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Abstract[1]

This paper seeks to identify the main determinants of the formation of inflation expectations in Paraguay since the adoption of the inflation targeting regime. This work bases the analysis on the results obtained from the expectations surveys conducted by the country's monetary authority. Likewise, it is important to note that the dispersion of respondents'' answers was adjusted within the inflation range and that it has also decreased according to the reduction in this range. This further demonstrates the effectiveness of the expectations channel, thanks to the credibility that the central bank has been achieving.

JEL classifications: E31, E52, E58
Keywords: Inflation targeting, Inflation expectations, Monetary policy

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1. Introduction

In May 2011 the Central Bank of Paraguay (BCP) officially adopted the inflation targeting regime to regulate its monetary policy. Prior to this policy framework, Paraguay exhibited marked levels of volatility, even though there were no historical records of high inflation periods. Under the inflation targeting regime, volatility and inflation levels have been reduced. These inflation levels fostered uncertainty among economic agents in forming their inflation expectations. All this was reflected in the fact that these expectations showed considerable variability, in accordance with the results obtained in the expectations surveys of economic variables carried out by the central bank on a monthly basis.

The main purpose of this paper is to try to identify some of the determinants that Paraguay's economic agents consider important when forming their inflationary expectations. In view of the results of the survey, a series of factors that may influence the expectations formation of those who answered the survey have been considered. To do this, simple econometric regressions are carried out, and their results can be considered a first attempt to find the determinants of inflation expectations in Paraguay. In addition, the regressions highlight the importance of the establishment of the inflation targeting framework, not only in reducing inflation levels and their volatility, but also in lowering inflation expectations. Furthermore, it can be affirmed that the BCP has managed to gain significant credibility with respect to the handling of the monetary policy in its attempt to maintain low and stable inflation. This is reflected in the credibility index, which shows the alignment of expectations around the inflation target since the establishment of the inflation targeting regime.

Inflation expectations play a critical role in the process of price formation in the market. In addition, the decisions of households and firms depend heavily on the real return that could be expected on the savings and investments they make. Therefore, central banks closely monitor the development of inflation expectations in order to implement their monetary policy in a successful manner.

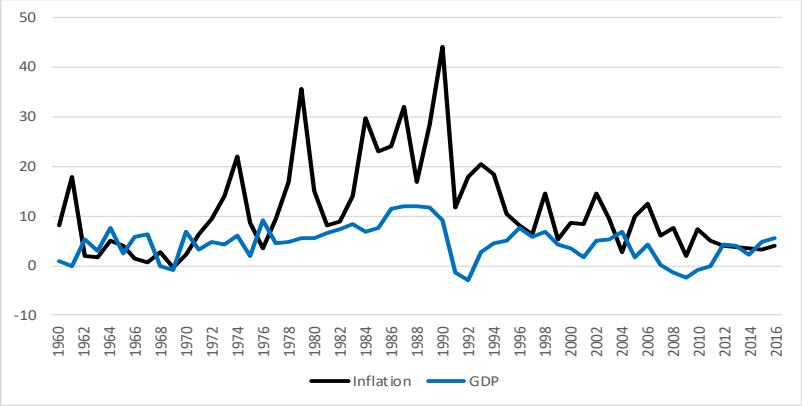
The results of the empirical model of this paper show that the establishment of the inflation targeting scheme has helped to anchor expectations around the target, and that the dispersion of these expectations has been adjusted within the inflation range. Furthermore, this dispersion has been reduced with the decrease of the range during the consolidation process of the inflation targeting regime.

The first part of this document contains a brief narrative of monetary policy in Paraguay, highlighting the main characteristics, and delineates the most important results obtained from it, especially since the implementation of the inflation targeting framework. Next, the importance of inflation expectations in monetary policy, in general and specifically in Paraguay, is highlighted. Subsequently, after a description of the characteristics of the data according to the results of the economic variables survey, an estimation model of inflation expectations determinants in Paraguay is presented. The main outcomes of the model show the robustness of the results through different estimation methodologies. The final section presents conclusions and closing comments.

2. Monetary Policy in Paraguay

Throughout its history, the Paraguayan economy has not displayed significant macroeconomic imbalances, such as severe fiscal deficits or hyperinflationary episodes. The average growth gross domestic product (GDP) has been placed at relatively acceptable levels, although it has presented periods of high volatility. In regard to prices, inflation in Paraguay has been characterized by moderate levels, unlike most countries of the region.[2] Likewise, the main problem regarding inflation has been its volatility. The macroeconomic performance of Paraguay can be attributed in part to the sound management of monetary policy. This is reflected partly in the fact that the "guaraní," the local currency of Paraguay, has not been modified since its inception, thus making it one of the oldest currencies in the region. The relatively prudent management of fiscal policy has contributed, to a certain extent, to keeping inflation at a low level.

Figure 1. Inflation and Real GDP Growth, Percentage



Source: Central Bank of Paraguay.

[2] Average inflation in Paraguay in the period 1960-2016 was 11.2 period, while average real GDP growth in the same period was 4.5 percent.

As pointed out in Banco Central del Paraguay (2013), the design of monetary policy in Paraguay has considered the existence of a relationship between the growth of money supply and inflation. Historically, this design has adopted a monetary policy scheme of intermediate objectives, in this case setting targets for the growth of a specific monetary aggregate. Thus, the Central Bank used its instruments to control the money supply's growth to a level compatible with the inflation objective, which was based on the achievement of "low inflation," using the quantitative theory of money as a conceptual framework reference.

Regarding economic activity, in general, the average growth of the Paraguayan economy has been acceptable, even though it has been characterized by volatility. While the expansion of the economy was quite significant in the 1970s, mainly due to the construction of the Itaipú Dam, there was a period of slowdown in the 1980s and 1990s. In this weakened situation, and as a consequence of a weak financial system and the fragility of the regulatory and supervisory frameworks, the period from 1995 to 1998 witnessed a financial crisis. In this period, economic authorities needed a comprehensive reorganization of monetary and financial policy, which was attained through the enactment of important laws that allowed a much more stringent regulatory framework for financial institutions.[3]

In 2002, the Argentine economy fell into a deep crisis, causing the abandonment of the convertibility regime to which that country's exchange rate policy was subordinated. This episode also affected the Paraguayan economy. Despite the central bank's effort to curb capital outflows and exchange rate depreciation through sharp increases in the interest rates of monetary regulation instruments, the second financial crisis occurred towards the end of 2002, although of smaller magnitude than the first one.

Despite these crisis episodes, the enactment of the aforementioned regulatory laws for the financial system allowed the Central Bank to focus more on the achievement and maintenance of low and stable inflation, driving its monetary policy of intermediate objectives under a monetary aggregates framework.

As of 2004, the monetary authority began to lay the foundations for the establishment of an inflation targeting framework, albeit in an "experimental" way. Thus, the central bank

[3] Law No. 489 of the Central Bank and the Law No. 861 "General of Banks, Finance and Other Credit Institutions."

modernized its monetary policy operational instruments with the establishment of a medium-term inflation target with a tolerance range. Under this scheme, it was possible to reduce the average inflation rate in the period from 2000 to 2010 to a single-digit level.[4]

With a more consolidated and orderly monetary policy framework, the Central Bank formally adopted an inflation targeting regime in May 2011, establishing a target of 5 percent annually with a tolerance range of +/- 2.5 percentage points (pp). After the establishment of the inflation targeting regime lower levels of inflation and volatility were recorded. For this reason, monetary authorities decided to reduce the tolerance range to +/- 2 pp. In 2014 and at the end of that same year, they also reduced the inflation target to 4.5 percent annually, which would apply from 2015 onwards. In order to achieve its objective of maintaining low and stable inflation, at the beginning of 2017, the Central Bank announced a reduction of the medium-term target to a rate of 4 percent annually, maintaining the tolerance range of +/- 2 pp.

From the establishment of the inflation targeting regime, in the 2011-2016 period, average inflation was recorded at 3.9 percent. With these results and with monetary authorities' efforts to not only maintain low levels of inflation, but also reach a significant degree of credibility, inflationary expectations were aligned to values around the inflation target with less variability over the years.

3. Influence of Expectations on Inflation

Economics is a social science that somehow attempts to explain human behavior, so the perceptions of economic agents on the future evolution of a wide range of economic indicators are important. Therefore, an interesting challenge for monetary authorities is to try to interpret these perceptions in order to implement coherent policies that help guide them towards clear and precise objectives. Thus, it is in the macroeconomic field, and particularly the theory of monetary policy, where expectations have become a powerful analytical tool.

Under the inflation targeting framework, the transmission mechanism of inflationary expectations is crucial for the achievement of a medium-term inflation target. As the effectiveness of the expectations channel depends on the credibility of the central bank, establishing a systematic

[4] In that period average inflation was 8.1 percent, while in the 1990–2000 period it was 15.1 percent.

and transparent decision-making process in monetary policy is key in facilitating the process of price formation and private expectations.

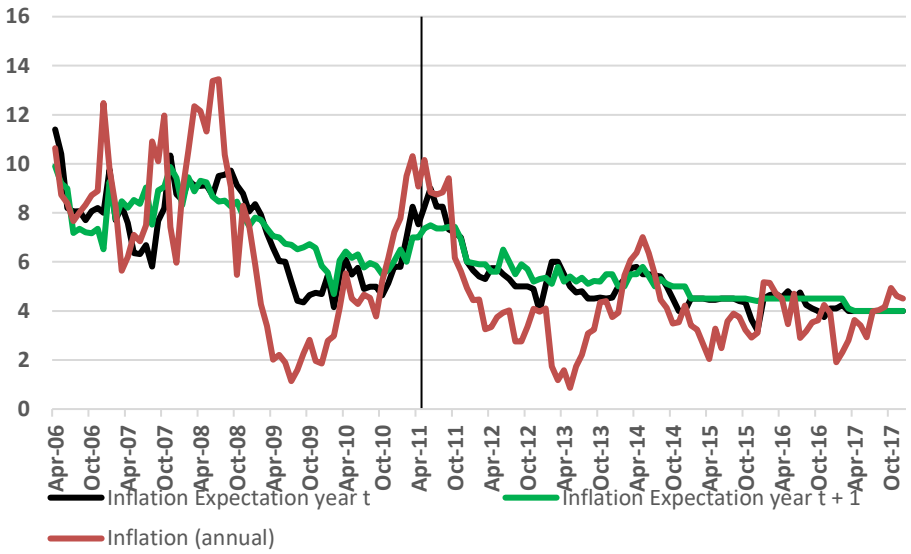
The achievement of the objectives proposed by the central bank, its transparency and communication increase its credibility, which contributes to that the expectations remain anchored to the target in the policy horizon. When a central bank has built a credible and transparent reputation, a monetary policy decision aimed at controlling inflation keeps inflation expectations anchored to the target. Therefore, in the face of an expectation of controlled inflation, decisions to adjust prices and wages will be made in line with the inflation target announced by the central bank.

Taking into account that the objective of clear and transparent communication is to give signals about the implications of monetary policy decisions, in general terms, the expectations channel may have a more rapid impact on the achievement of the inflation target compared to other transmission mechanisms that act with a greater lag. This makes the expectations channel an important and timely channel for the effectiveness of monetary policy.

Since the implementation of the inflation targeting regime, the Central Bank of Paraguay has made a great effort to improve its credibility. As mentioned above, Paraguay's main problem has not been high levels of inflation, but rather high volatility. Since the formal establishment of the inflation targeting scheme by the Central Bank of Paraguay, not only have inflation levels been reduced, but, above all, their volatility has been reduced. Likewise, it has been verified in the expectations data that there has been a decrease in both their levels and their volatility given the decrease in observed inflation rates. This suggests that the Central Bank of Paraguay has managed to increase its credibility in recent years.

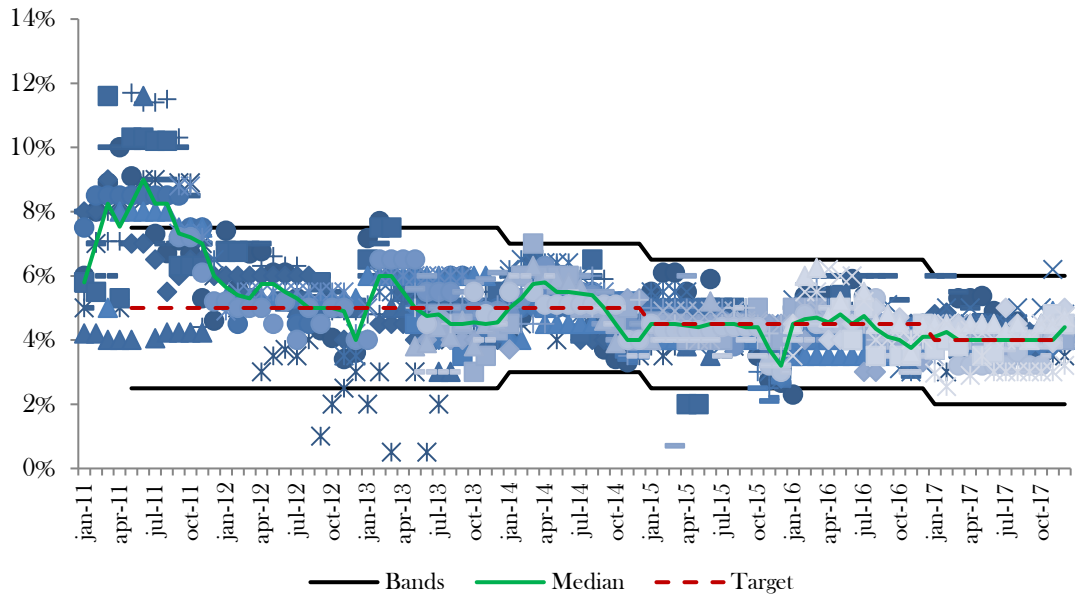
As mentioned above, an interesting fact that has been observed with the implementation of the inflation targeting regime is the reduction of inflation expectations (average or median) to levels closer to the target. Additionally, dispersion has been reduced, mainly because of the reduction of the tolerance range in 2014.

Figure 2. Annual Inflation and Inflation Expectation for Year t and t + 1, Percentage



Source: Central Bank of Paraguay.

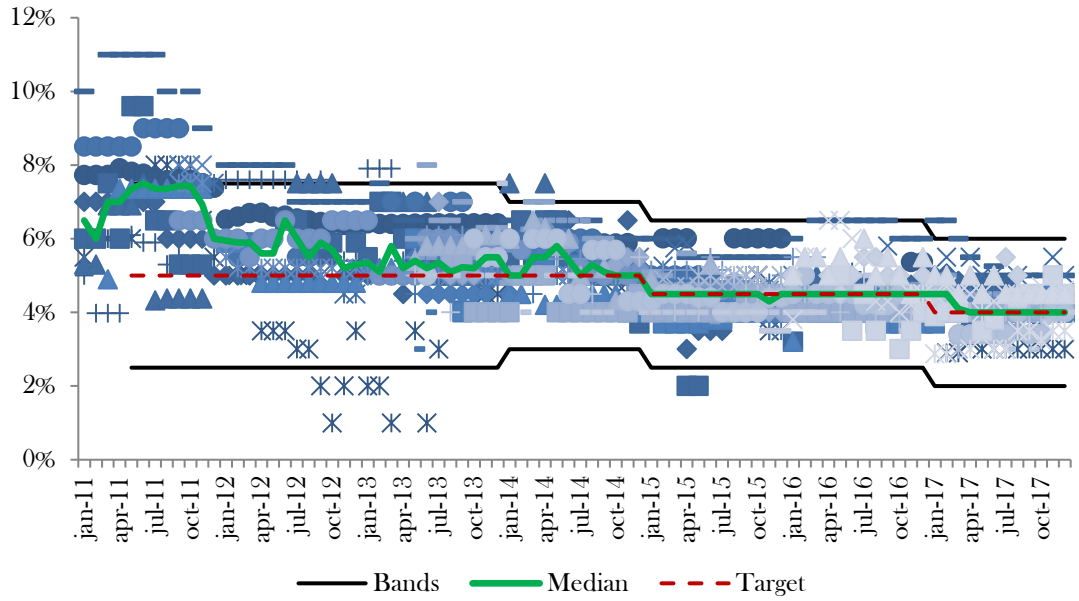
Figure 3. Dispersion of Inflation Expectations for Year t[5]



Source: Central Bank of Paraguay.

[5] The different dots represent the respondents in each period, which for ethical reasons cannot be identified individually.

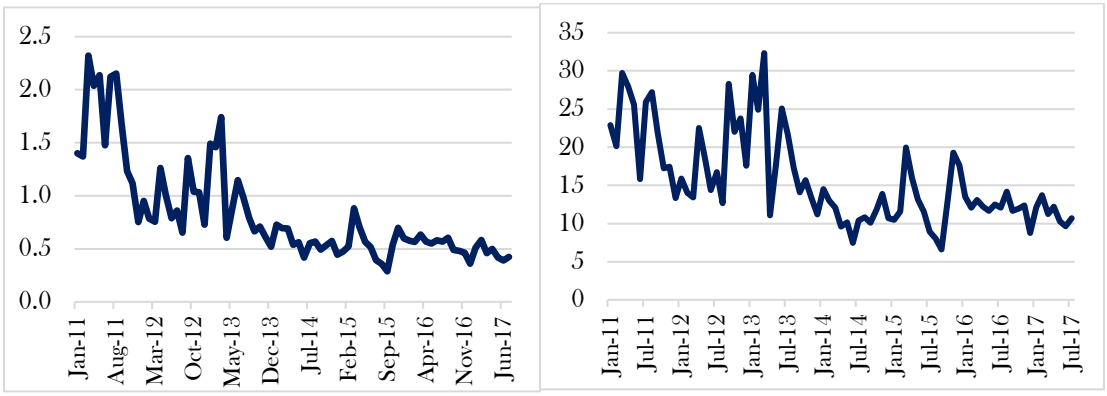
Figure 4. Dispersion of Inflation Expectations for Year t+1



Source: Central Bank of Paraguay.

The reduction of the tolerance range can be proven through traditional statistics of variability, such as the standard deviation and the coefficient of variation, which effectively show a reduction (on average) in recent years, coinciding with the reduction of tolerance bands.

Figure 5. Standard Deviation and Coefficient of Variation, Percentage



Source: Authors' calculations.

Finally, an additional test was run: a simple model of the volatility statistics with respect to a dummy variable that takes the value of one if there is a reduction in the band. The variable is significant with an expected negative sign. In summation, these results suggest that the reduction of the band contributed to decreasing the dispersion of economic agents' expectations.

4. Empirical Model for Paraguay

In the BCP, expectations of the main macroeconomic variables are obtained with monthly frequency—as of April 2006, from the Economic Variables Survey (EVE). The EVE initially focused on representatives of some of the country's banks. Currently, however, this survey is conducted among agents representing different economic sectors that include banks and financial companies, risk rating agencies, brokerage firms, consulting firms, independent analysts, economic organizations and universities. The survey now has 34 respondents, including 22 representatives of financial institutions.

The EVE is divided into four blocks that include questions related to the expectations of economic agents with respect to total inflation, measured by the variation of the consumer price index (CPI), the evolution of the nominal exchange rate (guaraní to U.S. dollar), GDP growth and the trajectory of the monetary policy rate.

The questions encompass expectations of the variables mentioned at different periods: for the end of this month and the following, the current year, the next 12 months, the following year and the Monetary Policy horizon (which ranges between 18 and 24 months).

Considering that inflation expectations constitute an important tool for the Central Bank in the management of monetary policy under the inflation targeting scheme, this paper aims to identify the main variables that affect the formation of inflation expectations.

4.1 Data Features

Taking into account the structure of the EVE surveys in relation to the expectations of the economic variables studied, the survey is designed to obtain information on the perspectives of the economic agents for the current year and for the following year. Thus, the survey data provide information for "fixed event forecasts," which, to a certain extent, imposes limitations on the estimation of an econometric model.

In order to identify the main determinants of the process of forming expectations, it is necessary to have a series of "fixed horizon" inflation expectations. To carry out an approximation of fixed horizon forecasts from the fixed event forecasts of the EVE, we follow the work of Dovern, Fritsche and Slacalek (2009), in which this approximation is made as a weighted average of "fixed-event forecasts" as follows:

$$F^{fh}_{y0,m,12}(x) = \frac{12-(m-1)}{12} F^{fe}_{y0,m,y0}(x) + \frac{m-1}{12} F^{fe}_{y0,m,y0+1}(x)$$

where:

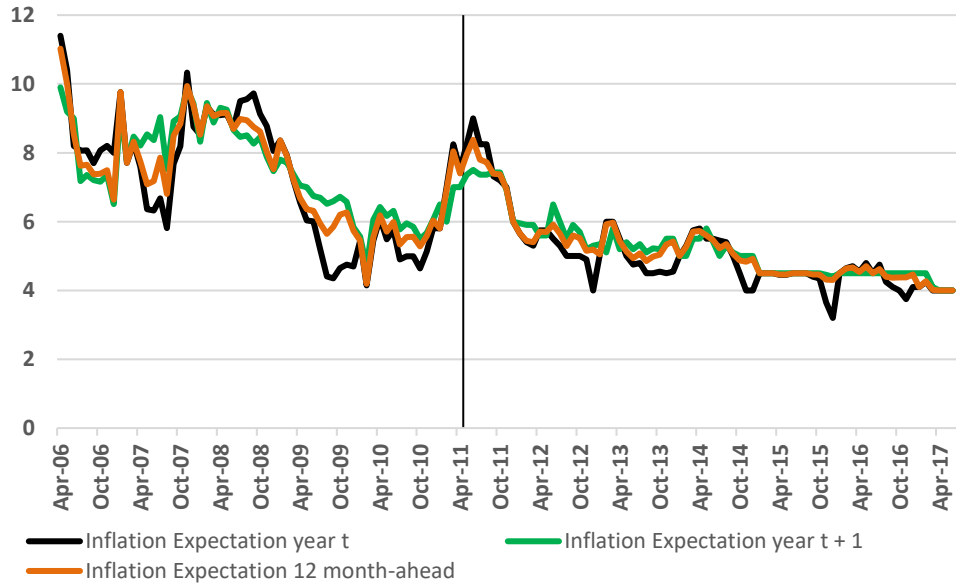
$F^{fe}_{y0,m,y0}(x)$ is the fixed-event forecast of the variable *x* for the current year (y0) made in the month *m* of the year y0,

$F^{fe}_{y0,m,y0+1}(x)$is the fixed-event forecast of the variable *x* for the following year (y0 + 1) made in the month *m* of the year y0,

and $F^{fh}_{y0,m,12}(x)$is the fixed horizon twelve-month-ahead forecast made in the month *m* of the year y0.[6]

For example, the inflation expectation made in October 2014 for the time period between October 2014 and October 2015 is approximated by the sum of $F^{fe}_{2014,10,2014}(\pi)$ and $F^{fe}_{2014,10,2015}(\pi)$, and weighted by $\frac{3}{12}$ and $\frac{9}{12}$, respectively.

Figure 6. Inflation Expectations for Year t and t+1, and 12 Months Forward, Percentage



Source: Central Bank of Paraguay.

[6] As an example, $F^{fh}_{2014,10,2015}(x)$ corresponds to the forecast made in October 2014 for 2015.

In this section, we identify some variables that determine inflation expectations in Paraguay, according to empirical literature related to the subject, and consider some characteristics of the Paraguayan economy.

Taking into account that price formation has a certain persistence in its adjustment process, for a certain period, the expectations of the recent past period should also be considered, since in these expectations agents are acquiring more information about events that may affect those expectations. In addition, the evolution of inflation should be an important factor to consider, since this evolution provides significant information when determining the future evolution of prices.

On the other hand, the establishment of the inflation targeting regime in Paraguay has been an important factor in the formation of inflation expectations, since it has led to a significant structural change in Paraguayan monetary policy, thus constituting an anchor that serves as a guide for the formation of these expectations. According to the observed inflation data, which were reduced both in levels and in variability, and the inflation targeting framework, monetary policy in Paraguay has achieved important credibility with economic agents. This is reflected, in part, in that when effective inflation data were adjusted around the target after the implementation of the inflation targeting scheme, expectations were also adjusted to the inflation target determined by the Central Bank.

For the correct functioning of the expectations channel, it is essential that the monetary authority in power has sufficient credibility. Economic agents must trust that the central bank will do everything necessary to achieve price stability and its inflationary objective in the medium term. Credibility would be able to neutralize, in part, the effects of economic shocks on prices that are transmitted through the channel of expectations.

In this sense, to try to capture the effect of the credibility that the Central Bank of Paraguay has acquired during the inflation targeting regime. A credibility index has been constructed following the work of (de Mendonça, 2007), in which it is assumed that the central bank is able to guide inflation expectations towards the target and reaffirm its commitment to stated inflation ranges. Thus, the credibility index is equal to one when expectations are equal to the inflation target and decreases when expectations move away from the target. In cases where inflation expectations are located outside the inflation target bands, the index is equal to zero (see Appendix).

Finally, it may be thought that a priori changes in the nominal exchange rate (guaraní-dollar) should influence the formation of inflation expectations of economic agents on the cost side of imported goods (and inputs), especially when considering that Paraguay is a relatively open economy.[7] A similar analysis could be made when considering variations in oil price, since this product directly affects the price of fuels, an important input for any productive process.

4.2 Estimation of the Empirical Model

To guarantee the robustness of our results, the model we use has been estimated by three econometric methods: ordinary least squares (OLS), fully modified OLS (FMOLS), and the generalized method of moments (GMM).[8] The FMOLS method assumes the existence of a co-integration relationship between the variables, while the GMM method is created to avoid potential endogeneity problems with some regressors using OLS. The model has been estimated in monthly frequency. In accordance with the aforementioned information, and taking into account some characteristics of Paraguayan monetary policy, the estimated model is as follows:

$$\pi_t^e = \alpha_0 + \alpha_1 \pi_{t-1}^e + \alpha_2 \pi_{t-1} + \alpha_3 \Delta ner_{t-1} + \alpha_4 \Delta oil_{t-1} + \alpha_5 cred_{t-1} + \alpha_6 cred_{t-1} * \pi_{t-1}^e + \alpha_7 dummy_t^{IT} + \varepsilon_t$$

where:

π_t^e is the inflation expectation for 12 months ahead,

π_{t-1} is the annual inflation of period t – 1,

Δner_{t-1} is the annual variation of the nominal exchange rate (guaraní-dollar),

Δoil_{t-1} is the annual variation in the price of oil,

$cred$ is a variable that measures the credibility of the central bank,[9] and

$dummy_t^{IT}$ represents the period since the implementation of the inflation targeting regime.

According to our regressions outcomes, inflation expectation formation in Paraguay (12-month-ahead) is determined mainly by the inflation expectation of the previous month. In addition, the annual inflation information of the previous month is significant at the time of forming expectations.

[7] Imports represent more than 35 percent of GDP.

[8] The lags of the dependent and explanatory variables were used as instruments. In order to evaluate the validity of the instruments, the Sargan J test was performed, and the results were satisfactory.

[9] This index was constructed according to the work of de Mendonça (2007), whose criterion is described in the Appendix.

On the other hand, the credibility index presents an expected negative sign, as inflation expectations have effectively aligned around the medium-term inflation target since the implementation of the inflation targeting scheme.

Changes in the exchange rate and the price of oil were not significant in the inflation expectation formation process. This could partly be due to a relatively low pass-through of the exchange rate to total inflation, especially in the last few years.[10] Likewise, the oil price reduction in international markets has influenced the decrease of fuel prices in the local market.

Since the establishment of the inflation targeting scheme, both the level of inflation and its volatility have decreased. This behavior is also reflected in the results of the surveys, in which it is observed that inflation and its expectations present an important variability. The credibility achieved by the monetary authority has been essential in ensuring that expectations are adjusted to the inflationary objective of the medium term. On the other hand, as of May 2011, the estimate of a dummy variable reflects the change in the monetary policy regime. In addition, it is proven that under the inflation targeting regime inflation expectations have been adjusted downward, as observed inflation data were aligned around the inflation target.

[10] "Recent Evolution of the Exchange Rate and Inflation," Box I of *Monetary Policy*, Central Bank of Paraguay, September 2015.

Table 1. Estimated Equations for Inflation Expectations

	Models		
Dependent variable	**Inflation expecations (12 month-ahead)**		
	OLS	**FMOLS**	**GMM**
Sample	**2006M05 - 2017M12**	**2006M05 - 2017M12**	**2006M05 - 2017M12**
$Constant$	2.41	1.84	2.57
	(0.0000)	*(0.0005)*	*(0.0071)*
π_{t-1}^{e}	0.53	0.62	0.49
	(0.0000)	*(0.0000)*	*(0.0002)*
π_{t-1}	0.16	0.13	0.17
	(0.0000)	*(0.0000)*	*(0.0000)*
Δner_{t-1}	-0.0003	-0.0006	-0.0003
	(0.9570)	*(0.9230)*	*(0.9633)*
Δoil_{t-1}	*-0.0009*	*-0.0008*	-0.0015
	(0.5948)	*(0.5962)*	*(0.3086)*
$cred_{t-1}$	*-1.791*	*-1.904*	*-2.0967*
	(0.0028)	*(0.0011)*	*(0.0061)*
$cred_{t-1} * \pi_{t-1}^{e}$	0.27	0.31	0.32
	(0.0047)	*(0.0006)*	*(0.0022)*
$dummy^{IT}$	-0.31	-0.23	-0.30
	(0.0049)	*(0.0276)*	*(0.0224)*
Adjusted R^2	**0.92**	**0.92**	**0.92**

p-values in parenthesis

Table 2. Estimated Equations for Inflation Expectations for Bands Reduction

	Models		
Dependent variable	**Inflation expecations (12 month-ahead)**		
	OLS	**FMOLS**	**GMM**
Sample	**2006M05 - 2017M12**	**2006M05 - 2017M12**	**2006M05 - 2017M12**
$Constant$	2.67	2.19	2.92
	(0.0000)	*(0.0005)*	*(0.0000)*
π^{e}_{t-1}	0.47	0.55	0.43
	(0.0000)	*(0.0000)*	*(0.0000)*
π_{t-1}	0.19	0.18	0.20
	(0.0000)	*(0.0000)*	*(0.0000)*
Δner_{t-1}	0.0055	0.0047	0.0020
	(0.3606)	*(0.3744)*	*(0.7471)*
Δoil_{t-1}	*-0.0014*	*-0.0019*	-0.0029
	(0.3760)	*(0.1929)*	*(0.0639)*
$cred_{t-1}$	*-0.502*	*-0.640*	*-0.7481*
	(0.4371)	*(0.2710)*	*(0.1869)*
$cred_{t-1} * \pi^{e}_{t-1}$	0.03	0.07	0.07
	(0.7699)	*(0.4350)*	*(0.4295)*
$dummy^{IT}$	-0.20	-0.18	-0.20
	(0.0598)	*(0.0564)*	*(0.0552)*
$dummy^{bands}$	-0.57	*-0.489*	*-0.570*
	(0.0001)	*(0.0001)*	*(0.0000)*
Adjusted R²	**0.93**	**0.93**	**0.93**

p-values in parenthesis

A different exercise was carried out, however, that reflects the behavior of the inflation expectations of the group of respondents categorized as financial entities (banks and financial companies). The results show that the expectations of the financial agents show a similar pattern to the base equation.

Table 3. Estimated Equations for Inflation Expectations of Financial Entities

Dependent variable	Inflation expecation (12 month-ahead)
	OLS
Sample	2011M02 - 2017M12
Constant	1.82
	(0.0045)
π^{e}_{t-1}	0.55
	(0.0000)
π_{t-1}	0.14
	(0.0001)
Δner_{t-1}	-0.0046
	(0.4850)
Δoil_{t-1}	*0.0010*
	(0.6300)
$cred_{t-1}$	*-2.333*
	(0.0019)
$cred_{t-1} * \pi^{e}_{t-1}$	0.46
	(0.0006)
Adjusted R²	**0.89**

p-values in parenthesis

5. Conclusion

The implementation of an inflation targeting regime is relatively recent, and because of this economic agents have a learning curve with respect to the functioning of monetary policy transmission mechanisms and/or with respect to other macroeconomic variables that are relevant to explaining inflation. In the case of the Paraguayan economy, finding an econometric model that helps determine the main factors of inflation expectations is not a trivial task.

The establishment of the inflation targeting framework has led to an important structural change in the conduct of monetary policy in Paraguay. On top of helping reduce inflation levels and their volatility, this framework has also helped guide economic agents' inflation expectations through the nominal anchor of the medium-term inflation target.

Considering that the formation of prices is characterized by a change in persistence, it is reasonable to think that both the data of the observed inflation rate and that of their expectations

in a previous period are important determinants at the time that economic agents define their expectations of inflation in the current period.

The observed trajectory of the inflation data shows that the implementation of the inflation targeting scheme has been satisfactory. This proves that the BCP has achieved significant credibility in its purpose of keeping inflation low and stable around the inflation target. Therefore, the alignment of inflation expectations around the target can be attributed to an increase in credibility.

It should be noted that the reduction in inflationary bands also reflects an adjustment of inflation expectations around the target, attesting likewise to greater credibility of economic agents in the management of monetary policy under the inflation targeting scheme. In addition, when the respondents are grouped in the category of financial entities, it is observed that the expectations of these agents follow a pattern similar to that observed in the base equation.

Appendix

1. Credibility Index

$$\begin{cases} 1 & \textit{if} \quad \pi_t^e - \pi^* \\ 1 - \dfrac{1}{\pi^{lower} - \pi^*}[\pi_t^e - \pi^*] & \textit{if} \quad \pi^{lower} < \pi_t^e \\ 1 - \dfrac{1}{\pi^{upper} - \pi^*}[\pi_t^e - \pi^*] & \textit{if} \quad \pi^{upper} > \pi_t^e \\ 0 & \textit{if} \quad \pi_t^e \geq \pi^{upper} \quad or \quad \pi_t^e \leq \pi^{lower} \end{cases}$$

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