAR in difference. The significance of the Brazilian CPI rather than the Argentine CPI can be explained by the relatively larger share of imports coming from Brazil, and the higher level of economic integration with Brazil, especially in the east of the country.[22]

Table. 2. Summary results of the markup model

	Unrestricted	Restricted	DOLS
Cointegrating vector 1/			
CPIX1	1	1	
ULC	-0.79*	-0.78*	0.77*
CPI Brazil	-0.24*	-0.22*	0.14*
Loading coeff.	0.05	0.05	
Proba. of restriction		0.63	

1/ The coefficient of price (CPIX1) is normalized to -1
"*" denotes significance at the 5 percent level.

[20] Information criteria tend to give different results about the optimal lag structure of the VAR, sometimes favoring very long or very short lags. A lag structure of 3 quarters usually ensures both satisfying properties for the residuals and significant coefficients in the short-term dynamics.

[21] There is a wide dispersion in the estimates of the ULC coefficient in other countries. Some studies report a relatively low estimate: De Brouwer and Ericsson (1998) estimates 0.47 for Australia; Lissovolik, (2003) gets 0.45 for Ukraine; and Oomes and Ohnsorge,(2005) estimate 0.39 for Russia. However, in other studies the ULC coefficient is on the high side, Sekine (2001) finds a coefficient of 0.94 in Japan. See Table VI.1 for a selected survey.

[22] Over the sample period, 28 percent of registered imports came from Brazil against 20 percent from Argentina, but the share of Argentina have been consistently shrinking since the depreciation of the peso in January 2000 and now represents only 12 percent of registered imports against 23 percent from Brazil. The composition of

(continued…)

By contrast, we fail to find a significant impact of oil and administered prices. The lack of significance of these variables is surprising but robust to different modeling assumptions[23].

Figure2a: Mark-up determinants of core inflation

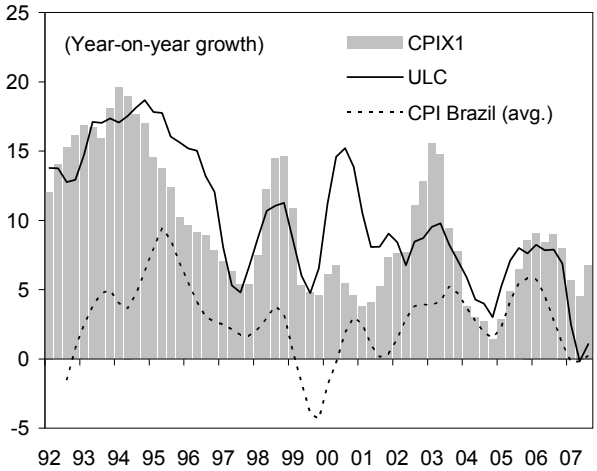
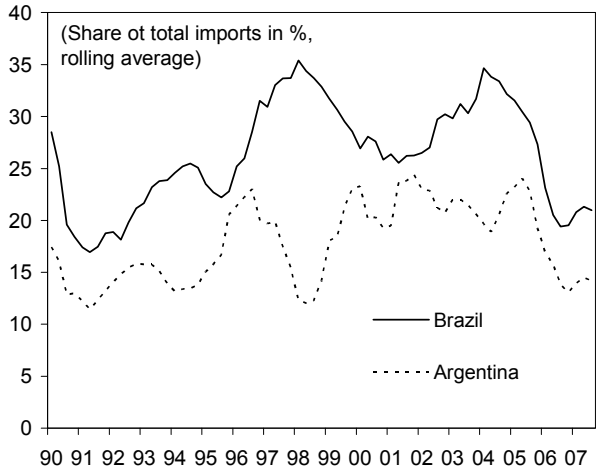


Figure 2b: Import share of Brazil and Argentina



The linear homogeneity restriction is accepted for our baseline model. In particular, the equation suggests that about 80 percent of core inflation (CPIX1) can be explained by the growth in labor costs (ULC), whereas the remaining 20 percent can be explained by imported inflation from Brazil (CPI Brazil). However, the model is somehow sensitive to the choice of inflation indicator for the dependent variable. When the model is estimated using core tradable prices (instead of core prices), the coefficient of Brazilian CPI has the same weight as ULC, around 0.8 (in this specification the constraint of price homogeneity is rejected). The model using Brazilian CPI and ULC as explanatory variable performed worst when the dependent variable was CPIX rather than CPIX1: the homogeneity constraint is accepted with CPIX1 at a high significance level but not with CPIX. Estimating the model with DOLS tends to give an even lower coefficient for Brazilian inflation, at 0.14.

Table 3: Short term dynamics 1/

	Loading coeff.		R2
	Coeff.	Std.dev.	
CPIX1	0.06	-0.05	0.41
ULC	0.29*	-0.06	0.67
CPI Brazil	0.17	-0.10	0.38

1/ with cointegrating vector:
CPIX1 - 0.88 ULC - 0.22 CPI Brazil

imports may play a role, especially if one country exports more capital goods while another exports more consumer goods, but statistics on registered trade do not show any significant difference in trade composition. For the most recent period, export restriction in Argentina may have also lowered the importance of Argentinean prices.

[23] For example, we introduce the international price of oil expressed in domestic currency or the local component for fuel in the CPI; we introduce administered prices and fuel prices separately, together, or lumped in a common price variables; finally, we use alternative prices indicators, such as the CPI, CPIX, or CPIX1, in all cases oil and administrative prices were not significant.

The model however performs poorly as an error-correction mechanism (ECM) for prices and explains less than half of the short term dynamics of inflation. The loading coefficient of the cointegrating vector in the short-term dynamics of prices is usually not significant (or significant with the wrong sign), which means that deviations from long-term determinants of consumer prices have little influence on prices in the short-term. By contrast, the coefficient is highly significant and with a correct sign for the dynamics of the ULC. The model also explains better the short term dynamics of ULC. This suggests that the cointegrating vector identified may be more relevant for a wage equation than for a CPI equation and that the relation may indicate a stronger link from prices to wages rather than the opposite. This result may come from the mechanism for minimum wage adjustment, which are automatic when cumulative inflation reaches 10 percent after the last adjustment.[24] Although minimum wage has direct influence only in the formal sector, it may also affect other labor costs, as it represents a reference wage for workers in general.

VI. MONETARY THEORY OF INFLATION[25]

A. The Demand for Currency

In this section, inflation is measured by core inflation CPIX. As earlier, the specification of the VAR is based on judgment and statistical tests. The choice of the lag structure of the VAR is based on judgment rather than solely on information criteria.[26]

In an unconstrained model, the coefficients of currency is close to unity while that of income significantly above unity. The constraint of long run price homogeneity (unit coefficient of money) cannot be rejected at reasonable significance levels by the model (i.e., no money illusion). By contrast, the constant velocity assumption is narrowly rejected, while the vector resulting from the constraints is not interpreted as a cointegrating vector by the trace and

---

[24] As stipulated by law, the National Council for Minimum Wages (CONASAM) is summoned to decide on an adjustment whenever the cumulative rise of the cost of living since the previous adjustment surpasses 10 percent. The council consists of nine representatives (three each for workers, employers, and the government), presided by a Director of Labor. The size of the adjustment is determined in negotiations, with government representatives often assuming a moderating role. The resulting wage adjustment is therefore not strictly bound by the actual rise in costs of living, and has historically often surpassed 10 percent.

[25] Annex tables VI.3 and VI. 4 report the full detail of the regressions using different definitions of monetary aggregates. In-text tables provide a summary of the main results.

[26] Information criteria such as AIC and BIC suggest the use of only one lag in difference ($k = 2$). However, most often, the residuals of the VAR have better statistical properties with a longer VAR and some of the coefficients of the second difference are significant. Finally, the number of cointegrating vectors is usually not affected by the lag structure, but the income coefficient is consistently higher and beyond the reasonable with a shorter lag structure. For a VAR with two lags, both eigenvalue and trace tests indicate the existence of one cointegration vector. The dynamics are thus driven by two stochastic trends, one for prices and one for real income, and one cointegration vector, which can be interpreted as a money demand relation.

eigenvalue tests. A stronger response of real currency demand to real income may reflect the gradual monetization of the economy has it developed over the period. The coefficient is higher than warranted in the Baumol-Tobin model (which predicts an income elasticity of 0.5); and it is also higher than predicted by a traditional monetarist model (in the quantity theory of money the income elasticity is equal to 1). While higher than predicted by theoretical model, income elasticity is in line with other studies.[27]

Table. 4. Model with currency in circulation

	Unrestricted	Cons-trained 1/	Cons-trained 2/
Cointegrating vector			
CPIX	1	1	1
Currency in circ.	-1.08*	-1(c)	-1(c)
Output	1.97*	1.50*	1.65*
Opportunity cost	-0.65*	-0.75*	-0.69*
Loading coeff.	-0.11*	-0.10*	-0.10*
Proba. of restriction		0.48	0.21

1/ Restriction on coefficient of currency.
2/ Also weak exogoneity restriction.

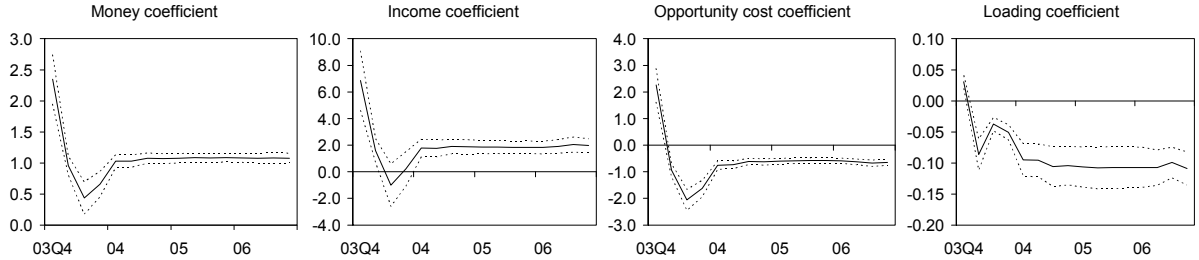
Several variables were used as a proxy for the opportunity cost of holding *guaranies.* The variable that best captured this relationship was the backward year-on-year depreciation of the *guaraní* with respect to the U.S. dollar. A model with either the quarterly backward depreciation of the exchange rate or the forward depreciation of the exchange rate (assuming perfect foresight) is less robust in terms of coefficients or number of cointegrating relations. When two opportunity costs are introduced, for example the annual backward depreciation with respect to the U.S. dollar and the return on *guaraní* time deposits, cointegration tests suggest the existence of one or of no cointegration relation, while some coefficients are not significant or with an unexpected sign.[28]

Recursive estimation techniques to assess a break in the regime show that the currency demand model has been broadly stable for the past three years, but breaks down beyond. We perform a rolling regression for the past three years, by estimating the model over a gradually increasing time period. Excluding 2005-07 has little impact on the coefficients of the model. By contrast, it becomes unstable when 2004 is excluded. An alternative estimation without the opportunity cost of currency (only indicative since tests do not show consistently the existence of one cointegration relation) suggests that this may be due to the high variability of the exchange rate around this period.

[27] For example, studies on Albania (Rother, 2000), Armenia (Grigorian et al., 2004) or Russia (Oomes, and Ohnsorge, 2005) found income elasticity in a model with broad money of 2.3, 2.7 and 1.8 respectively. Oomes and Ohnsorge (2005) suggest that the higher coefficient for Russia may be explained by monetization: as the country grows richer, barter transaction decreases, which implies that an increase in income would be more than by the increase of money. By contrast, a coefficient lower than unity could reflect financial development, as economic agents moves away from lower monetary aggregates to use more sophisticated means of payment or savings.

[28] When the backward year-on-year depreciation of the *guaraní* with respect to the U.S. dollar is evaluated in a relationship along with the return on a slightly less liquid assets, such as local currency deposits, both the trace and eigenvalue reject the existence of a cointegrating vector.

Figure 3: Recursive estimation of the money demand model with currency in circulation



B. The Demand for Narrow Money and Broad Money

The results of estimating money demand based on M1 and M2 tend to be generally weaker than those for currency in circulation, reflecting the significant and sharp variations of these aggregates over the sample period.[29] In addition, test statistics suggest the existence of a second cointegration relation, which is difficult to interpret.[30] The difficulty to estimate a stable money demand function for M1 and M2 while finding a stable demand for currency may reflect the recurrence of banking crisis during the sample period, where deposits could be lost in a financial crisis, whereas cash is a safe asset and is always accepted and honored (see Table 5)[31]. The variables included in the VECM encompass demand and return, but not the need for liquidity, which may explain the massive transfer of time and saving deposits in local currency to demand deposits or foreign currency deposits, thus affecting M1 and M2.

By contrast, the results for broad money are consistent with the quantitative theory of money. The estimation of M3 gives a coefficient of money close to unity. In addition, the income coefficient is also close to unity (when the opportunity cost is measured as the spread between assets

Table 5. Monetary aggregate 1990-2007
(Percentage, in share of GDP)

	1990	1996	2002	2007
Broad money M3	20.1	27.0	28.3	24.3
Foreign currency deposits	2.9	9.1	16.5	9.6
Money M2	17.3	17.9	11.8	14.7
Time and savings deposits	3.5	7.1	1.9	1.6
Narrow money M1	7.2	7.7	7.6	11.3
Demand deposits	3.2	3.3	3.6	6.7
Currency in circulation	4.1	4.4	4.0	4.6
		←	→	
		Banking crises 1996-2002		

[29] In a model without trend (regardless of the proxy used for the opportunity cost), the income coefficient tends to be insignificant. In a model with a trend, the estimation yields somewhat better results, but it is difficult to interpret the trend results, in particular because the trend is positive for M1 and negative for M2. The trend may capture some regularity in the data, such as an increase in the demand for liquidity (for M1) or the dollarization of deposits (for M2). Given the contrasting results on trend for M1 and M2, it is doubtful that the results can be interpreted as a proxy for financial development, and all the more so because no such trend is required for M3.

[30] When the test statistics suggested the existence of two cointegrating relations, we assumed that the first relation was a money demand function, and tried to identify the second relation through exclusion of some of the variables. We failed however to achieve any interesting results.

[31] See Mlachila (forthcoming), "Recurrent Financial Crises: Causes, Costs, and Consequences" for an analysis of the different banking crises in Paraguay (1995, 1997, 1998, 2002, 2003).

within M3 and LRM). In this specification, the unit elasticity of the income coefficient is also accepted, which means that the velocity of money is stationary. The significance of the LRM suggests the effectiveness of monetary policy, as the policy rate has an impact on the public's decision to hold broad money. However, this results need to be taken with caution for a number of reasons: the loading factor is significant but with the wrong sign, which makes it difficult to interpret the relation as an equilibrium one; the eigenvalue test suggest the existence of another cointegration relation; finally, as noted earlier, LRM were not widely available during the first half of the sample period.

The impact of monetary aggregate on short term fluctuations of inflation tends to diminish for broader aggregates. Comparing the result of the estimation among different monetary aggregates, show that the loading coefficient tends to decrease as the monetary aggregate broadens. For currency in circulation, the loading coefficient to the long-run relation is significant (and between 0.07 and 0.11), and implies that half of the deviation from the equilibrium relation is absorbed between 1 and 1½ years. By contrast, the half life benchmark is closer to 3 to 6 years for M1 and M2. Given the other weak statistical properties of the results for higher monetary aggregates, this makes currency in circulation the most relevant aggregate for studying short-term fluctuations of inflation.

Table 6. Comparison of results with difference monetary aggregates

Monetary aggregate	Currency in circulation	M1	M2	M3
Loading coefficient 1/	0.07*-0.13*	0.02*-0.04*	0.04*	n.a.
Half life of deviation (in quarters)	4-7	13-25	25	∞
Price homogeneity	Yes	Yes	Yes	Yes
Constant velocity	No	No	No	Yes
Income coefficient 2/	1.5*-1.6*	1.6*-2.9*	0.6*-1.6*	0.5ns-1*
Relevant opportunity cost	Depreciation with U.S. dollar	...	...	Sterilization paper (LRM)

1/ When with correct sign 2/ In model with price homogeneity

C. Why has Inflation not Picked up with High Monetary Growth?

The excess growth of currency in circulation over nominal GDP since 2005 has raised concerns about the potential for fueling inflationary pressures (Figure 4a). Some market observers argue that the limited impact of high currency growth on inflation since 2005 is due to re-monetization after the contraction and low growth of currency in circulation following the currency and banking turmoil of 2001-02. While this question will be analyzed in the next section (in the context of the analysis of short-term determinants of inflation), the long-term cointegration relationship on currency already identified can shed light on this issue.

The coefficient of real income in the baseline model of currency demand is high and already captures monetization of the economy over the sample period. In addition, the appreciation of the exchange rate with respect to the dollar (coming from favorable external conditions) makes local currency more attractive, thus explaining an additional increase in real currency demand. As seen from Table 7, this effect had been almost as important as that of real income in 2007 and contributes significantly to reduce the difference between actual and expected inflation (as measured by the cointegration relationship).[32] In 2008, the growth of currency in circulation has reached new high, and the deviation from the long-term equilibrium has increased, despite a sizable appreciation of the currency by about 20 percent. In both years, expected inflation based on the long-run relation remains higher than actual inflation, which points to possible inflation risks. As seen in Figure 4b, an increase of the deviation of currency in circulation from its long run relationship is followed by a pick up of inflation.

Table 7. Determinants of inflation in 2007 and 2008 1/

	Coeff.	In 2007		In 2008	
		Growth	Contrib.	Growth	Contrib.
Currency	1	24.2	24.2	32.4	32.4
Real income	-1.65	6.4	-10.6	4.4	-7.3
Opportunity cost	0.69	-9.8	-6.8	-12.7	-8.8
Expected inflation			6.8		16.4
Actual inflation			5.3		10.5

1/ Average Q1-Q3 for 2008.

Figure 4a: core inflation (annualized quarterly growth)

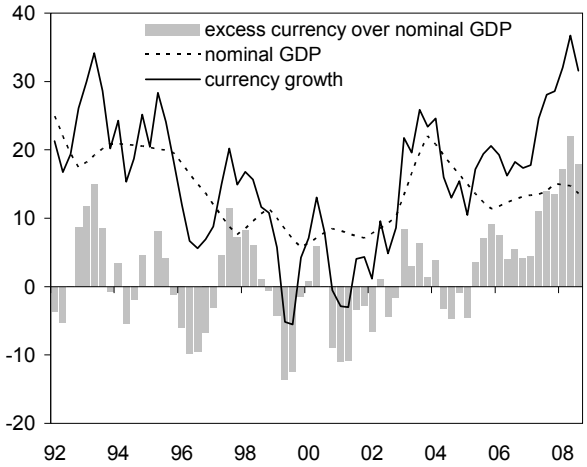
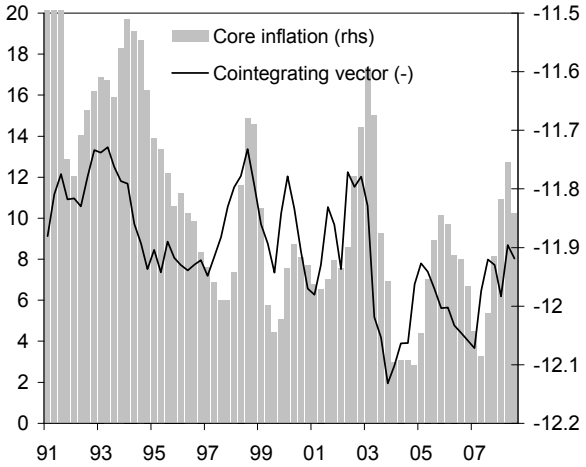


Figure 4b: cointegration vector



1/ Cointegrating vector: m -p - 1.6 y + 0.7 r

[32] The relation between exchange rate strength and currency growth (or reversely depreciation and low currency growth) only holds for the second half of the period (in 2001-02 with the depreciation or in 2003-07 for the appreciation). This left one wonders whether the model is picking some statistical regularity in the data rather than the correct opportunity cost of domestic currency. We take comfort in that another study of a dollarized economy with currency instability also find significant and high coefficients of depreciation for money in the range of -0.3/-0.5 in the Russian case examined by Oomes and Ohnsorge (2005).

Panel Figures 5: Basic statistics on monetary aggregates

Figure 5a: Monetary aggregates as share of GDP

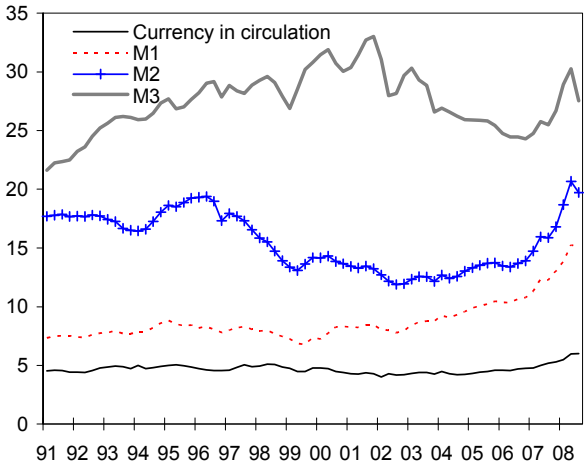


Figure 5b: Money velocity

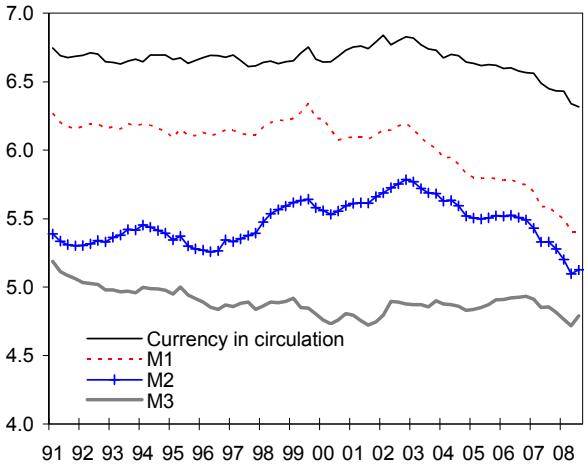


Figure 5c: Y-o-y growth of money and nominal GDP

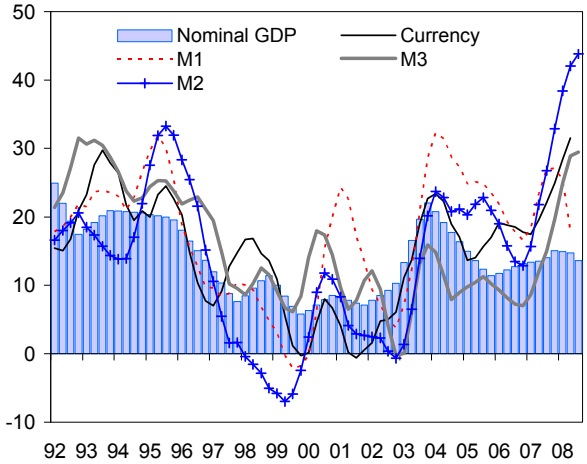


Figure 5d: Deposit dollarization

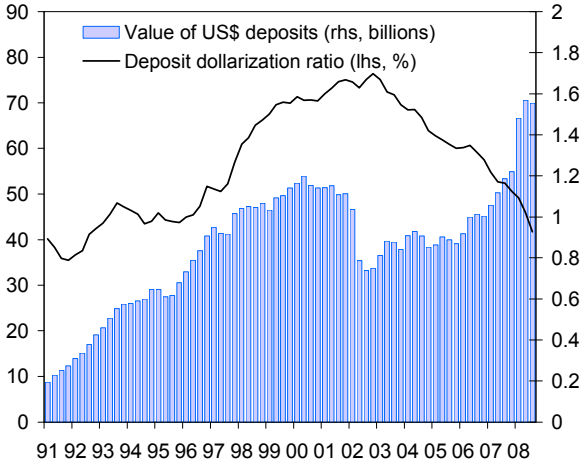


Figure 5e: Rate of return on domestic assets

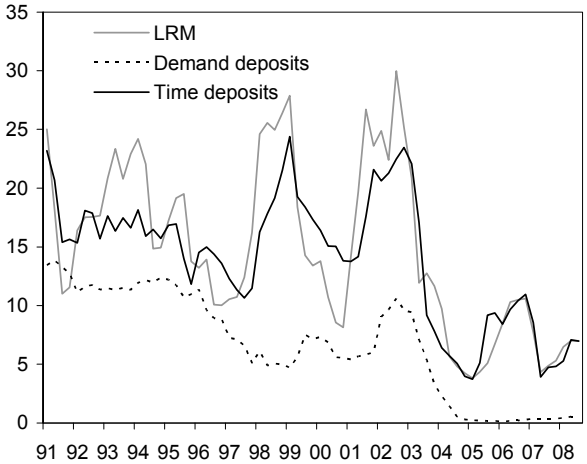
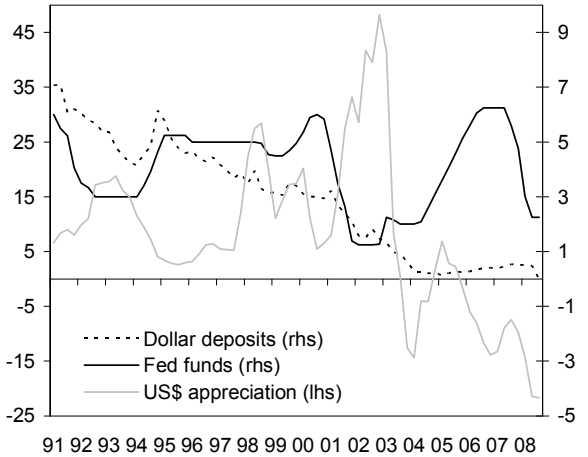


Figure 5f: Rate of return of foreign assets



Over the most recent period, the correlation between high currency growth and the appreciation of the currency is not an accident. The appreciation of the currency reflects in part a reversal after the depreciation of the earlier years linked to regional and domestic shocks (Argentine crisis in 2001 and its spillover on Paraguay's banking system with a banking crisis in 2002). In addition, significant capital inflows and improvement in current account have led the BCP to reconstitute its international reserves. Currency in circulation has picked up as only a fraction of the international reserves accumulation has been sterilized. The model suggests that the appreciation of the currency has contributed to increase the demand for real money balances in local currency, thus limiting the inflationary impact of higher currency growth. However, the model predicts that currency growth is higher than what would be warranted to avoid feeding inflationary pressures.

VII. Short-Term Determinants of Inflation

A. Short-Term Dynamics

This section encompasses the long-term results obtained in the preceding sections to study the short-term dynamics of core inflation. As seen in the previous section on the VECM with currency in circulation, the test of weak exogeneity allows to consider separately the inflation equation. It is assumed that the coefficients of the variables in the long-run relation are those in the model with price homogeneity and weak exogeneity. A second long-term relation from the mark-up model is also added. Since the focus is on core inflation measure by CPIX, the coefficient with this measure of inflation in the unconstrained model is chosen, and then the coefficients of the short-term dynamics are analyzed separately. All the endogenous variables of the VECMs with two lags ("initial" equation) are included initially, then reduce them to the significant variables and add a few additional exogenous variables ("final" equation). Table 8 reports the results of these two equations; only the statistical significant coefficients are reported in the first column (with the exception of the long-run mark-up equation). The first two lags of inflation are significant, which illustrates the persistence of price shocks.[33]

Table 8. Dynamics of core inflation 1/

	Initial	Final
Loading coefficients to long run cointegration relations		
Money demand equation	-0.05***	-0.04***
Mark up equation	0.04	
Short run		
d Price (-1)	0.49***	0.42***
d Price (-2)	-0.30***	-0.22**
d ULC		0.17**
d CPI Brazil (-1)	0.06***	0.03*
d Adm prices		0.10**
d Fruits and veg.		0.02***
Constant	0.55**	0.50***
Statistics		
R2	0.65	0.74
Log likelihood	208.8	218.4
Durbin-Watson	2.02	1.86
Akaike criteria	-6.25	-6.51
Schwartz criteria	-5.99	-6.17

Sources: staff estimates

[33] The first autoregressive coefficient is around 0.49, which amplifies an initial shock on inflation, although the second autoregressive coefficient, at -0.30, tend to reduce this impact after two quarters.

The long-run markup cointegration relation is insignificant and the autoregressive coefficients also lack significance. The contemporaneous change in ULC was introduced to improve the fit, and it turns out to be significant. In this case, the first autoregressive coefficient for price also tends to be lower, which suggests that ULC influences prices also by anchoring inflation inertia. ULC may also have a direct effect by raising input costs of products entering into the consumer price index.[34]

Concerning imported inflation, the exchange rate with Brazil matters for inflation dynamics more than any other exchange rates. Price changes in Brazil also influence the short-term inflation dynamics (but surprisingly not changes in the *guaraní* to US dollar rate). Quarterly changes in prices in Brazil enter the equation with a lag of one quarter (as the contemporaneous change of prices in Brazil is not significant).[35] These results are interesting in that in the same inflation model, two different exchange rates affect the results, one in the money demand equation through opportunity cost (the *guaraní*/ U.S.dollar exchange rate) and the other in the short-term dynamics through its impact on imported products (the *guaraní*/Brazilian real exchange rate). It cannot be excluded, however, that the impact of the *guaraní*/U.S. dollar exchange rate (captured the long run relation) reflects more than portfolio arbitrage, but also some traditional imported inflation impact. In this case, the impact of the exchange rate with the U.S. dollar would however remain smaller than that of the Brazilian real.[36]

Finally, to enrich the analysis, specific components of the CPI index were introduced in the analysis of the short-term dynamics. Two measures of oil prices were introduced, international prices converted to local currency and the domestic fuel component taken directly from the CPI index. Surprisingly, none of these variables are significant, although one would have expected the coefficient to be significant and larger than the share of fuel in core CPI to account for spillover. By contrast, administrated prices are significant and with a

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[34] Other studies have find similar results that excess money supply seems to matter more for the short-run dynamics than disequilibrium related to the goods market, either captured by a mark-up equation or a purchasing power equation; see Annex Table VI.1, with examples from the above mentioned studies on Dominican Republic, Madagascar, or Russia. By contrast, both the studies on Australia and Japan found significant and large (larger) loading coefficients for the mark-up equation.

[35] Quarterly inflation in Argentina also appears to influence the dynamics of domestic inflation, but this effect is driven by an outlier, the collapse of the currency board in early 2002. When the variable is corrected for this effect, prices from Argentina cease to be significant. An alternative model was estimated by introducing the depreciation with respect to the U.S. dollar independently or along the depreciation with the Brazilian real, but this variable also turn out to be not significant.

[36] The annual depreciation with respect to the U.S. dollar enters in the long run relation with a coefficient of 0.69. Taking into account the impact the loading coefficient and correcting for the horizon (annual instead of quarterly), this could give a impact of a quarterly devaluation of about 0.01, much lower than that of the depreciation with respect to Brazil with a coefficient of 0.03.

coefficient slightly higher than their share in core CPI: the estimated coefficient is of 0.10 against a share in CPIX of 8.3 percent. This probably reflects that the two main items (urban transport and electricity, accounting together for ⅔ of the weights of administrated prices) are important cost components of other products. Finally, although fruits and vegetables are excluded from the core inflation index, they have a specific although modest effect on the dynamics of core inflation, possibly because they tend to reinforce inflation inertia.

The extended model explains accurately the short term dynamics of inflation. It tends to explain about ¾ of the variance of inflation over the sample period. In the extended model with additional exogenous variables in the short run, the loading coefficient to the cointegrating relation is reduced by half to -0.04 against -0.07 in the restricted VECM and up to -0.13 is some unrestricted specifications presented earlier. The model is also used to make out-of-sample forecast for 2008, using actual data for the exogenous variables. The model captures the uptick in core inflation in 2008, also it tends to underestimate the actual results by about one percentage point.

Figure 6a: core inflation (annualized quarterly growth) 1/

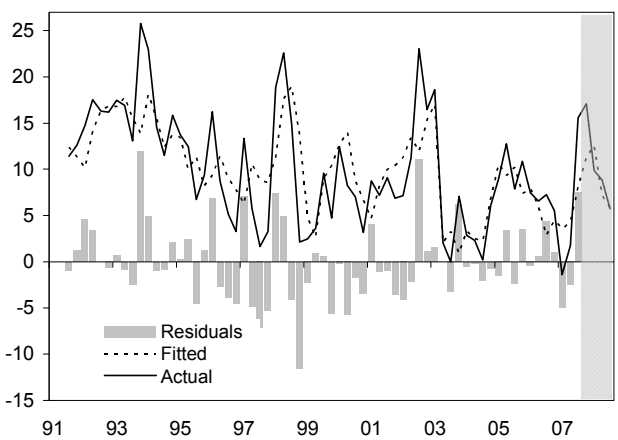
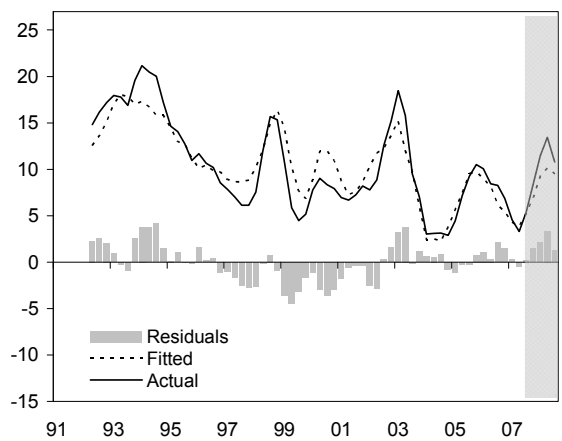


Figure 6b: core inflation (year-on-year growth)



1/ The shaded area represents out-of-sample forecasts (2007Q4-2008Q3).

B. Dynamic Contributions

Dynamic contributions allow to visualize the role of past and contemporaneous shocks on each explanatory variable estimated in a univariate mode. They are produced by inverting the polynomial structure of the model. Using equation (6) and loosed notations in terms of coefficients, we can extract the univariate equation for prices:

$$(7)\ \Delta p_t = \Sigma_{i=1}^{k} \gamma_{p,i} \Delta p_{t-i} + \Sigma_{i=1}^{k} \gamma_{z,i} \Delta z_{t-i} - \alpha(p_{t-1} - \beta' z_{t-1}) + \varepsilon_t$$

where p_t is the price index, z_t a vector of endogenous or exogenous variables, and the terms γ describes either scalars or vectors of coefficients, as appropriate. Using the lag operator L, we can define two polynomials $A(L)$ and $B(L)$ such that:

$$(8)\ A(L)p_t = B(L)z_t + \varepsilon_t\ .$$

The dynamic contribution of each variable of z_t to inflation is derived from rearranging and

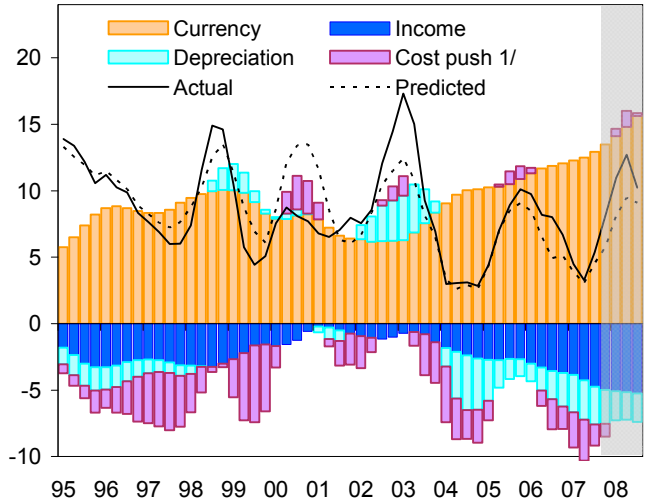
differentiating this equation such that:

$$(9)\ \Delta p_t = B(L)/A(L)\Delta z_t + \Delta\varepsilon_t / A(L).$$

Given that dynamic contributions rely on infinite polynomials (because of the inversion of $A(L)$), their precision is poorer for the earlier part of the sample.

Dynamic contribution show that the bulk of inflation dynamics is driven by the evolution of currency in circulation, which is not surprising given the structure of the model we imposed and tested on the data. However, currency in circulation has less influence on the short term dynamics and none of the periodic spikes in inflation, for example the rebounds in inflation in 1999, 2003, or 2005, are directly related to currency in circulation. Since 2004, currency in circulation has contributed by 10 to 12 percent to inflation, and that would have pushed inflation up had this impact not been compensated by two impacts, already discussed above: (i) a buoyant money demand related to the transaction motive (real income) has added a negative impact on inflation increasing from 2 to 5 percent since 2004; and (ii) the appreciation of the *guaraní* (leading to higher demand for local currency) has contributed to reduce inflation by 2.5 percent on average.

Figure 8: Dynamic contribution to core inflation



1/ Represent all other factors only in the short-term dynamics such as ULC, inflation from Brazil, or fruits and vegetables.

The exchange rate has played an important role to explain the short–run dynamics of inflation. For example, the depreciation of the *guaraní* against the U.S. dollar (influencing inflation through the opportunity cost) has added about 3.2 percent to inflation in 2002-03, while the depreciation against the Brazilian real added another 0.7 percent of inflation in 2002. The spike in inflation in 2005 can also be explained by exchange rates: the slowdown in the appreciation of the *guaraní*, despite continued currency growth, contributed to about 2 percent to inflation, while the depreciation against the Brazilian currency added another 1 percent to inflation.

Over the sample period, the trend decline of unit labor cost has contributed to a decline of inflation, although occasionally, it had the reverse effect of locking-in some inflation increases, for example in 2003 or 2006. The moderation of administrated prices since 2003 has also contributed to reduce core inflation by about 1 percentage point over the most recent period, although this is a temporary measure.

In 2008, the uptick in core inflation is explained by the continued increase of monetary supply in excess over money demand. In particular, money supply has continued to increase, while the contribution of the other long term components of money demand, output and opportunity cost, is now broadly constant. At the same time, the contribution of cost-push factors, notably administrated prices, has switched from negative to slightly positive.

VIII. Summary and Conclusion

This paper has attempted to shed light on the determinants of inflation dynamics. Among the key findings of the paper are:

- **Money talks.** Although subject to some modeling uncertainty and while the transmission mechanism seems relatively slow, currency in circulation appears as the most relevant monetary aggregate for inflation dynamics. An increase of currency in circulation by 1 percent leads to an increase of inflation by 0.05 points after one quarter, but by 1 percent in the long-run. In the money demand function, the coefficient of income larger than unity suggests a trend increased monetization over the sample period. In the long-run, the quantitative theory of money holds for broad money, but this result has little relevance for short-term inflation.

- **Pass-throughs matters.** In the short run, a 1 percent increase of imported inflation from Brazil adds 0.03 percent to inflation in Paraguay. In the long-run, the exchange rate with respect to the US dollar remains a key factor for portfolio allocation decisions and for money demand. The significance of the depreciation with respect to the U.S. dollar could possibly also capture some pass-through effect from exchange rates to prices.

- **Food feeds inflation.** Food accounts for about 35 percent of the CPI basket. However, food prices tend to have a spillover effect on non-food prices, as evidenced by Granger-causality tests and their coefficient in a price equation. The final impact is larger than its weight.

- **Inertia remains strong.** A shock of 1 percent to inflation in a given quarter gives rise to an additional increase by 0.4 percent after one quarter and by 0.2 percent after two quarters. The wage indexation mechanism may be partly responsible for locking in any inflation increase, although more generally the high level of inertia could be related to inflation expectations and the credibility of the anti-inflationary efforts.

This study thus allows to highlight some of the risks for the inflation outlook in 2008-09. Inflation has been subjected to supply shocks, in particular from food, or exchange rate shocks. A reversal of the appreciation of the *guaraní* against the U.S. dollar, further depreciation against the Brazilian real, or an end of the moderation of administrated prices could lead to higher inflation.

At the same time, this study also presents evidence of monetary policy effectiveness, both through volume or through policy rates. Currency in circulation, the monetary aggregate most easily controlled by the Central bank (as opposed to broader monetary aggregates), is also the best predictor of inflation. Controlling the rate of currency growth through emission of sterilization paper allows to moderate the inflationary impact of money. Also, for broad money, the study suggests that the policy interest rate is also significant in influencing the portfolio allocation of real money balances.

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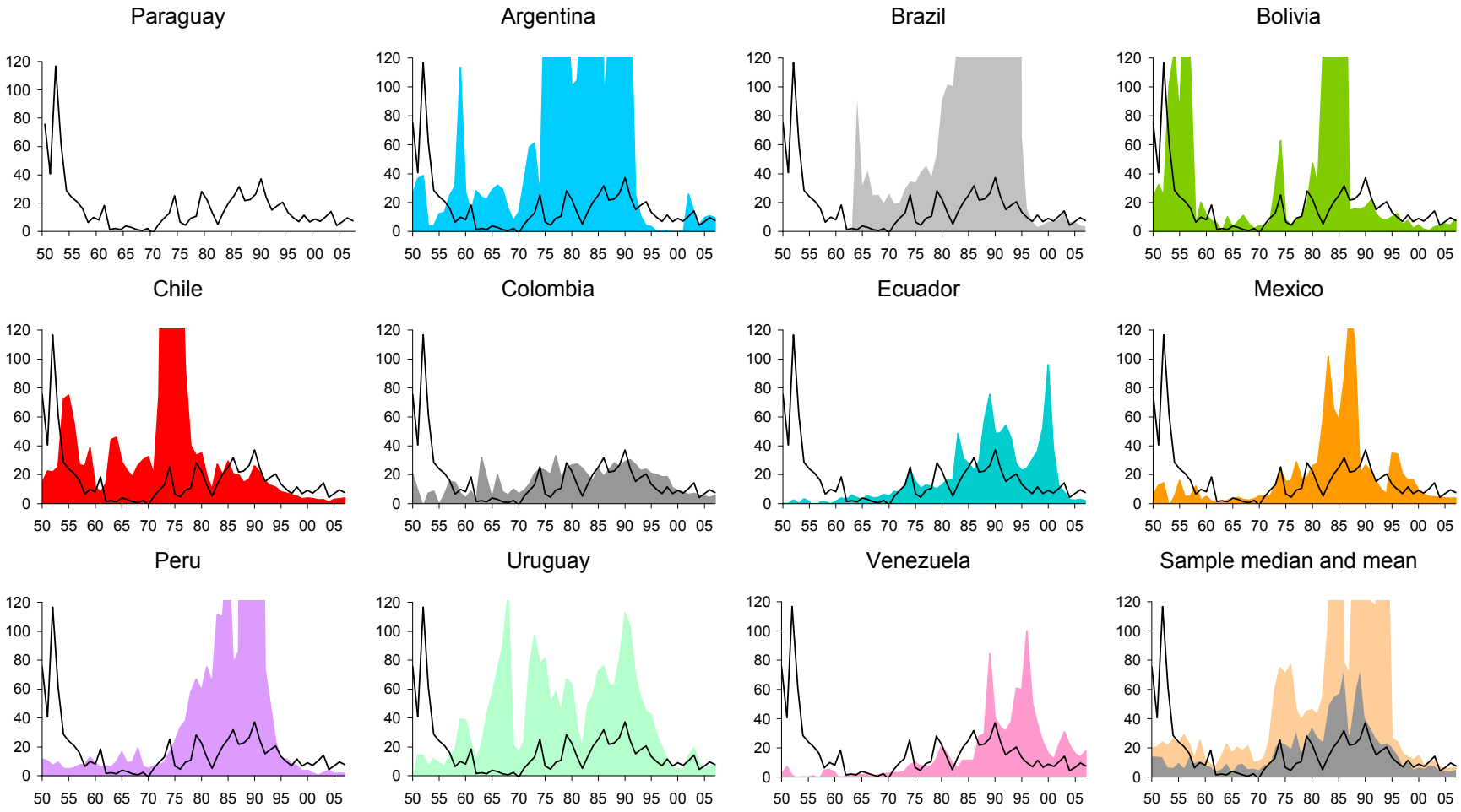
ANNEX I: INFLATION IN A SELECTION OF LATIN AMERICAN COUNTRIES SINCE 1950



Note: In all charts, the plain line represents inflation in Paraguay, while the stacked area represents inflation in a comparator country.

ANNEX II: MICRO LEVEL ANALYSIS OF PRICES

Paraguay: Micro-level Analysis of Prices, 1994-2007 using the 1992 based CPI basket

	Number of items	Weight in CPI	Share of tradables	Average monthly change	Standard deviation	Coeff. of var.	Persistency (first AR coeff)	Proba. in a given month to:			Seasonal coefficients 1/			
								Rise	Fall	Remain constant	Q1	Q2	Q3	Q4
Food	91	39.0	89	0.80	2.02	2.5	0.32	0.54	0.35	0.12	1.02	1.02	1.00	1.00
Meat	21	10.7	100	0.83	2.35	2.8	0.45	0.57	0.39	0.03	0.98	0.96	0.95	1.00
Fruits and vegetables	17	6.2	100	1.35	9.20	6.8	0.13	0.50	0.50	0.01	1.14	1.10	0.99	1.00
Other	53	22.1	81	0.72	1.23	1.7	0.59	0.54	0.28	0.18	1.01	1.02	1.02	1.00
Clothing	52	8.6	97	0.40	0.57	1.4	0.26	0.36	0.09	0.54	1.00	1.00	1.00	1.00
Housing	46	20.8	43	0.66	0.81	1.2	0.57	0.49	0.22	0.29	1.00	1.01	1.00	1.00
Health	22	4.8	32	0.67	0.74	1.1	0.68	0.38	0.08	0.54	1.00	1.00	1.00	1.00
Transportation	14	7.4	39	0.97	1.86	1.9	0.38	0.32	0.12	0.56	1.01	1.00	1.00	1.00
Education and reading	16	4.2	20	0.76	2.07	2.7	0.13	0.23	0.06	0.71	1.00	1.03	1.02	1.00
Miscellaneous expenditures	52	15.2	62	0.58	0.74	1.3	0.72	0.49	0.20	0.31	1.01	1.00	1.00	1.00
Administrated prices	8	7.7	0	0.90	1.96	2.2	0.26	0.13	0.01	0.86	1.02	1.01	1.00	1.00
Fuel	6	3.6	100	1.21	2.96	2.4	0.41	0.32	0.18	0.50	1.01	1.01	1.01	1.00
Core inflation (CPIX)	276	93.8	65	0.70	0.67	1.0	0.76	0.45	0.19	0.36	1.00	1.00	1.00	1.00
Core inflation (CPIX1)	262	82.5	69	0.65	0.67	1.0	0.75	0.46	0.20	0.34	1.00	1.00	1.00	1.00
Non food items	202	61.0	52	0.67	0.64	1.0	0.74	0.28	0.10	0.61	1.00	1.01	1.00	1.00
Tradable	101	66.7	100	0.76	1.40	1.8	0.41	0.50	0.25	0.25	1.01	1.01	1.00	1.00
Non tradable	192	33.3	0	0.65	0.67	1.0	0.66	0.29	0.05	0.65	1.00	1.01	1.01	1.00
Domestic	228	78.1	57	0.71	0.70	1.0	0.73	0.42	0.15	0.43	1.00	1.01	1.00	1.00
Imported	65	21.9	100	0.79	3.15	4.0	0.05	0.51	0.27	0.22	1.03	1.02	1.00	1.00
All items	293	100.0	67	0.72	1.0	1.4	0.80	0.45	0.21	0.34	1.01	1.01	1.00	1.00

Sources: BCP and authors' estimates.

1/ Coefficients are normalized to 1 for Q4; for example, a coefficient of 1.14 for fruits of vegetables in Q1 means prices are on average higher by 14 percent in Q1 compared to Q4.

ANNEX III: THE NEW CONSUMER PRICE INDEX

The BCP started publishing from January 2008 a new CPI based on the 2005 household budget survey. Until then, the weights were based on the 1992 household budget survey. The CPI index is not subject to revision, on accounts of legal constraints, in particular its use for wage indexation. The new CPI series, with a base month in December 2007, will thus be spliced with the older series by applying the same monthly inflation pattern.[1]

All things being equal, the new index used from January 2008 should lead to a lower inflation measurement. The new basket gives less weight to food items, which have been one of the main reasons of price increases over the past two years. Had the weights of the new index been used in 2007, headline inflation could have been 1.5 percent lower on average. In addition, the new CPI basket integrates new products (cell phones, internet services, personal computers, cable television, etc.) which have experienced low or negative price increases due to lower international prices and network externalities. By contrast, it has a larger weight for oil related products. Table III.1 provides a comparison of the weights of the IPC in the new and the old index using the new breakdown.[2]

Annex Table III.1. Weights in the previous and new IPC

Base month	Dec. 1992	Dec. 2007
Goods		
Food	35.3	32.0
Fruits and vegetables	6.2	5.1
Meat	10.7	10.4
Other	18.4	16.5
Clothing	8.6	4.9
Alcohool and tobacco	2.1	1.2
Furnitures	8.0	7.7
Services		
Transport	7.4	14.8
Communication	0.7	3.4
Housing	10.4	8.9
Health	4.8	4.1
Entertainment	5.1	6.1
Education	2.7	4.0
Restaurants and hotels	4.8	5.5
Misc. goods and services	10.3	7.3
Memorandum		
Fuel	3.6	5.8
Administrated prices	7.7	[7.0]

Food items will continue to have a large influence in CPI and their weights remain among the highest in Latin America. In the older CPI index, food items accounted for 39 percent of the CPI basket. The new CPI presents a different categorization, with food items and accounting for about 5 percentage points of the old index distributed to other categories: these are mostly non-tradable items, such as alcohol and tobaccos (1.5 points) or restaurant and hotels (3.7 points). Using the same scope for food products as in the new index (i.e. non-alcohol food consumed at home), the share of food items declines by a tenth from 35 percent to 32 percent. This decline is consistent with Engel's Law, stating that the relative share of income devoted to food tend to diminish as income grows.

[1] Until a full year of data is available based on the extended basket and the new weights, year-on-year inflation would thus be difficult to interpret, as reflecting inflationary pressures, but also the impact of changing weights or new products.

[2] Comparing old and new weights is not a straightforward exercise. The new basket comprises 450 products against 293 in the previous basket. A few items have disappeared (e.g. anklet or makeup set), other have been added (most notably all communication items beyond fixed lines), and quite a few have been reclassified, either as a group (alcohol removed from food) or independently (school transport removed from education to be included in transport). We have tried to reclassify each item of the old index into the categories of the new index. Annex II presents statistical analysis of each category using the breakdown in the old CPI basket.

ANNEX IV: FOOD INFLATION IN LATIN AMERICA

This annex discusses whether non-food inflation could be considered as a relevant core inflation indicator. We use Granger causality tests to determine whether food inflation cause or not non food inflation for a sample of Latin American countries. We test for Granger causality using quarterly growth of prices in VAR with 1 to 4 lags.

Unlike in most Latin America countries, food inflation in Paraguay is a predictor of non-food inflation. In VAR with long lags, food inflation does not influence non-food inflation, except for Paraguay and Venezuela. In a VAR with two lags, food inflation also Granger-cause non-food inflation in VAR in Brazil and Colombia. By contrast, non-food inflation almost never Granger causes food inflation (for example through higher input costs of primary products) except for Colombia, and, depending on the number of lags, in Ecuador or Mexico.

The results for Paraguay and Venezuela are interesting in that the situation that food inflation Granger-cause non-food inflation is robust to the number of lags considered. For Paraguay, we can offer two reasons for these results: food is a large part of the CPI basket and thus represents a larger share of worker's consumption baskets; in addition, food price increases have potentially an impact on general prices (and thus non-food prices) through the wage indexation mechanism.

Table. Granger-causality tests between food and non-food inflation

	Share of food in CPI	Food inflation does not cause non-food inflation Lags (quarters)				Non food inflation does not cause food inflation Lags (quarters)			
		1	2	3	4	1	2	3	4
Paraguay	39.0	0.11	**0.02***	**0.02***	**0.03***	0.72	0.93	0.66	0.79
Argentina	31.3	0.77	0.72	0.95	0.92	0.06	0.35	0.51	0.82
Bolivia	49.1	0.07	0.17	0.23	0.28	0.95	0.13	0.36	0.29
Brazil	20.0	0.28	**0.03***	0.11	0.25	0.64	0.94	0.77	0.84
Chile	27.2	0.31	0.27	0.40	0.71	0.90	0.68	0.68	0.35
Colombia	29.5	0.46	**0.05***	0.49	0.29	0.30	**0.02***	**0.00***	**0.00***
Ecuador	23.5	0.32	0.07	0.26	0.36	0.07	**0.02***	0.22	0.22
Mexico	22.7	0.11	0.58	1.00	0.78	0.43	0.68	0.11	**0.04***
Peru	47.5	0.08	0.20	0.34	0.52	0.26	0.35	0.61	0.25
Uruguay	28.5	0.22	0.31	0.64	0.45	0.45	0.41	0.72	0.79
Venezuela	22.9	**0.03***	**0.00***	**0.00***	**0.02***	0.35	0.53	0.51	0.24

Sources: staff estimates.

ANNEX V: DATA ISSUES AND DATABASE USED IN ECONOMETRIC ANALYSIS

Data for the Mark-Up Theory

The most important gap in available statistics to estimate a markup model concerned unit labor cost. Unit labor cost is defined here as average wage index minus labor productivity for the economy as a whole. Average wages in the economy are available on a semi-annual basis, while minimum wages are available on a monthly basis. Employment data is only available on annual basis with a lag of about a year. To extrapolate the wage index, we assumed a linear relationship of the variables for the missing quarters. Concerning labor productivity, we used quarterly GDP from the national accounts[1] as the denominator and construct a quarterly time series of labor for the numerator. We extrapolate quarterly time series for labor using again quarterly output and the Chow-Lin (1971) methodology. In effect the pattern of output affecting both the numerator and the denominator is smoothed out as the component entering ULC is labor productivity.

Concerning the price of foreign inputs, we used a set of alternative variables: the nominal effective exchange rate, the exchange rate with the US$ (with or without adjustment for U.S. inflation), and the prices of imported consumer goods from Argentina and Brazil, using the CPI index in both countries converted to *guaranies*.

In the preferred set-up, inflation is measured by CPIX1, but we also estimate the model on headline inflation and core inflation CPIX.

Data for the Monetary Theory

Inflation is measured by the core indicator CPIX. Income is proxied by quarterly real GDP. An alternative proxy for income could be the gross disposable income, including in addition GDP the role of foreign transfers and in particular of private transfers which have increased significantly in the recent period. However, this time series is not available in volume and at the desired frequency.

[1] Quarterly GDP is only available from 1994Q1 to 2006Q4. To extend the time series before 1994 and in 2007, we used an older quarterly indicator of activity and the Chow-Lin methodology (1971). The methodology used is the same as the one currently used to construct quarterly national accounts in Paraguay. One advantage of using this methodology over simply splicing existing fixed-weight quarterly indicators of activity is that the resulting time series is commensurate with GDP. The indicator of activity used for 1991-1994 is based on a more restricted set of sectoral indicators than in the current monthly index of economic activity (IMAEP) and as such is also more volatile and less reliable.

The demand for money is estimated for different monetary aggregates. This will allow to study with monetary aggregates offer the most stable money demand function and present the best statistical properties. Our four monetary aggregates are defined as followed.[2, 3]

Currency in circulation: CC

Narrow money M1 = CC + cash in vault and demand deposits

Guarani Broad Money M2 = M1 + time and saving deposits + certificates of deposits

Broad Money M3 = M2 + dollar deposits

To measure the opportunity cost of a given monetary aggregate with respect to an alternative asset, we explore, when possible, the role of two different assets: one alternative asset presents the same liquidity as the monetary asset considered but is denominated in another currency, while the other has the same currency denomination but is less liquid. To provide some examples: we compare the zero nominal return of holding domestic currency to the return of holding dollars in cash (the depreciation of the exchange rate) and the return on local currency time and saving deposits; for Guarani broad money, alternative assets could be dollar deposits (for the same liquidity in another currency) or local bonds (less liquid but in the same currency). Using local bonds present an additional problem, as Treasury bills are not widely traded, especially since the government default in 2003. Another class of assets is the Central Bank sterilization paper (*Letras de Regulacion Monetaria* or LRM): these remained marginal during most of the 1990s. As of 1998, they represented less than a tenth of currency in circulation. In recent years, significant foreign exchange inflows have led the Central Bank to steep up its issuance of LRM for sterilization, which stood by end-2007 at close to ¼ of currency in circulation.

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[2] Oomes and Ohnsorge (2005) in the study of money demand in Russia found that the "effective broad money", which also includes cash dollar in circulation, provides the most stable aggregate for money demand. We would have liked to explore this effect for Paraguay given that the economy is highly dollarized but such time series is unfortunately not available. However, according to economists at the Central Bank, the use of dollar cash for direct transactions in the economy is limited, in contrast to the role of dollar as storage (through dollar deposits) and as calculation unit (most large aggregates are discussed in dollars).

[3] Following an earlier study of money demand in Paraguay from Rojas and Wenniger (2006), we have also tried to estimate adjusted narrow money M1A defined as M1 + time and savings deposits. The results were closed to those of M1 and M2 and are not reported here. Rojas and Wenniger estimate demand for M1A on annual data for 1970-2002 after imposing price homogeneity; they find a unit elasticity with respect of income, and a significant opportunity cost measured by the interest rate on certificates of deposits. Differences of frequency and time period may explain why we could not replicate their results.

Database Used

Annex Table V.1 : Database Used

Time series	Code	Description
Activity and price		
GDP	lysa	Quarterly GDP from National Accounts. 1/
CPI	lcpi	Consumer price index in Greater Asuncion.
Core prices	lcpix	CPI exlcuding fruits and vegetables
Core tradables	lcpixt	Tradable prices, excluding fruits and vegetables
Core non tradables	lcpixnt	Non tradable prices
Wages	lwag	Average wage in Greater Asuncion
Minim. wages	lwmin	Minimum wages
Unit labor cost	lulc	Average wage cost per unit of output, using labor force data from national accounts.
Monetary aggregates 2/		
Currency	lcc	Currency in circulation
Narrow money	lm1	Currency in circulation + cash in vault and demand deposits
M1A	lm1a	Narrow money + time and savings deposits
M2	lm2	Narrow money + time and savings deposits, certificates of deposits
M3	lm3	M2 and foreign currency deposits
Opportunity cost of money on: 3/		
Demand deposit	r_ddg	Demand deposit in local currency
Time and saving dep.	r_tsg	Time and saving deposits in local currency
Dollar deposit	r_d$	Weighted average of time and saving dollar deposits
Dollar deposit in Gs.	r_d$g	Above plus y-o-y nominal Gs. depreciation
Policy rate on LRM	r_lrm	Avg. interest rate on sterilzation paper (LRM)
M1	r_m1	Weighted average
M1A	r_m1a	Weighted average
M2	r_m2	Weighted average
M3	r_m3	Weighted average, converted in Gs.
Dollar cash	r_$y	Y-o-y depreciation of the Gs
Dollar cash	r_$q	Q-o-q depreciation of the Gs
Dollar cash	r_$fq	Forward looking q-o-q depreciation of the Gs
Exchange rate and foreign prices		
Nominal effective exchange rate	lneer	INS based NEER with correction from hyperinflation in Brazil before 1994.
Nominal exch. rate	ler	Exchange rate with U.S. dollar
U.S. CPI	lcpi_usa	CPI price in USA, converted in Gs
Brazil CPI	lcpi_bra	CPI price in Brazil, converted in Gs
Argentina CPI	lcpi_arg	CPI price in Argentina converted in Gs

Sources: Banco Central de Paraguay (BCP); International Finance Statistics (IFS, IMF); and authors'
1/ Extrapolated using monthly indicator of activity for 1991-94 and 2007.
2/ BCP after January 1995, backdated using IFS.
3/ Expressed in percentage: 100 bp is 0.01.

Annex Table V.2: Stationarity Tests

		ADF test			KPSS		
		Level	First diff.	Order integ.	Level	First diff.	Order integ.
Activity and price							
GDP	lysa	-0.62	-5.65	I(1)	0.15	0.16	I(2)
CPI	lcpi	-2.81	-3.56	I(1)	0.23	0.10	I(1)
Core prices	lcpix	-2.70	-3.69	I(1)	0.25	0.08	I(1)
Core tradables	lcpixt	-1.06	-4.55	I(1)	0.13	0.05	I(0)
Core non tradables	lcpixnt	-5.03	-2.16	I(0)	0.29	0.13	I(1)
Wages	lwag	-3.98	-1.58	I(0)	0.26	0.13	I(1)
Minim. wages	lwmin	-1.29	-5.16	I(1)	0.21	0.08	I(1)
Unit labor cost	lulc	-4.46	-4.68	I(0)	0.29	0.05	I(1)
Monetary aggregates 2/							
Currency	lcc	-0.33	-3.12	I(1)	0.17	0.23	I(2)
Narrow money	lm1	0.35	-3.05	I(1)	0.16	0.18	I(2)
M1A	lm1a	-0.27	-3.39	I(1)	0.16	0.27	I(2)
M2	lm2	0.00	-2.80	I(2)	0.15	0.20	I(2)
M3	lm3	-3.40	-4.57	I(0)	0.28	0.23	I(2)
Opportunity cost of money on: 3/							
Demand deposit	r_ddg	-1.43	-3.14	I(1)	0.07	0.04	I(0)
Time and saving dep.	r_tsg	-1.90	-4.45	I(1)	0.13	0.05	I(0)
Dollar deposit	r_d$	-1.02	-4.85	I(1)	0.08	0.07	I(0)
Dollar deposit in Gs.	r_d$g	-2.80	-4.21	I(1)	0.15	0.04	I(1)
Policy rate on LRM	r_lrm	-2.39	-5.24	I(1)	0.10	0.04	I(0)
M1	r_m1	-1.85	-3.23	I(1)	0.08	0.05	I(0)
M1A	r_m1a	-0.81	-4.04	I(1)	0.15	0.04	I(1)
M2	r_m2	-0.88	-4.65	I(1)	0.13	0.07	I(0)
M3	r_m3	-2.55	-4.32	I(1)	0.15	0.05	I(1)
Dollar cash	r_$y	-3.01	-4.15	I(0)	0.15	0.04	I(1)
Dollar cash	r_$q	-3.24	-6.19	I(0)	0.14	0.04	I(0)
Dollar cash	r_$fq	-3.11	-6.21	I(0)	0.15	0.04	I(1)
Exchange rate and foreign prices							
Nominal effective exchange rate	lneer	-1.74	-4.22	I(1)	0.09	0.08	I(0)
Nominal exch. rate	ler	-1.72	-2.95	I(1)	0.13	0.15	I(0)
U.S. CPI	lcpi_usa	-1.69	-3.08	I(1)	0.13	0.14	I(0)
Brazil CPI	lcpi_bra	-0.79	-5.47	I(1)	0.12	0.07	I(0)
Argentina CPI	lcpi_arg	-2.79	-5.87	I(1)	0.25	0.06	I(1)

Sources: Banco Central de Paraguay (BCP); International Finance Statistics (IFS, IMF); authors' est
1/ Extrapolated using monthly indicator of activity for 1991-94 and 2007.
2/ BCP after January 1995, backdated using IFS.
3/ Expressed in percentage: 100 bp is 0.01.

Annex Table V.3. Correlation between growth rate of selected variables 1/

	lcpi	lcpix	lwag	lulc	lcc	lm1	lm2	lm3	lysa	ler	lcpi_usa	lcpi_bra	lcpi_arg
lcpi		0.98	0.82	0.82	0.57	0.34	0.25	0.63	0.08	0.34	0.41	0.36	0.40
lcpix	0.89		0.84	0.86	0.53	0.28	0.20	0.63	0.03	0.39	0.46	0.37	0.41
lwag	0.57	0.68		0.93	0.64	0.57	0.53	0.77	0.30	0.04	0.12	0.43	0.38
lulc	0.23	0.42	0.34		0.44	0.38	0.33	0.73	0.00	0.23	0.31	0.37	0.37
lcc	0.30	0.36	0.39	0.18		0.70	0.63	0.60	0.59	-0.22	-0.15	0.48	0.37
lm1	0.10	0.15	0.35	0.17	0.64		0.83	0.53	0.53	-0.46	-0.41	0.47	0.30
lm2	0.12	0.16	0.37	0.10	0.53	0.77		0.61	0.57	-0.54	-0.49	0.45	0.20
lm3	0.33	0.43	0.52	0.29	0.31	0.43	0.64		0.32	0.02	0.11	0.33	0.63
lysa	-0.01	-0.04	0.10	-0.04	0.27	0.25	0.30	0.21		-0.44	-0.41	0.30	0.08
ler	0.30	0.30	0.03	0.09	-0.12	-0.36	-0.39	0.07	-0.16		0.99	0.10	0.05
lcpi_usa	0.34	0.35	0.10	0.08	-0.09	-0.34	-0.36	0.13	-0.15	0.99		0.10	0.12
lcpi_bra	0.22	0.20	0.16	0.18	0.18	0.23	0.29	0.34	0.19	0.15	0.15		0.01
lcpi_arg	0.27	0.31	0.23	0.25	0.27	0.19	0.17	0.50	0.03	0.29	0.31	0.02	

Sources: authors' estimates.

1/ Correlation with quarterly growth rate above the diagonal and correlation with annual growth rate below the diagonal.

ANNEX VI: ECONOMETRIC RESULTS

Annex Table VI.1. Some results of other country studies 1/

Choice of push-cost equation:	Mark up equation				Traded goods equation	
Country:	Australia	Japan	Ukraine 2/	Russia 3/	Dom. Rep.	Madagascar
Authors	DeBrouwer Ericsson	Sekine	Lissovolik	Oomes Ohnsorge	Willians Adedeji	Sacerdoti Xiao
Date	1998	2001	2003	2005	2004	2001
Sample period	1977-1993		1996-2002	1996-2004	1991-2002	1971-2000
Frequency	Q	Q	M	M	Q	Q
Monetary aggregate	...	Broad money	Broad money	Effective broad money	Broad money	Broad money
Long run coefficients						
Excess money						
Money	...	1 (c)	1 (c)	1 (c)	1 (c)	1 (c)
Income	...	-0.50	-1.30	-1.26	-1.65	- 1 (c)
Opportunity costs	...	2.15	0.00	0.01	1.72	0.04
Markup model						
ULC	0.47	0.94	0.45	0.39	...	...
Foreign prices in local curr.	0.44	0.06	0.17	0.49	...	...
Admin./ oil prices	0.09	...	0.33	0.11	...	...
Traded goods						
Foreign prices in $	...	...	...	...	1 (c)	1 (c)
Exchange rate	...	...	...	...	- 1 (c)	- 1 (c)
Terms of trade	...	...	...	...	...	0.22
Loading coefficients						
Excess money	...	-0.03*	...	3.8*	-0.06*	-0.05*
Markup model	-0.09*	-0.04*	...	-0.08ns	...	...
Purchasing power parity	...	...	...	...	ns	0.00ns
Output gap	0.08*	...	...	...	...	...

1/ In the long run relation, the coefficient of price is normalized to 1. In addition:
... indicates that the results were not reported because of the specification chosen,
* / ns indicates if the loading coefficient is or is not significant.
2/ Model estimated by dynamic autoregressive lag models which explains the absence of loading coefficients.
3/ Short term model estimated in second difference, due to a I(1) inflation process.

Annex Table VI.2. Markup model of inflation 1/

	Prefered equation 2/			Additional cost factors					Alternative choice of exchange rate									
	Unres-tricted	Res-tricted 3/	DOLS	Fuel 4/	Fuel 5/	Adm. prices	Adm. and fuel 5/	Adm. and fuel 5/	NEER	G/US$	U.S. CPI	Argent. CPI	Brazil and Arg. CPI	Core	Core 3/	Head-line	Core tradable	Core tradable 3/
Cointegrating vector																		
ULC	0.79***	0.78***	0.77***	0.84***	0.88***	1.07***	0.74***	0.97***	-1.7	1.08***	0.89***	0.64***	1.57**	0.84***	0.80***	0.81***	0.78**	0.56***
	(0.08)	(0.06)	(0.03)	(0.09)	(0.09)	(0.18)	(0.25)	(0.10)	(1.44)	(0.06)	(0.06)	(0.05)	(0.78)	(0.07)	(0.04)	(0.10)	(0.33)	(0.11)
Exchange rate									0.54	-0.07	-0.01							
									(1.90)	(0.05)	(0.04)							
CPI Brazil	0.24***	0.22***	0.14***	0.25***	0.20***	0.14***	0.19***	0.14***					-2.04***	0.25***	0.20***	0.33***	0.83***	0.44***
	(0.07)	(0.06)	(0.03)	(0.08)	(0.06)	(0.05)	(0.06)	(0.04)					(0.53)	(0.07)	(0.04)	(0.10)	(0.32)	(0.11)
CPI Argentina							0.19	-0.11				0.1	0.01					
							(0.23)	(0.07)				(0.07)	(0.50)					
Oil prices				-0.04	-0.05													
				(0.02)	(0.05)													
Administrated prices						-0.18	-0.12*											
						(0.13)	(0.07)											
Loading coeff.	0.05	0.05		0.05	0.07*	0.06	0.07*	0.05	-0.01***	0.17***	0.01	-0.07**	-0.01**	0.08**	0.09	0.07**	0.01*	0.04
	(0.03)	(0.04)		(0.03)	(0.04)	(0.05)	(0.04)	(0.05)	(0.00)	(0.05)	(0.05)	(0.03)	(0.00)	(0.03)	(0.06)	(0.03)	(0.01)	(0.03)
R2	0.46	0.45		0.50	0.50	0.49	0.55	0.48	0.57	0.61	0.54	0.48	0.55	0.50	0.47	0.37	0.43	0.42
Log likelihood	458.1	458.0		528.3	579.6	617.8	747.6	627.2	480.7	502.5	502.9	500.2	613.0	461.6	458.5	444.2	445.0	437.4
AIC criteria	-13.3	-13.3		-14.7	-16.4	-17.6	-20.7	-17.9	-14.1	-14.7	-14.7	-14.6	-17.4	-13.4	-13.3	-12.9	-12.9	-12.6
Schwarz criteria	-12.0	-12.0		-12.6	-14.2	-15.4	-17.5	-15.7	-12.9	-13.4	-13.4	-13.3	-15.3	-12.1	-12.0	-11.5	-11.6	-11.3
Lag structure	3	3		3	3	3	2	2	3	3	3	3	3	3	3	3	3	3
Cointegration rank																		
Trace	1	1		1	1	2	2	2	1	2	0	1	2	1	1	1	1	1
Eigenvalue	1	1		1	1	1	2	1	1	2	0	1	2	1	0	1	1	1
Prob. of LR test on restriction		0.63													0.01			0.00

Source: staff estimates

Note: "*", "**", and "***"denote statistical significance at the 10, 5, and 1 percent level respectively.

1/ For simplicity, in the long-run relation, the coefficient reported are consistent with a normalization of price to -1. By contrast, for the loading coefficient of the price equation, the coefficient is consistent with a normalization to 1 (hence a negative loading coefficient is expected).

2/ Prefered equation: CPIX1 with or without price homogeneity restriction on ULC and exchange rate.

3/ With constraint of linear homogeneity.

4/ International oil price

5/ Domestic fuel component.

Annex table _. Results of money demand equation with currency in circulation 1/

	Preferred model 2/					Sensitivity to opportunity costs				Sensitivity to inflation index			
	Unres-tricted	Res-tricted	Res-tricted	Res-tricted 3/	DOLS	Quarterly deprec.	Quarterly deprec. forward	Interest rate on savings	Dom. and ext. interest	Headline CPI	Core CPIX1	Core non tradable	Core tradable
Cointegrating vector													
Money	-1.08***	-1	-1	-1	1.18***	-1.14***	-1.19***	-1.44***	-0.87***	-1.14***	-1.09***	-0.78***	-1.14***
	(-0.08)	(c)	(c)	(c)	(0.04)	(-0.07)	(-0.07)	(-0.08)	(-0.09)	(-0.06)	(-0.08)	(-0.14)	(-0.13)
Output	1.97***	1.50***	1	1.65***	-2.20***	2.44***	2.85***	3.51***	0.62	2.14***	1.89***	1.18	2.09**
	(-0.51)	(-0.17)	(c)	(-0.19)	(0.28)	(-0.47)	(-0.46)	(-0.49)	(-0.59)	(-0.42)	(-0.57)	(-0.89)	(-0.86)
Opportunity cost													
over foreign asset	-0.65***	-0.75***	-0.92***	-0.69***	0.30***	-0.43***	-0.31***		-1.18***	-0.57***	-0.63***	-0.53***	-0.91***
	(-0.11)	(-0.12)	(-0.15)	(-0.14)	(0.06)	(-0.08)	(-0.08)		(-0.19)	(-0.08)	(-0.12)	(-0.18)	(-0.19)
over domestic asset								-2.37***	1.52***				
								(-0.60)	(-0.52)				
Loading coeff.	-0.11***	-0.10***	-0.07***	-0.10***		-0.11***	-0.09***	-0.07**	-0.09***	-0.13***	-0.14***	-0.10***	-0.09***
	(-0.03)	(-0.02)	(-0.02)	(-0.02)		(-0.03)	(-0.03)	(-0.03)	(-0.02)	(-0.04)	(-0.05)	(-0.02)	(-0.03)
R2	0.59	0.60	0.54	0.60		0.61	0.60	0.43	0.61	0.31	0.39	0.54	0.44
Log likelihood	641.8	641.6	638.8	638.9		549.4	551.4	743.8	821.2	599.8	602.6	619.1	614.9
AIC criteria	-18.6	-18.5	-18.5	-18.5		-15.8	-15.9	-21.9	-23.5	-17.4	-17.2	-17.8	-17.7
Schwarz criteria	-16.9	-16.9	-16.8	-16.8		-14.3	-14.4	-20.4	-21.1	-15.9	-15.2	-16.2	-16.1
Lag structure	2	2	2	2	2	2	2	2	2	2	3	2	2
Cointegration rank													
Trace	1	1	0	1		2	1	0	1	1	1	1	1
Eigenvalue	1	1	0	1		0	0	0	0	1	1	1	1
Prob. of LR test on restriction		0.48	0.05	0.21									

Source: staff estimates

1/ In both the long-run relation and the short-term dynamics, the coefficient reported are consistent with a normalization of price to 1.
2/ Prefered model: core inflation (CPIX), annual G/$ depreciation for opportunity cost
3/ Constrained coefficient on currency and weak exogeneity restrictions.

Annex Table _. Money demand equation with different monetary aggregates 1/

	Narrow Money M1							Guarani Broad Money (M2)				Broad Money M3			
Alternative asset: 2/	Time and saving deposits				Dollar currency 3/			Dollar deposits 3/				None	U.S. Fed. funds 3/	LRM	LRM
Cointegrating vector															
Money	-0.74***	-1	-2.62***	-1	-0.61***	-1.43***	-1.63***	-1.17***	-1	-0.72***	-1	-0.95***	-0.94***	-0.99***	-1
	(-0.13)	(c)	(-0.73)	(c)	(-0.06)	(-0.26)	(-0.22)	(-0.19)	(c)	(-0.19)	(c)	(-0.06)	(-0.05)	(-0.06)	(c)
Output	0.93	2.93***	5.93***	1.59**	-0.25	1.38**	2.20***	1.45	0.56**	0.69	1.59***	0.48	0.69*	0.99**	-1
	(-1.08)	(-0.37)	(-1.96)	(-0.75)	(-0.44)	(-0.70)	(-0.57)	(-1.03)	(-0.27)	(-0.71)	(-0.38)	(-0.41)	(-0.39)	(-0.44)	(c)
Opportunity cost	-3.53***	0.59	-4.84***	-3.34***	-1.10***	-1.56***	-1.38***	-1.92***	-2.06***	-1.27***	-1.41***		-0.40**	-1.40***	-1.43***
	(-0.78)	(-0.64)	(-1.22)	(-0.73)	(-0.11)	(-0.18)	(-0.16)	(-0.23)	(-0.25)	(-0.17)	(-0.18)		(-0.19)	(-0.32)	(-0.28)
Trend			0.04**	0.01**		0.02***	0.03***			-0.01***	-0.01***				
			(-0.02)	(0.00)		(-0.01)	(-0.01)			(0.00)	(0.00)				
Loading coeff.	-0.03**	-0.04**	-0.02**	-0.04***	-0.09***	-0.06***	-0.08***	-0.04***	-0.04***	-0.08***	-0.06***	0.05**	0.08***	0.07***	0.07***
	(-0.01)	(-0.02)	(-0.01)	(-0.01)	(-0.02)	(-0.01)	(-0.02)	(-0.01)	(-0.01)	(-0.02)	(-0.02)	(-0.02)	(-0.03)	(-0.02)	(-0.02)
R2	0.41	0.41	0.40	0.42	0.66	0.66	0.72	0.65	0.65	0.68	0.66	0.39	0.53	0.55	0.55
Log likelihood	678.5	678.2	680.3	679.1	623.8	627.8	636.2	650.6	650.4	652.5	651.9	514.2	693.3	674.2	674.1
AIC criteria	-19.8	-19.8	-19.9	-19.8	-18.0	-18.1	-18.1	-18.7	-18.7	-18.7	-18.7	-15.2	-20.0	-19.4	-19.4
Schwarz criteria	-18.3	-18.3	-18.3	-18.3	-16.4	-16.4	-15.9	-17.0	-16.9	-16.9	-16.9	-14.3	-18.3	-17.7	-17.7
Lag structure	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cointegration rank															
Trace	2	2	1	1	2	1	1	0	1	1	1	1	2	1	1
Eigenvalue	1	2	0	0	2	1	1	0	1	1	1	1	2	2	2
Prob. of LR test on restriction				0.12							0.27				0.95

Source: staff estimates

1/ In both the long-run relation and the short-term dynamics, the coefficient reported are consistent with a normalization of price to 1.

2/ Opportunity cost measured as a spread of the return of the alternative asset over the rate of return of a given aggregate.

3/ Return measured with backward depreciation over a year.