Inflation expectations and dollarisation in Peru[1]

Renzo Rossini, Marco Vega, Zenon Quispe and Fernando Perez

Abstract

Dollarisation intensifies the challenges posed to monetary policy by the pass-through of the exchange rate to domestic prices. These challenges become even greater when real transactions are dollarised, contaminating the formation of inflation expectations. This introduces non-linearities and asymmetries into the implications of the exchange rate for inflation during larger currency depreciations, in contrast to the case of smaller depreciations and appreciations.

Keywords: Inflation expectations, exchange rate pass-through into prices, SVAR models

JEL classification: E52, E58, F31

[1] Prepared for the BIS Deputy Governors' meetings on "Inflation mechanisms, expectations and monetary policy", 28–29 January 2016, Basel. We thank Adrian Armas and Teresa Lamas of the Department of Information and Economic Analysis for their excellent support and comments.

1. Introduction

During periods of high and hyperinflation, the use of the local currency is often abandoned in favour of a foreign one. The sequence of substitution begins with the currency's role as a store of value, followed by its roles as a unit of account and, last, as a medium of exchange. A well documented fact is that, after inflation is brought down, even to the point of sustained price stability, economic agents stick to using the foreign currency in all its roles. This lack of reversibility is known as hysteresis, since the end of inflation does not necessarily ensure the end of dollarisation.[2]

The high degree of dollarisation inertia can be attributed to transactional costs associated with contract revisions, or to insufficient incentives to change market practices. The dollarisation literature mostly emphasises the financial risks involved with dollar liabilities within the local banking system. However, the existence of an extended practice of keeping prices in dollars generates important complications to the objective of price stability, given the greater uncertainty about the pass-through of a depreciation to inflation and about the feedback loops of these variables with inflation expectations.

In this article, we revise the estimates of the exchange rate pass-through (ERPT) to inflation in the case of a partially dollarised economy, like that of Peru. We also try to identify how far movements in the exchange rate contaminate inflation expectations. In Section 2, we outline the high rate of dollarisation for transactions in contrast to the significant reduction in financial dollarisation. In Section 3, we discuss the ERPT and its feedback into inflation expectations, while Section 4 develops a simple view of the determinants of inflation expectations and discusses the stability of the parameters weighting the importance of each determinant. Finally, conclusions are presented.

2. Dollarisation of transactions between firms

Financial dollarisation has declined significantly in Peru, for both deposits and loans, but there is still a high degree of dollarisation in transactions. For example, some 57% of contracts between firms are still settled in dollars (see Graph 1). Big-ticket items for consumers, such as durables, house rents or apartments, are also priced in dollars. To some degree, inertia and transaction costs explain this persistence, despite the prevailing low inflation. An additional factor is that exchange rate movements imply arbitrary redistributive effects among buyers and sellers.[3]

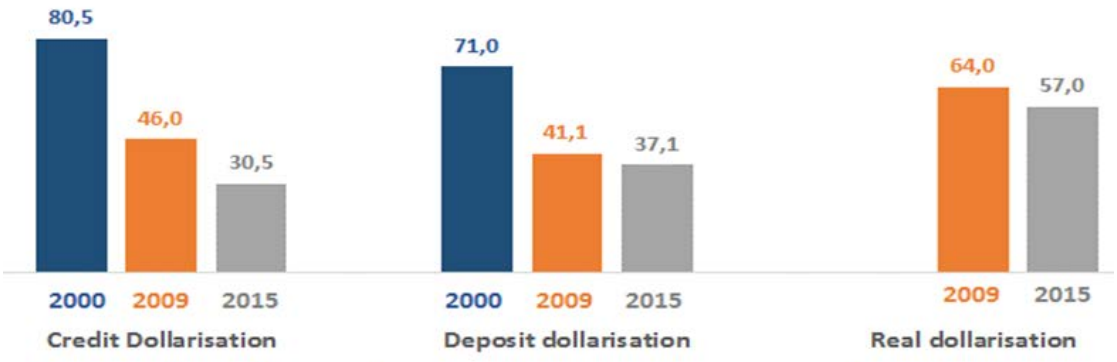
The sectors with the highest proportion of dollar transactions are commerce (72%), manufacturing (64%), transportation and communications (50%) and services (45%) (see Table 1). This shows that typical producers of non-traded goods index their prices to the exchange rate, which has important implications for real exchange rate adjustment in a dollarised economy.

[2] See Calvo and Vegh (1996).

[3] The Peruvian constitution guarantees the freedom to hold and transfer foreign currency.

Dollarisation[1]

(Percentages) Graph 1



1/ For credit and deposit dollarisation the ratios are shares from total credit and total deposits. The real dollarisation corresponds to surveyed firms acknowledging that most of their imput costs are denominated in foreign currency

Currency denomination of input purchases

(As percentage of surveyed firms) Table 1

Industry	Purchase of inputs	
	Domestic currency	Foreign currency
Agriculture	50	50
Commerce	28	72
Construction	67	33
Energy (Electricity, Gas and Water)	57	43
Manufacturing	36	64
Mining and oil	48	52
Fishing	67	33
Services	55	45
Transportation and comunications	50	50
Total	43	57

To understand the dollarisation of transactions and its implications in price-setting behaviour, it is important to study the process of price determination. To this end, one common explanation for inertia in inflation is the fact that firms adjust their prices in a discrete fashion, at different moments in time and at different frequencies. This affects the realisation of shocks over time.

In order to identify the speed of adjustment of prices to changing economic conditions, the Survey of Macroeconomic Expectations of the Central Reserve Bank of Peru included one question about the frequency of firms' price adjustments. At the sector level, manufacturing firms adjust their prices every eight months, commercial firms every 7.5 months and the services sector every 6.7 months on average. Using the 1983 Calvo model of price rigidities, where the frequency of price adjustments is related to the economy's degree of price rigidity, the degree of price rigidity in Peru would be 0.87, slightly lower than the value estimated for other economies (Table 2).

Indicators of price rigidity

Table 2

	United States	Eurozone	Peru
Frequency of price adjustments (f months)	8.3	10.8	7.5
Rigidity (Θ)	0.88	0.91	0.87

Source: Alvarez et al. (JEEA, 2006); EEM BCRP (2015)

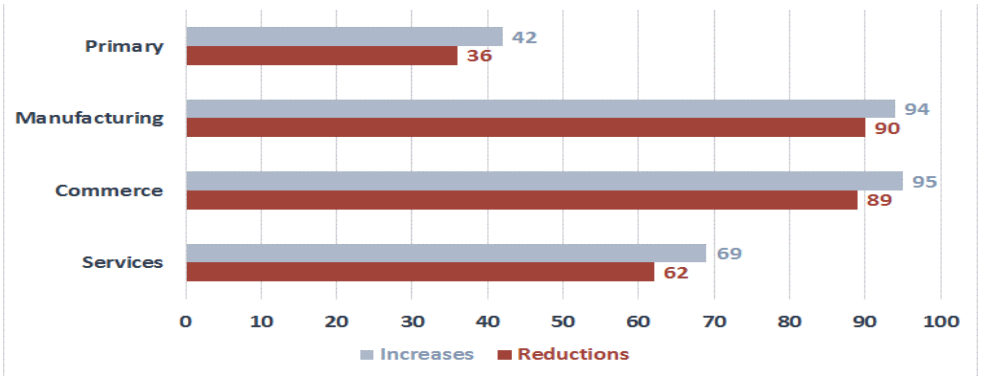
From Calvo's (1983) Price rigidity model: $f = \frac{1}{1-\theta}$

There are also some asymmetries in the impact of changing costs on prices. Graph 2 shows that reductions in input prices (whether policy- or market-driven) would not fully translate into the final prices; instead, they would also induce margins to be raised. Final prices also evince some downside rigidities in responding to lower labour costs, mainly in the services sector (Graph 3). However, in all the sectors, the impact of changes in input prices is greater than the impact of changes in labour costs.

Asymmetries of price adjustments to changes in input prices

(As a share of surveyed firms per sector)

Graph 2

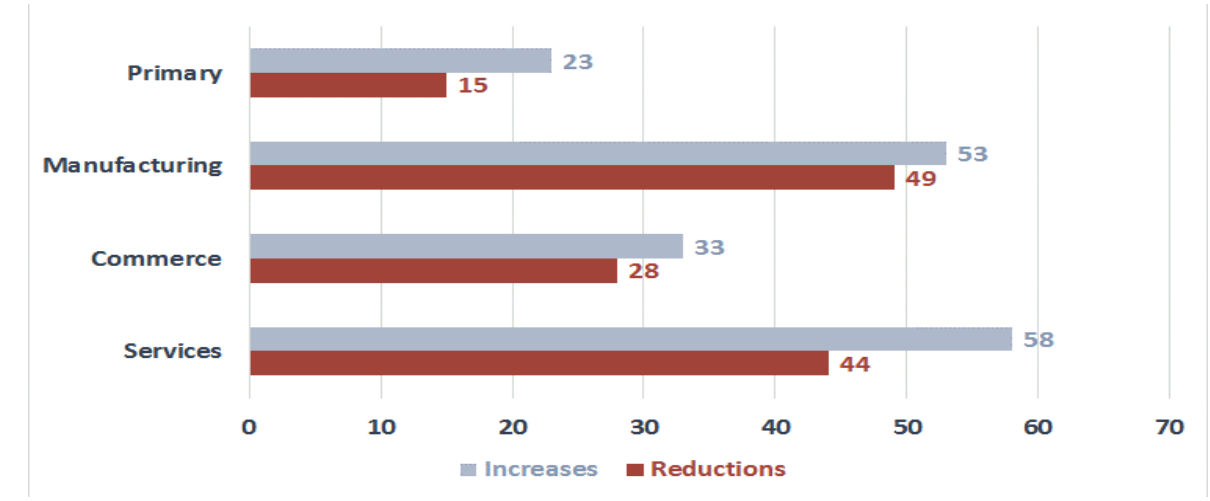


On the demand side, the responses are higher for reductions in demand than for increases in demand. Moreover, a firm's prices respond more to a competitor's price reductions than to its price increases. Furthermore, one of the main reasons to consider price adjustments is market share (Graph 4).

Given these asymmetries in price adjustments to changes in input prices and labour costs, and with an implied degree of rigidity in prices similar to that of the United States, the next section will discuss the role of the exchange rate on inflation and inflation expectations in a partially dollarised Peru.

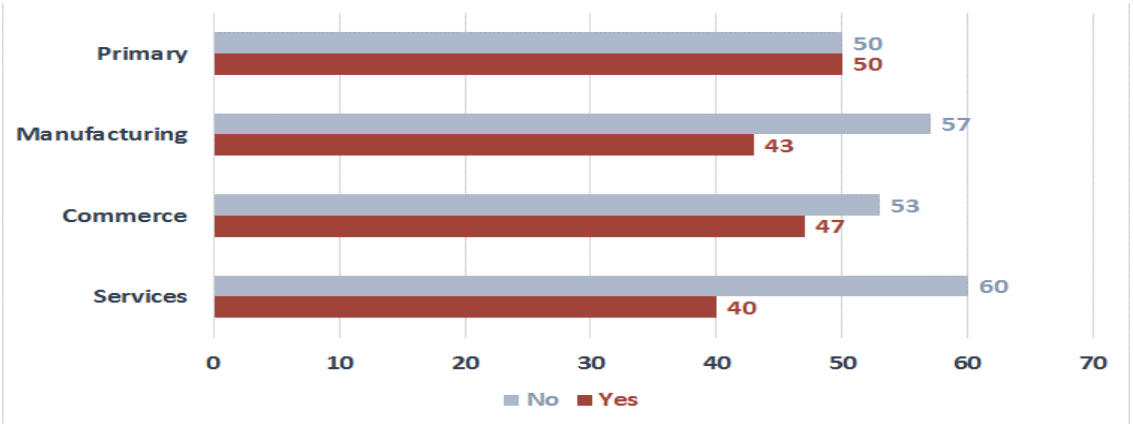
Asymmetries of price adjustments to changes in labour costs

(As a share of surveyed firms per sector) Graph 3



Likelihood of market share losses from rising prices

(As a share of surveyed firms per sector) Graph 4



3. Inflation expectations and the exchange rate

Although the fluctuations of inflation and inflation expectations are much smaller than those of currency depreciation, these dynamics signal a lower correlation and a non-proportional ERPT (Graph 5).

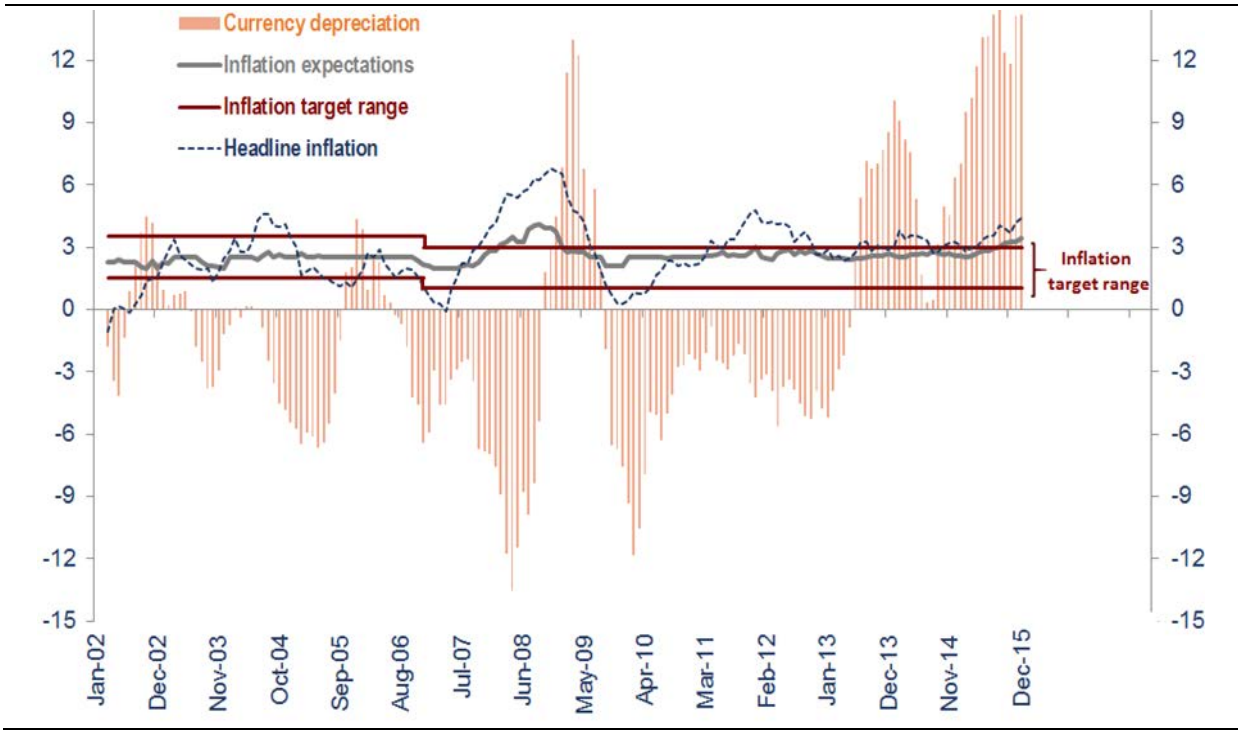
The empirical research on the ERPT provides a variety of results for different scenarios such as pre- and post-inflation targeting framework periods, asymmetries during different stages of exchange rate behaviour and during different phases of the business cycle.

During the years before the inflation targeting framework was implemented in 2002, the estimated ERPT averaged 21% in the short run and 47% in the long run

(with specific estimates ranging from 10% up to 50% for the short run and up to 100% for the long run).[4] After the inflation targeting framework was implemented, the estimates ranged from 0 to 10% in the short run and from 6 to 10% in the long run.[5]

Headline inflation, inflation expectations and currency depreciation

(Year-on-year percentages) Graph 5



Considering the behaviour of the exchange rate, Perez and Vega (2015) found evidence of an asymmetric ERPT, with a persistent and significant 30% pass-through to CPI inflation during periods of currency depreciations. But during periods of currency appreciations, estimated pass-through is neither persistent nor significant. Winkelried (2003) found a 25% pass-through rate during higher currency depreciations (larger than 2.5%), versus 18% during smaller depreciations; he also found 31% pass-through during economic expansions versus 14% during contractions; and 30% pass-through when inflation is accelerating versus 12% when inflation is slowing.

According to the Central Bank of Peru's Quarterly Forecasting Model, the ERPT is estimated to be 26% after two years (Table 3). More recently, the currency depreciation seems to be strongly influencing inflation expectations. For the design and implementation of monetary policy, the central bank's inflation forecast takes into account the high ERPT and the relatively large impact of food and energy prices.

[4] Clinton and Perrault (2001), Gonzales (2000), Hausmann et al (2000), Mihaljek and Klan (2001), Miller (2003), Morón and Winkelried (2002), Quispe (2001).

[5] Maertens, Castillo and Rodriguez (2012), Winkelried (2012).

Impact of structural shocks on inflation

Table 3

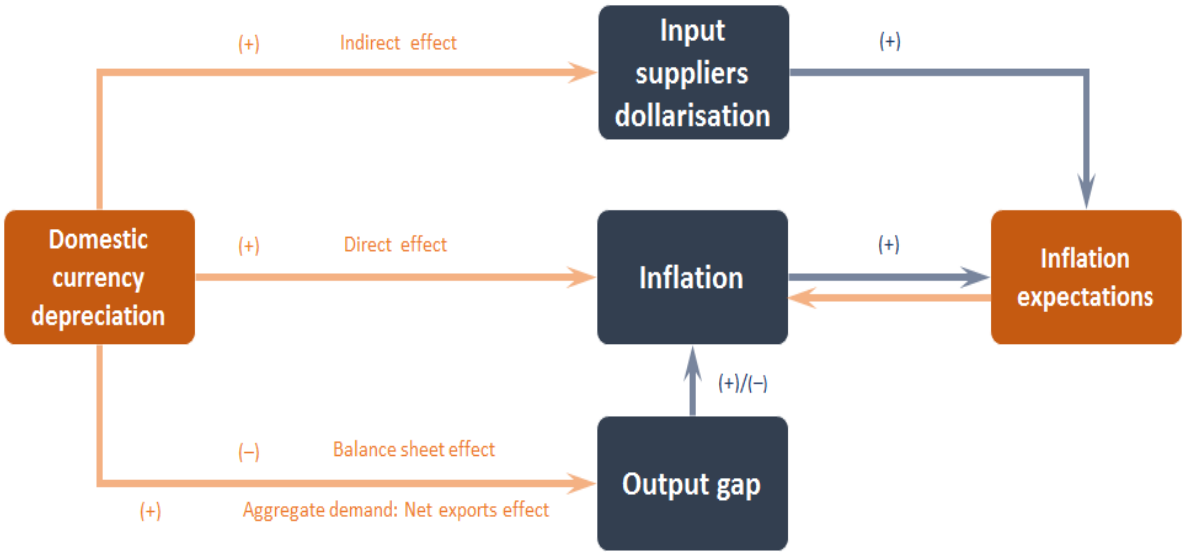
	Headline Inflation	
	Passthrough (years)	
	1	2
Imported Inflation	0.25	0.30
Currency Depreciation	0.13	0.26
Inflation Expectations	0.44	0.54
Output Gap	0.10	0.15
Food and Energy	0.44	0.46

Source: Quarterly Forecasting Model, Central Reserve Bank of Peru

A better understanding of the exchange rate's effect on the formation of inflation expectations requires a study of the transmission mechanisms of monetary policy implied in the central bank's Quarterly Forecasting Model. Variation in the nominal exchange rate passes directly into inflation through the prices of final goods and indirectly through dollarised input prices, which also influence inflation expectations. The exchange rate also generates a balance sheet effect and translates into inflation through the output gap (Graph 6).

Currency depreciation channels towards inflation

Graph 6



Also, it would be helpful to measure how correlated the components of the CPI basket are with the exchange rate. Although the components of the CPI basket with a very high correlation to the exchange rate have reduced their share from 9.2% to 4.0%, the components with a high correlation have increased from 11.9% to 27.8%. Those with a medium correlation have remained at a similar level, while those with a low correlation have fallen from 17.5% to 6.1% (Table 4).

Share of the CPI basket according to the degree of correlation with the exchange rate

Table 4

Correlation (ρ)		Jan-96 : Dec-05	Jan-06 : Dec-15
Very high	: ρ≥0.75	9,2	4,0
High	: 0.50≤ ρ<0.75	11,9	27,8
Medium	: 0.25≤ ρ<0.50	61,4	62,1
Low	: ρ<0.25	17,5	6,1

Given the previous evidence of partially dollarised contracts for price-setting, it is natural to assume that exchange rate fluctuations do affect decisions and the expectations of price setters. There is ample evidence for the ERPT to prices in Peru but the pass-through to inflation expectations has not been studied so far. In terms of the ERPT, the evidence in Peru[6] shows that it is low; about 10% one year after an exchange rate shock. Furthermore, there is also evidence of an asymmetric behaviour, ie the ERPT to prices after a depreciation is 20%, whereas the ERPT to prices after an appreciation is 10% (Pérez-Forero and Vega (2015)).

In this section we extend the asymmetric framework of Pérez-Forero and Vega (2015) to consider the case of the Survey of Expectations presented above. That is, we study the effect of exchange rate fluctuations on inflation expectations. Specifically, we include the time series of one-year ahead inflation expectations in the Structural Vector Autoregressive (SVAR) model in Pérez-Forero y Vega (2015). The effective sample for this exercise is from March 2002 to October 2015, which coincides with the inflation targeting period.

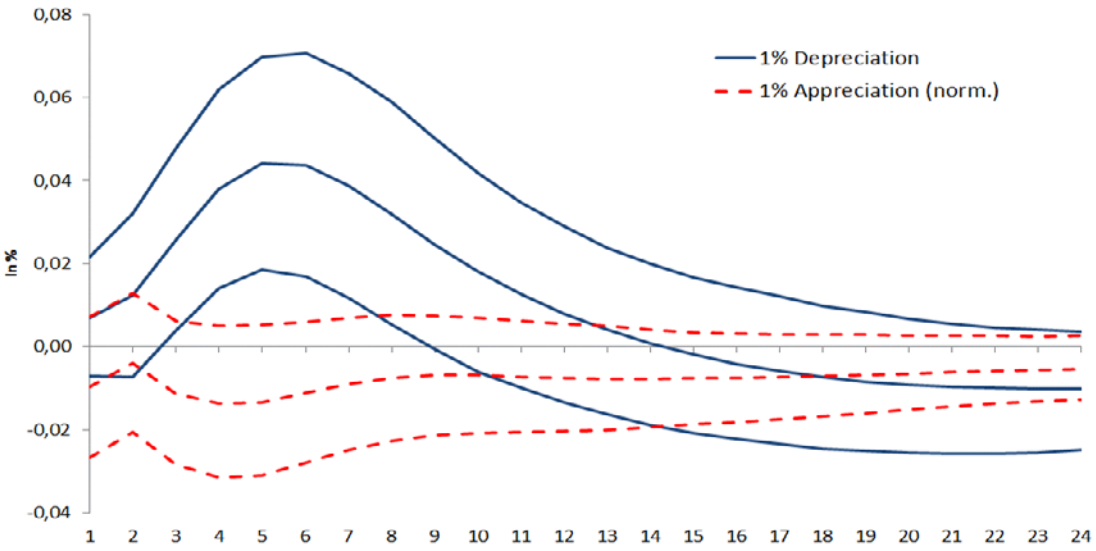
We present the results in Graph 7. In particular, we observe that a 1% depreciation will increase inflation expectations by approximately 5 basis points within six months. Moreover, as the new sol depreciation in 2015 was around 14.2%, we can estimate that the rise in inflation expectations explained by the exchange rate is around 0.7% in 2015. On the other hand, the response of inflation expectations after an appreciation shock is not significant at all.

There are two possible regimes, depreciation and appreciation. We observe that inflation expectations respond strongly and persistently after a depreciation shock, and the response is hump-shaped. The latter indicates that there are informational frictions, suggesting that, in the process of expectations formation, economic agents have to forecast the forecasts of others (Townsend (1983)) so that higher-order expectations matter. These results can be associated with theoretical models for price setters with informational frictions, such as Nimark (2008). The main idea is the fact that agents use public and private information in order to form their expectations. Furthermore, because of strategic complementarities, and because public signals might be observed with a lag, inflation and expectations respond with some inertia to aggregate shocks.

[6] For instance, see Winkelried (2003), Miller (2003), Maertens Odría, Castillo, and Rodríguez (2012), Winkelried (2013).

Response of one-year-ahead inflation expectations

(Percentages) Graph 7



Note: The responses for the appreciation shock are multiplied by minus one in order to compare both type of shocks. Under the symmetric case, both impulse-response functions would overlap.

Regarding the appreciation episode, we found no evidence of a significant reaction on the part of expectations. Of course, many factors can explain this result. First, prices and expectations exhibit downward rigidity. Therefore, a negative shock to the exchange rate of the same size as the depreciation will not produce the same results. We also have to take into account that appreciation episodes are long and persistent, whereas depreciation episodes are fast and abrupt. Therefore, it is less obvious to expect a strong negative response on the part of expectations after an appreciation.

We now turn our attention to the features of each identified regime. In reality, it turns out that depreciation episodes produce more news about inflation than appreciations do (more public signals available). That is, agents are more concerned about inflation whenever there is a depreciation episode.[7] Therefore, the expectations formation procedure is different with respect to the appreciation regime, and that is why the expectations reaction to an exchange rate shock is larger and more significant. However, these public signals can potentially be very noisy, meaning that there is more uncertainty about the future inflation rate during a depreciation episode.[8] Moreover, using the argument of Morris and Shin (2002), a public signal works as a coordination device, especially when economic agents face strategic complementarities, as is the case with price setters. Nevertheless, if the public signal

[7] In fact, another way to interpret the same phenomenon is by using a Rational Inattention argument (Sims (2002)). That is, price setters pay more attention to public signals about inflation whenever there is a depreciation episode. On the other hand, price setters pay more attention to their private information whenever there is an appreciation episode.

[8] See Nimark (2014) for a detailed characterisation of this setup.

is too noisy, then more information does not necessarily produce a better outcome for society.

In sum, we found that inflation expectations are more sensitive and volatile during depreciation episodes, whereas they remain anchored in the case of appreciation episodes. This result helps to inform the role of monetary policy communication (see also Svensson (2006)), in the sense that more precise signals about inflation are needed during a depreciation episode than during an appreciation.

4. Determinants of inflation expectations

For a simple view of how inflation expectations are determined, we run a very straightforward regression:

$$\boldsymbol{\pi_t^e = \alpha_0 \pi_{t-1}^e + \alpha_1 \pi_{t-1} + \alpha_2 \bar{\pi}_t + \varepsilon_t}$$

Where π_t^e is the inflation expectation for next calendar year observed at the end of period t; π_{t-1} is the year-on-year inflation rate and $\bar{\pi}_t$ is the central bank's inflation target. Expectations are taken from the monthly surveys gathered by the central bank. We take the simple average of what analysts and financial firms expected for next calendar year. The sample period goes from February 2002 to December 2015 (Table 5).

Determinants of inflation expectations

(As percentage of surveyed firms) Table 5

	Coefficients (t-stats)	
Lagged inflation expectations (π_{t-1}^e)	0.915	***
	(24.57)	
Lagged inflation (π_{t-1})	0.023	*
	(1.92)	
Inflation target ($\bar{\pi}_t$)	0.073	**
	(2.202)	
R^2	0.85	

Note: t statistics are in parenthesis (estimated with HAC errors). *** [**] {*} denotes rejection of the null hypothesis about the no significance at 1% [5%] {10%}. The adjusted sample goes from March 2002 to December 2015.

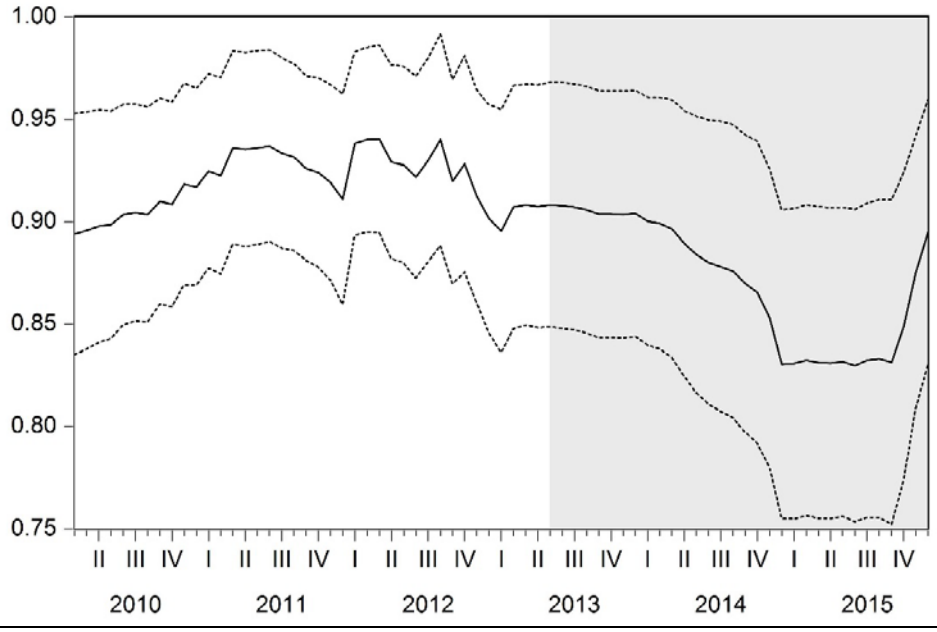
This result is similar to that in Armas et al (2011), where the estimated coefficients are broadly similar. With the updated data, there is a slight increase in the coefficient of lagged inflation expectations.

The key question is whether these coefficients have been stable during the sample period. We run rolling regressions using various possible sample sizes, starting with 60 months up to 120 months. Results for sample periods show similarities and qualitative conclusions are the same. We present the results for 96 months samples (rolling regressions for eight years).

The α_0 coefficient (parameter capturing the importance of the history of inflation in explaining inflation expectations) falls after the taper tantrum until mid-2014 when it reaches a relatively stable level. At the end of the sample, the coefficient starts increasing again very quickly. According to our specification, inflation expectations are themselves a function of all past inflation levels. In a sense, α_0 measures the weight of all past inflation history while α_1 is the effect of the most current inflation level.

The apparent reason for the decrease in the value of the α_0 coefficient is that observed inflation increased in 2013 as a result of the increased depreciation of the sol brought about by the taper tantrum. But this increased inflation did not translate into inflation expectations, which remained fairly stable (Graph 8).

Test of parameter stability: coefficient of lagged inflation expectations (α_0) Graph 8



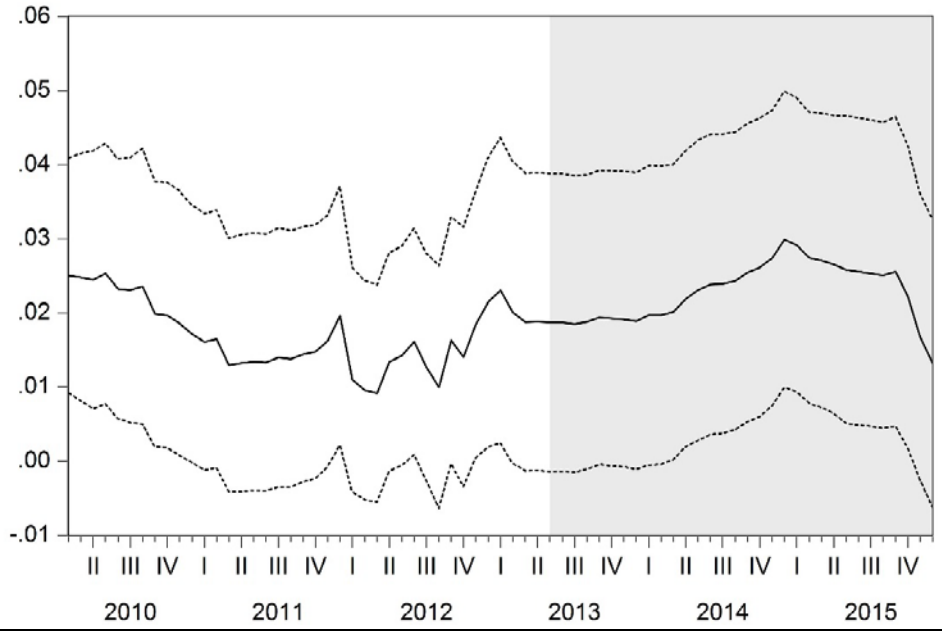
Note: One standard deviation confidence bands.

On the other hand, the coefficient α_1 does not change by much with the advent of the taper tantrum, as Graph 9 shows. It is the long-run, forward-looking element of inflation that explains the build-up of inflation expectations according to Graph 9 where we depict the coefficient α_2 associated with the constant inflation target.

Graph 10 indicates that, for a given level of the inflation target (2%), inflation expectations have been growing since 2013 and reached a high level during 2015. The coefficient collapses at the end of 2015 but, by that time, the inflation expectation component associated with the inflation history is the one that gains strength.

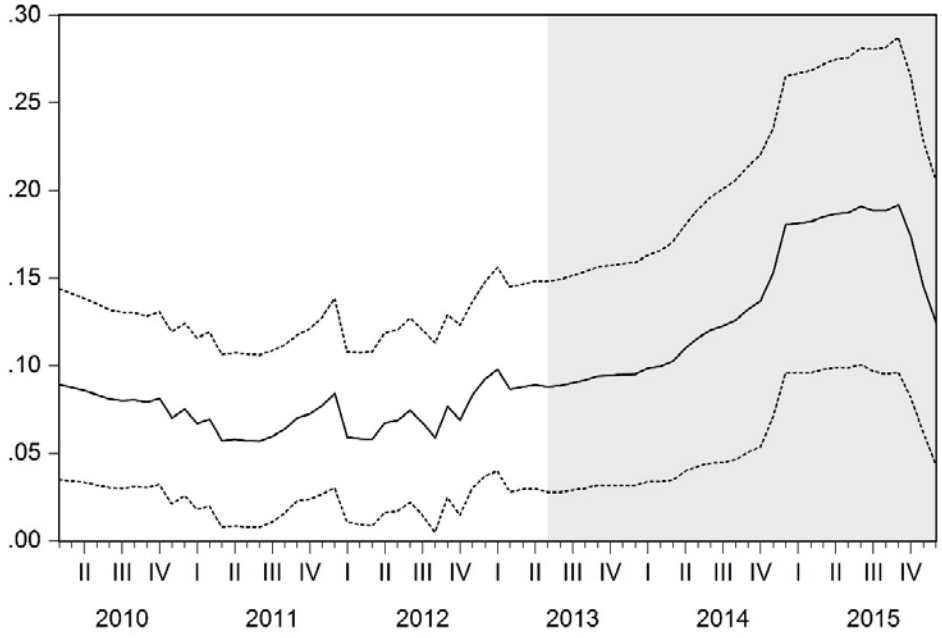
Therefore, the build-up of higher inflation expectations seems to be explained first by an increase in the long-run component of inflation expectations (associated to the constant term in inflation expectation equation) and then by the higher inflation levels embedded in past inflation expectations.

Test of parameter stability: Coefficient of lagged inflation (α_1) Graph 9



Note: One standard deviation confidence bands.

Test of parameter stability: Coefficient of lagged inflation (α_2) Graph 10



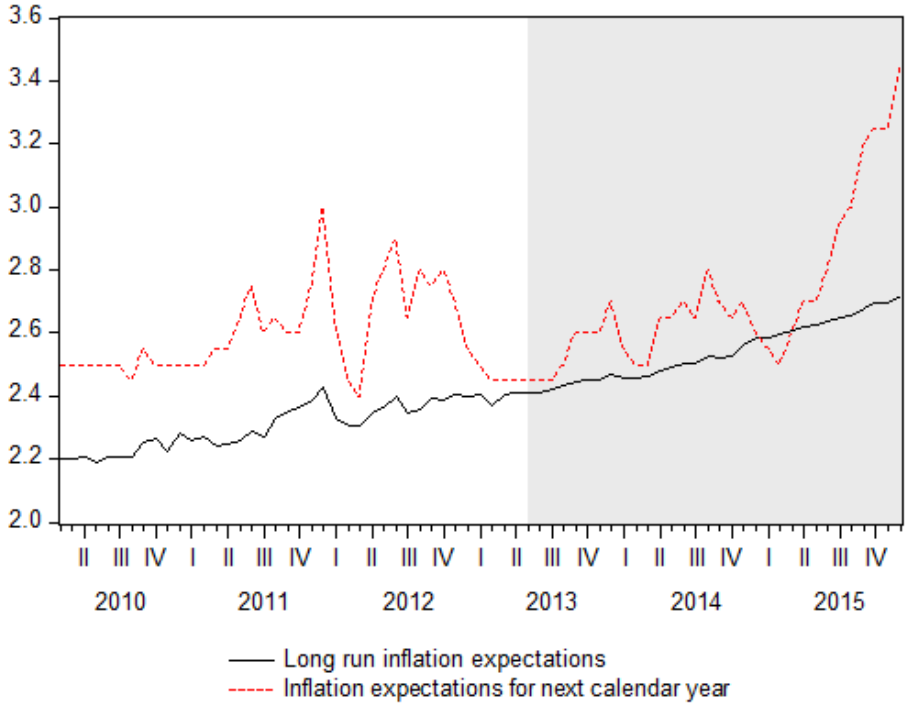
Note: One standard deviation confidence bands.

With the rolling coefficient estimates, we can approximate a measure of long-run inflation expectations by assuming that, in the long run, inflation expectations and inflation are constant and have the same value. This means

$$\pi_{LR}^{e} = \frac{\alpha_{2,t}}{1 - \alpha_{0,t} - \alpha_{1,t}} \overline{\pi}_t$$

Where, π^e_{LR} are the long-run inflation expectations. This expectation level is proportional to the target. In fact, given the coefficient estimates, the coefficient of proportionality should be close to unity. When the parameter α_2 alone rises, it directly implies a rise in long-run inflation expectations. Also, when α_0 or α_1 rise, they also indicate a rise in long-run expectations. When we combine the dynamics of all three coefficients as the above equation suggests, we see that the estimated long-run expectations increase over the 2013–15 period (Graph 11). This period coincides with the period of increased volatility in financial markets that have delivered higher depreciation pressures for the sol against the dollar.

Long-run inflation expectations — Graph 11



As we have seen in the previous section, the implied pass-through of exchange rate depreciation to inflation expectations has contributed to this build-up of higher inflation expectations. On the other hand, Table 8 shows Granger causality tests among the central bank projections published in the inflation reports and analysts' inflation expectations obtained from the Survey of Inflation Expectations. We perform the tests for two types of projection and expectations: short-run (current calendar year-end) and for the next calendar year. We reject only the hypothesis that central bank short-run projections do not cause private sector short-run expectations. This means that, in the short run, there is evidence of causal precedence that goes from the central bank's communications to short-run inflation expectations.

All in all, in terms of causal precedence, the communication tools of the central bank do affect short-run expectations (expectations for the current calendar year) but expectations for the next calendar year and long-run inflation expectations are both influenced by the historical record of inflation and the monetary policy stance.

Granger causality tests

Table 6

	F-statistic	Prob.	Result
Granger causality for short-run inflation expectations (Null hypothesis)			
Analysts inflation expectations for current year do not granger cause Inflation Report projections for current year	1.038	0.37	Cannot reject
Inflation Report projections for current year do not granger cause analysts' inflation expectations for current year	10.74	0.00	**Reject**
Granger causality for short run inflation expectations (Null hypothesis)			
Analysts inflation expectations for next year do not granger cause Inflation Report projections for next year	1.28	0.29	Cannot reject
Inflation Report projections for next year do not granger cause analysts' inflation expectations for next year	0.40	0.68	Cannot reject

5. Conclusions

Anchoring inflation expectations is crucial for the effectiveness of monetary policy if the price stability goal is to be attained. This objective is more challenging when an economy faces the vulnerabilities associated with partial dollarisation, in particular when price setters are influenced by exchange rate movements. This requires them to evaluate the implications of the exchange rate for price formation through input costs. It is also important to understand the speed and magnitude of price adjustments to changing economic conditions.

In Peru, inflation expectations were anchored within the inflation target range for most of the period 2002–15, and the importance of the inflation expectations channel has increased sustainably. The exchange rate pass-through to inflation is around 20%. Also, if most firms adjust prices more than once a year (ie every 7.5 months or so), the degree of price rigidity would be 0.87, a level slightly lower than those estimated for many other economies.

References

Armas, A, L Vallejos and M Vega (2011): "Indicadores tendenciales de la inflación y su relevancia como variables indicativas de política monetaria", *Revista Estudios Económicos*, no 20, Central Reserve Bank of Peru.

Calvo, G and C Vegh (1996): "From currency substitution to dollarisation and beyond: Analytical and policy issues", in G Calvo (ed), *Money, exchange rates, and output*, MIT Press, pp 153–76.

Central Reserve Bank of Peru (2015): "Encuesta mensual de expectativas macroeconómicas", *Notas de Estudios*, various numbers.

Clinton, K and J-F Perrault (2001): "Metas de inflación y tipos de cambio flexibles en economías emergentes", *Revista Estudios Económicos*, no 7, Central Reserve Bank of Peru.

González, J (2000): "Exchange rate pass-through and partial dollarisation: Is there a link?", mimeo, Stanford University and World Bank.

Hausmann, R, U Panizza and E Stein (2000): "Why do countries float the way they float?", Working Paper, no 418, Inter-American Development Bank.

Mihaljek, D and M Klau (2001): "A note on the pass-through from exchange rate and foreign price changes to inflation in selected emerging market economies", *BIS Papers*, no 8, pp 69–81.

Maertens Odría, L, P Castillo and G Rodríguez (2012): "Does the exchange rate pass-through into prices change when inflation targeting is adopted? The Peruvian case study between 1994 and 2007", *Journal of Macroeconomics*, no 34, pp 1154–66.

Miller, S (2003): "Estimación del pass-through del tipo de cambio a precios: 1995–2002", *Revista Estudios Económicos*, no 10, Central Reserve Bank of Peru.

Morón, E and D Winkelried (2002); "Reglas de política monetaria para economías financieramente vulnerables", *Revista Estudios Económicos*, no 8, Central Reserve Bank of Peru.

Morris, S and H S Shin (2002): "Social value of public information", *American Economic Review*, vol 92, no 5, pp 1521–34.

Nimark, K (2008): "Dynamic pricing and imperfect common knowledge", *Journal of Monetary Economics*, vol 55, pp 365–82.

——— (2014): "Man-bites-dog business cycles", *American Economic Review*, vol 104, no 8, pp 2320–67.

Organisation for Economic Co-Operation and Development (2003): *Business tendency surveys: a handbook*, OECD.

Pérez-Forero, F and M Vega (2015): "Asymmetric exchange rate pass-through: Evidence from Peru", Central Reserve Bank of Peru, Working Paper Series, no 2015-011.

Quispe, Z (2001): "Transmission mechanisms of monetary policy in an economy with partial dollarisation: the case of Peru", *BIS Papers*, no 8, Bank for International Settlements.

Rossini R and M Vega (2008): "The monetary policy transmission mechanism under financial dollarisation: the case of Peru 1996–2006", *BIS Papers*, no 35, Bank for International Settlements.

Sims, C (2003): "Implications of rational inattention", *Journal of Monetary Economics*, vol 50, pp 665–90.

Svensson, L (2006): "Social value of public information: Comment: Morris and Shin (2002) is actually pro-transparency, not con", *American Economic Review*, vol 96, no 1, pp 448–52.

Townsend, R (1983): "Forecasting the forecasts of others", *Journal of Political Economy*, vol 91, no 4, pp. 546–88.

Velarde, J (2015): "The future of monetary policy", in A Werner and A Santos (eds), *Peru: Staying the Course of Economic Success*, IMF Publications.

Winkelried, D (2003): "¿Es asimétrico el Pass-through en el Perú?: Un análisis agregado", *Revista Estudios Económicos*, no 10, Central Reserve Bank of Peru.

——— (2013): "Modelo de proyección trimestral del BCRP: actualización y novedades", *Revista Estudios Económicos*, no 20, Central Reserve Bank of Peru.