Relative Prices and Inflation: New Evidence from Different Inflationary Contexts

María Ángeles Caraballo. Universidad de Sevilla and centrA
Carlos Dabús. Universidad Nacional del Sur (Argentina) and CONICET
Carlos Usabiaga. Universidad Pablo de Olavide and centrA

Abstract- This paper carries out a comparative analysis of the inflation effects on relative price variability (RPV) in two economies with a inflationary experiences clearly different: Argentina and Spain. The results indicate non-neutrality of inflation, particularly in extreme inflation. The main determinants of RPV are the inflation rate, its variability, and unexpected inflation. Hence, our results neither supports the "menu-cost" approach -there are not monetary rigidities in high inflation-, nor the signal "extraction" approach, although the latter seems to be suitable for the Spanish case. In turn, we found significant structural changes in this relation in both countries, which suggest that the Inflation-RPV relation is different among different inflationary regimes.

1. Introduction

A substantial body of empirical evidence supports the existence of a positive relation between inflation and the higher moments of the price change distributions. The traditional approach analyzes that relation in terms of the non-neutrality of inflation: the causality goes from inflation to relative price variability (RPV). The literature includes from the early studies of Mills (1927) and Glesjer (1965), to more recent empirical research, which has shown a tendency to look at disaggregated evidence -Fischer (1981), Sellekaerts and Sellekaerts (1984), Domberger (1987), Van Hoomissen (1988), Llach and Tsiddon (1992), Tommasi, (1993), Debelle and Lamont (1997), Wang *et al.* (1999), Jaramillo (1999) and Dabús (2000)-. In turn, some studies focused on the effects of inflation on real prices at intrasectoral level -Blejer and Leiderman (1982), Moura and Kadota, (1982), Palerm (1991), and more recently Caglayan and Filiztekin (2003)-.

On the other hand, from the seminal work of Parks (1978), empirical literature have emphasized expected and unexpected inflation as the main links in the "inflation-RPV" relation -Blejer (1981, 1983), Palerm (1991), and more recently Aarstol (1999), Bakhshi (2002), Caglayan and Filiztekin (2003), and Miszler and Nautz (2004)-. The theoretical explanations of the impact of inflation on RPV are based on "menu-costs" and "signal extraction" models. Both of them predict that RPV is increasing in inflation, but by means of different transmission mechanisms. While "menu-costs" models are focused on the effects of expected inflation on relative prices, the "signal extraction" models underlie the positive effect of unexpected inflation.

Instead, we state that such mechanisms could be relevant in low inflation, but not enough to scope the high price volatility associated to extreme inflation. Even with perfect price flexibility, inflation should affect relative prices, and the non-neutrality of inflation can´t be limited to the ¨signal extraction¨ mechanism, but to the influence of abrupt fluctuations of inflation rate[1]. High inflation volatility provokes a loss of information that must induce adaptive changes in expectations, but with greater

[1] Previous empirical evidence reports that a higher inflation is also more variable. Among others, see Blejer (1979) and Dabús (2000), who found a positive relation between the inflation rate and its variability in different Latin American high inflation experiences.

difficulties to forecast inflation. Indeed, Dabús (2000) found that inflation rate variability, inflationary "surprise" and RPV increase strongly in both Argentine hyperinflations; moreover, they reached the highest values in the months of highest inflation, when the price system suffered a virtual collapse.

In short, the "magnitude" and the transmission mechanisms of such non-neutrality must be different at different inflation levels. Nonetheless, there is not comparative evidence of the effects of inflation on relative prices in countries with different inflationary contexts. Therefore, the goal of this paper is to analyze two economies with very different inflationary experiences: Spain and Argentina. The first has been historically stable in the last fifty years, specially during the 1985-2001 period, in which the monthly inflation rate oscillated in a narrow range between zero and 2%. On the contrary, Argentina shows a very rich inflationary history. In the last forty years its monthly inflation rate fluctuated from deflation to hyperinflation.

We show that not only expected and unexpected inflation can be relevant, but inflation volatility also matters to explain RPV, in particular at high inflation. Moreover, our empirical results suggest that RPV is increasing in inflation and inflation rate volatility. In addition, the relation between inflation and relative prices exhibits structural change among different inflation levels in both countries.

The remainder of the paper is organized as follows. In the next section we present the price data and variables used. Section 3 explains the methodology to determine different inflation regimes in each country. In section 4 we carry out a brief statistics description. Section 5 reports the results of the regressions of the "inflation-RPV" relation, as well as the structural change of this relation. Finally, section 6 concludes.

2. Price data and variables

For both countries monthly frequency prices are used, as well as disaggregated price data to calculate the variability of relative prices (see eq. (4)). For Argentina price series have been extracted from the statistical bulletins of the Instituto Nacional de Estadísticas y Censos, from January 1960 to November 1993. Individual price data correspond to the items of the national Wholesale Price Index (WPI), at the level of WPI groups (i.e. three digits of the International Standard Industrial Classification). Since the structure of WPI in Argentina changed in July 1984, we use 87 price indexes

for the January 1960-June 1984 period and 64 for the July 1984-February 1991 period. In turn, for the Spanish case, we cover a period from September 1985 to December 2001, using 57 individual price data, at the level of the Consumer Price Index (CPI) groups. These data have been collected from the Instituto Nacional de Estadística.

2.1. Collection of price data

In general, price data are collected in two ways. Some prices are sampled daily or several times a week, and from this information a monthly average is obtained. Other prices are sampled the same day each month. In Argentina, for example, the WPI price data are collected in those two ways. The prices of agricultural products are sampled as a monthly average from daily information, and the prices of industrial and imported products are sampled the same day (the 15th) of each month. On the other hand, in Spain most of price data are collected between the 1st and the 22nd day of each month. This latter methodology of price collection can provoke spurious correlation between RPV and inflation if this one is high, but not in price stability[2]. Fortunately, as said, in our high inflation case (Argentina) most of prices are collected the same day, or result from a monthly average from daily (or nearly daily) information. Hence, such correlation should be not "contaminated" by the methodology of price collection. A clear example is the notorious increase of the variability of relative prices in both Argentine hyperinflations, during 1989 and 1990. This should be a real increment. Data include 77 industrial and imported good prices from a total of 87 for the 1960-1984 period, and 55 from a total of 64 for the 1984-1991 period.

2.2. Variables

The variables used are the monthly inflation rate, three measures of inflation volatility, the components of expected and unexpected inflation, and, finally, the variability of relative prices. The volatility variables are:

[2] For example, if two prices are always equal, and every month one price is sampled on the first day and the other the last day, the actual variability of relative prices is zero. At low inflation a low relative price variability should be detected, but at high inflation a higher variability will be detected, which would be only consequence of the periodicity of price collection.

$$DIN_t = IN_t - IN_{t-1} \quad (1)$$

$$ABDIN_t = | IN_t - IN_{t-1} | \quad (2)$$

$$VARIN_t = | IN_t - (1/7) * \sum_{i=-3}^{3} IN_{t-i} | \quad (3)$$

where IN_t is the inflation rate at time t, DIN_t is the difference between the inflation rate of two consecutive months, $ABDIN_t$ is the absolute value of DIN_t, and $VARIN_t$ is a centred moving average of seven months of inflation. We choose three lags for $VARIN_t$ because the estimation results (R^2 and the significance of the explanatory variables) are very similar with more lags[3].

Expected inflation, INE, is the inflation rate forecasted by the agents for the current period. We estimate INE by means of the ARMA model that fits to the "best forecast" of inflation. The ARMA structure has been selected according to the Akaike-Schwarz criterion, i.e., the estimation with lower value of both tests. The results suggest AR(1) for Argentina, and ARMA(10,10) for Spain. In our opinion, these results are intuitively acceptable. In a stable economy agents could use long run information to forecast current inflation, while in a unstable and changing environment only short run information should be useful.

Unexpected inflation, INO, is the error of expected inflation. It can be defined as the difference between the current and the expected inflation, so INO=IN-INE. The absolute value of unexpected inflation, ABINO, reflects the magnitude of the forecasting error, so that ABINO=|INO|. Besides, the absolute value of expected inflation is ABINE=|INE|.

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[3] In fact, VARIN is a measure that captures transitory deviations of current inflation from certain inflationary environment. The key is to determine how long it is, i.e. how many periods "around" the current inflation form a similar period of inflation. In Argentina we select only three months because of the high fluctuations of the inflation rate, which implies the risk of capturing months with inflation rates that do not belong to a similar inflationary context of current inflation, and then of overestimating this measure. In Spain this problem is not so serious, but the estimation results are similar with three of more lags, therefore we select the measure with a lower number of lags, following the same criterion as for the Argentine case.

Finally, RPV is a measure of the non-uniformity of the variations of individual prices, relative to the average inflation rate. The variability of relative prices is obtained in quadratic terms, using the weighted sum of the monthly inflation rate of individual prices, as follows:

$$RPV_t = \sum_i w_{it}(IN_{it} - IN_t)^2 \qquad (4)$$

where RPV_t is the relative price variability, w_{it} is the weight of price i in the price index, IN_{it} is the inflation rate of price i and IN_t is the inflation rate[4].

3. Inflationary regimes classification

In this section we classify the different periods of inflation in four regimes: moderate, high, very high and hyperinflation. Following a version of the criterion suggested by Leijonhufvud (1990), the economy is classified in a regime of moderate inflation when the monthly inflation rate is lower than 1%-2%. High inflation corresponds to the 2%-10% range, very high inflation to the 10%-50% range, and hyperinflation to values beyond 50%.

The methodology to determine such regimes is based on a procedure that divides the total period in different sub-periods of inflation. A "smoothed-out" series from the original series of inflation is obtained as follows[5]:

$$SIN_t = \left\{ \left[\frac{PI_t}{(1/12)\sum_{i=1}^{12} PI_{t-i}} \right]^{1/6} - 1 \right\} * 100 \qquad (5)$$

[4] However, for Argentina we use a slight variation of (4). In fact, as it was verified in Dabús (1993) for that country, eq. (4) is not the best measure of relative price variability. In high inflation economies it is necessary to estimate the coefficient of variation, more than the simple variance, of the price change distribution. The intuition is that at high inflation the last measure has a "spurious correlation" with the mean of the distribution, i.e. the inflation rate. To avoid such problem, The RPV for Argentina is defined as follows:

$$RPV_t = \frac{\sum_i w_{it}(IN_{it} - IN_t)^2}{(1 + IN_t)^2}$$

where SIN_t is the "smoothed-out" series of monthly inflation rate and PI_t is the monthly price index (WPI or CPI) at period t. Discontinuities are detected in this series when variations of the "smoothed-out" inflation are larger than three standard deviations from the moving average of inflation, as follows:

$$SDESVIN_{t-1,t-12} = \left\{ \frac{\sum_{1}^{12} (SIN_{t-1} - MAVIN_{t-1,t-12})^2}{12} \right\}^{1/2} \qquad (6)$$

where SDESVIN is the standard deviation of the moving average of inflation, and MAVIN is the yearly moving average of inflation rate for the twelve previous months to the discontinuity. Thus, this procedure captures only persistent changes, disregarding transitory variations in inflation levels.

The next step is to detect changes in the regime of inflation if the following conditions are fulfilled: 1) $SIN_t > MAVIN_{t-1,t-12}+3SDESVIN_{t-1,t-12}$[6], 2) the discontinuity persists for three or more consecutive months, and 3) the averages of the inflation rate between two periods separated by such discontinuity are significantly different, which is verified by applying a simple test of difference of means. Once the discontinuities are detected we come back to the original inflation rate series and identify the months that correspond to the "critical points" that fulfil these conditions. Finally, once the periods of inflation are obtained, they are grouped in different regimes.

According to the aforementioned methodology, in Argentina each regime contains the following periods:

- Moderate inflation: January 1960-April 1970.

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[5] For a more detailed explanation of this methodology see Dabús (1993).

[6] This condition is too strong for low inflation countries as Spain, therefore for the Spanish case the following condition: $SIN_t > MAVIN_{t-1,t-12}+SDESVIN_{t-1,t-12}$ has been required in order to detect changes of inflation regimes.

- High inflation: May 1970-January 1975, May 1976-June 1982, July 1985-June 1987, September1988-March 1989, August 1989-November 1989 and April 1990-February 1991.
- Very high inflation: February 1975-April 1976, July 1982-June 1985 and July 1987-August 1988.
- Hyperinflation: April 1989-July 1989 and December 1989-March 1990.

On the other hand, in Spain we have only moderate inflation for all the period, because the test of difference of means was not significant in any case. However, we detect sustained changes of the inflation level in the beginning of 1992, when the condition $SIN_t > MAVIN_{t-1,t-12}+SDESVIN_{t-1,t-12}$ was verified. In order to consider the difference between inflation levels before and after 1992, we divide the total period in two periods: low and high inflation, for the September 1985-March 1992 and April 1992-December 2001 periods, respectively.

Once the inflationary regimes were determined, the total period for both countries has been divided into two sub-periods. The division was applied where our methodology reported the most significant breaks in the inflation rate evolution: February 1975 for Argentina and April 1992 for Spain.

4. Prices and RPV behaviour

The two cases studied in this paper are clearly different in terms of their inflationary experience. On one hand, Spain is an stable economy, with a monthly inflation rate ranging between zero and 2% approximately. On the contrary, Argentina is an economy with a very unstable history, with sundry inflationary episodes, going from the moderate inflation of the sixties to the extreme inflation periods of the late eighties (see figures 1 and 2, for Spain and Argentina respectively). Nevertheless, both economies share a common pattern: higher inflation is associated with higher RPV, and that relation is even more evident in the case of Argentina. In Spain there are two slightly different periods of low and high inflation, although they belong to moderate inflation according to our classification. The first corresponds to the September 1985-March 1992 period, and the last to the April 1992-December 2001 period. Both inflation and RPV are lower in the second period. In the case of Argentina RPV is clearly increasing in inflation, in particular when the inflation rate

increases suddenly. This is verified in the inflationary accelerations of 1962, 1975-76, 1985, and, specially, in the hyperinflations of 1989-1990. Indeed, RPV increases strongly in those cases, and reaches the highest values in the months of highest inflation. The months of hyperinflation seem to show a collapse of the price system, which implies favourable evidence for the hypothesis of non-neutrality of inflation.

On the other hand, there are two cases in which the evolution of individual prices seems to be coordinated with that of the inflation rate, and consequently price variability decreases. One of them is when the increase of inflation is gradual; for example in Argentina during the 1981-85 period. This evidence seems to be consistent with the intuition that abrupt variations of the inflation rate are required to increase RPV. High inflation volatility should increase the range between prices that adjust with the course of the general inflation and those that are indexed taking into account past values of the inflation rate. On the contrary, even at high levels, a gradual increasing trend in inflation would allow the agents to adapt to it, perhaps by means of indexation mechanisms, which may avoid important differences between the adjustment of individual prices and the average inflation. The other case occurs during the episodes of long standing stability. Here RPV remains at very low levels, for example in the Spanish lower inflation period and during the 1960s in Argentina[7].

In short, higher inflation seems to be related to a more volatile and less predictable inflation rate, and to a higher RPV. The behaviour of relative prices and inflation changes at different inflation levels. This is more evident by examining the average values of these variables for each inflationary regime, as it is reported in table 1. In all cases RPV is, on the average, systematically higher at higher inflation, specially in Argentina. These results state an interesting difference from previous findings. First, unlike Van Hoomissen (1988) for Israel, Palerm (1991) for Mexico and Tommasi (1993) for Argentina, we find a non-concave relation between RPV and inflation.

Moreover, price dispersion explodes in extreme inflation, therefore there is not evidence of unifying forces of price revisions at hyperinflation. It can be caused by

[7] These results are not compatible with recent evidence. For instance, Caglayan and Filiztekin (2003), studying the case of Turkey during the 1948-1997 period, find a lower effect of inflation on relative prices during the higher inflationary period, and the results of Miszler and Nautz (2002) indicate that there is not higher RPV in higher inflationary periods for two stable economies -United States and Japan-.

the high volatility and inflationary surprise verified in these situations. Indeed, inflation volatility (ABDIN and VARIN) and unexpected inflation increase systematically with the level of inflation, and particularly at hyperinflation.

5. The inflation-relative prices relation

5.1. Empirical methodology

In order to study the effects of inflation on RPV, the following equations are estimated:

$$RPV_t = a + b_1 IN_t + b_2 DIN_t + e_t \quad (7)$$

$$RPV_t = a + b_1 IN_t + b_3 ABDIN_t + e_t \quad (8)$$

$$RPV_t = a + b_1 IN_t + b_4 VARIN_t + e_t \quad (9)$$

$$RPV_t = a + b_5 INE_t + b_6 INO_t + e_t \quad (10)$$

$$RPV_t = a + b_7 ABINE_t + b_8 ABINO_t + e_t \quad (11)$$

For both countries monthly data are used. For Argentina, as we have chosen WPI, there are not seasonality problems because most of prices, in special prices of industrial and imported products, do not present a seasonal component. On the contrary, in Spain we use CPI, which presents an important seasonal component. In order to remove it, an X-12 ARIMA method is applied. Thus, all the estimation results presented here are referred to non-seasonal variables for Argentina and seasonally adjusted variables for Spain.

Before running the regressions we have checked the stationarity of the series by means of the ADF test[8], for the total period and for the lower and higher inflation

[8] In order to select the number of lags, the Akaike criterion has been applied.

periods, respectively. It was applied to the original series in Argentina, and to the seasonally adjusted series in the case of Spain. In all cases we found that the series are stationary, with the exception of the RPV in Spain, when it is applied for the total period. Given that the evidence of unit root is not conclusive, to deal with it we just include lags of RPV in the estimations, as it is shown in table 3. In turn, ADF test results show the presence of a deterministic trend in Spanish RPV for the total and lower inflation period, so that we include a trend term in the estimations in these cases.

On the other hand, even though the White test showed the existence of heteroskedasticity in some regressions of Argentina, the application of remedial measures did not change significantly the results. For example, the use of the White heteroskedasticity-consistent variances and standard errors did not change the significance of the regressors. In turn, to deal with autocorrelation we have introduced lags of the endogenous variable. In several estimations the values of the Breusch-Godfrey (BG) tests indicate that this modification did not remove the autocorrelation in the residuals[9]. Anyway, the BG tests results are very sensible to the number of lags selected, so that the evidence of autocorrelation problems is not conclusive (see footnotes of tables 2 and 3).

Finally, inflation volatility measures are related to inflation rate, so the estimations that include these variables are not free of multicolinearity. This problem is not avoidable, since we state that inflation as well as inflation volatility increase RPV. We have checked that there are only two cases in which the correlation between explanatory variables is higher than 0.50: IN-DIN for Spain and IN-VARIN for Argentina. Anyway, in these cases correlation is bounded between 0.50 and 0.75, for the total period and for each sub-period of inflation.

5.2. Regression results

Following the results of the methodology applied to determine different inflationary regimes, we carried out three kind of estimations: for the total period, and for the lower and higher inflation periods. In Argentina the lower inflation period

[9] This result indicates the existence of other factors influencing RPV, that were not included in our equations. The main variables to include are those related to high economic volatility, like important variations in real exchange rate, as well as the fluctuations in real wages verified in Argentina in these episodes. Among others, Fischer (1981) and Dabús (1993) report

corresponds to January 1960-January 1975, and the other to February 1975-February 1991. In Spain the higher inflation period corresponds to September 1985-March 1992, and the lower one to April 1992-December 2001.

Regression results are presented in tables 2 and 3. They show interesting differences between both countries at different inflation levels. In Argentina R^2 coefficients are, in general, higher in the higher inflation period, as well as the significance of the explanatory variables. On the contrary, in the case of Spain R^2 is generally higher in the lower inflation period, which is due to the significance of the negative trend. In addition, inflation rate is significant only for the total period. These results suggest the existence of structural changes in the "inflation-RPV" relation. Indeed, in the next section we analyze this possibility, and find significant structural changes among different inflation regimes.

The nature of this relation changes in extreme inflation. RPV exploded when the economy entered hyperinflation in Argentina, and the best estimation results correspond to the higher inflation period[10]. These findings suggest that there are not successful mechanisms to avoid the impact of inflation on relative prices, like indexation or a "good" model to form expectations on current inflation. In other words, our analysis suggests that agents cannot find an adaptive mechanism to minimize the inflationary surprise associated to those episodes.

We can also point out that there is similar empirical evidence in both countries. Firstly, VARIN is the best volatility measure to explain RPV. This result suggests that changes in the inflationary environment, more than the transitory variations of inflation rate, affect RPV. Secondly, the regressions of both expected and unexpected inflation indicate that the latter is generally significant, and with the expected sign, with the exception of the Spanish lower inflation period. Thus, inflationary "surprise" seems to be a relevant factor to explain RPV, independently of the level of inflation. Indeed, both INO and ABINO remain significant, so that the unexpected inflation and its magnitude increase RPV. Nonetheless, the interpretation of these results must be different in each case. In this sense, they can

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that real variations of key macroeconomic variables introduce drastic modifications in relative prices.

[10] Despite the existence of multicolinearity and autocorrelation, the R^2 and the significance of inflation volatility and the components of expected and unexpected inflation remain higher in the estimations for the higher inflation periods of Argentina.

support the "signal extraction" approach in the Spanish low inflation case, but they seem to be related to high economic instability in the chronic Argentine high inflation, and specially in extreme inflation.

Expected inflation shows different results between both countries. While in Argentina it affects positively RPV, it is never significant in the case of Spain. This difference has an interesting implication. Inflation expectations play different roles to explain the non-neutrality of inflation depending on the macroeconomic environment. In a stable economy our results seem to fit to the "signal extraction" approach: only inflation surprise is not neutral. However, in a very unstable economy, like Argentina, also expected inflation provokes higher RPV, so that the aforementioned approach seems to be only adequate to certain economic context.

The results for Spain are similar to Miszler and Nautz (2004) findings for Germany. They also found that unexpected inflation is significant to explain RPV, whereas there are not effects of expected inflation at low inflation. In stable economies these results point to the "signal extraction" approach, but not in the direction of the "menu-cost" approach. On the contrary, Caglayan and Filiztekin (2003) report strong support for "menu-cost" models, in comparison with the "signal extraction" approach, in the case of Turkey. Like Germany, in comparison with Argentina for example, this is a low inflation economy, even though it is slightly high in relation to international standards. Thus, recent empirical evidence is not conclusive supporting one of these approaches. Instead, the determinants of RPV change with the level of inflation, even within stable economies.

In the case of high inflation economies other kind of explanations are necessary. In first place, there are not nominal rigidities at high inflation, so that the "menu cost" approach is not feasible. In second place, the clear influence of unexpected inflation do not support the "signal extraction" approach, because expected inflation also affects RPV. Instead, it seems to indicate the existence of serious difficulties to forecast current inflation, as well as that agents face high macroeconomic volatility, and that turns their price decisions more complex.

In short, our findings are, in general, compatible with previous empirical evidence, in terms that they suggest clearly the non-neutrality of inflation. Nevertheless, they

seem to indicate that the "signal extraction" and "menu-cost" approaches can be feasible mainly for low inflation contexts. Moreover, in our analysis we found some interesting particularities: such non-neutrality is more evident at higher inflation, and particularly in extreme inflation.

5.3. Structural change

In this section we test the possible existence of structural changes suggested by the different results obtained in the estimations for the total period and for the sub-periods of lower and higher inflation, which were presented in the previous sub-section. Firstly, we follow the break points in the inflation evolution suggested by our methodology developed in section 3 in order to determine different inflationary regimes. After that, we verify if there exists (or not) such break from the results of the recursive residual estimation and the CUSUM test, and if such break is verified we apply the Chow test.

In all cases we verify the break in the periods indicated by the methodology of inflationary regimes, which are February 1975 in Argentina and March 1992 in Spain, approximately. In all cases we find significant structural changes for both countries, as it is showed in the table 4. There is a notable regularity of significant structural changes in all estimations at 1% of confidence, which seems to confirm the hypothesis that the effects of inflation, its volatility and the components of expected and unexpected inflation are different at lower and higher inflation. In fact, as it has been mentioned, in general these changes are associated with higher significance of the explanatory variables, which supports the idea that the non-neutrality of inflation is more evident with higher economic instability.

In conclusion, structural change seems to support the hypothesis that the determinants of RPV (and their relevance) change at different inflation levels, even in a narrow range of inflation, as in the Spanish case.

6. Conclusions

This paper analyzes the relation between inflation and relative prices for two clearly different economies: Argentina and Spain. While the former shows high price instability, the latter has had low inflation. Our findings support the hypothesis of the

non-neutrality of inflation, which is more evident at high inflation, and particularly at extreme inflation (for example in both Argentine hyperinflations). There is a non-concave relation between RPV and inflation in Argentina, which suggests that inflation affects more than proportionally RPV up from certain threshold of inflation.

The main determinants of RPV are inflation, inflation volatility and unexpected inflation. VARIN is the best inflation volatility variable in order to explain RPV, which suggests that the changes in the inflationary environment are more relevant affecting relative prices than the transitory deviations of inflation rate from its trend. Our results can support the "signal extraction" approach in low inflation; however, in extreme inflation they could reflect serious problems to forecast the current inflation rate, as well as to take price decisions.

Comparing both economies we find an interesting difference: expected inflation is only significant in the high inflation country (Argentina). Apparently, this result neither supports the "menu-cost" approach -there are not monetary rigidities in high inflation-, nor the signal "extraction approach". Instead, this latter approach seems to be suitable for Spanish results, where only unexpected inflation is, in general, significant.

Finally, the "inflation-RPV" relation exhibits significant structural changes among the periods that correspond to different inflation levels, which seems to confirm the idea that the determinants of RPV are different at different inflation levels.

This research can be deepened in several directions. A natural extension is to expand the sample to more economies, and verify if our results hold. Another extension is to analyze the role of the higher moments of price change distribution, like the skewness and kurtosis. This could determine if the "inflation-RPV" relation is influenced by them, as suggested by Bryan and Cecchetti (1999). Finally, other interesting branch is to investigate if the causality of that relation changes with the regime of inflation.

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Figures and tables

Figure 1

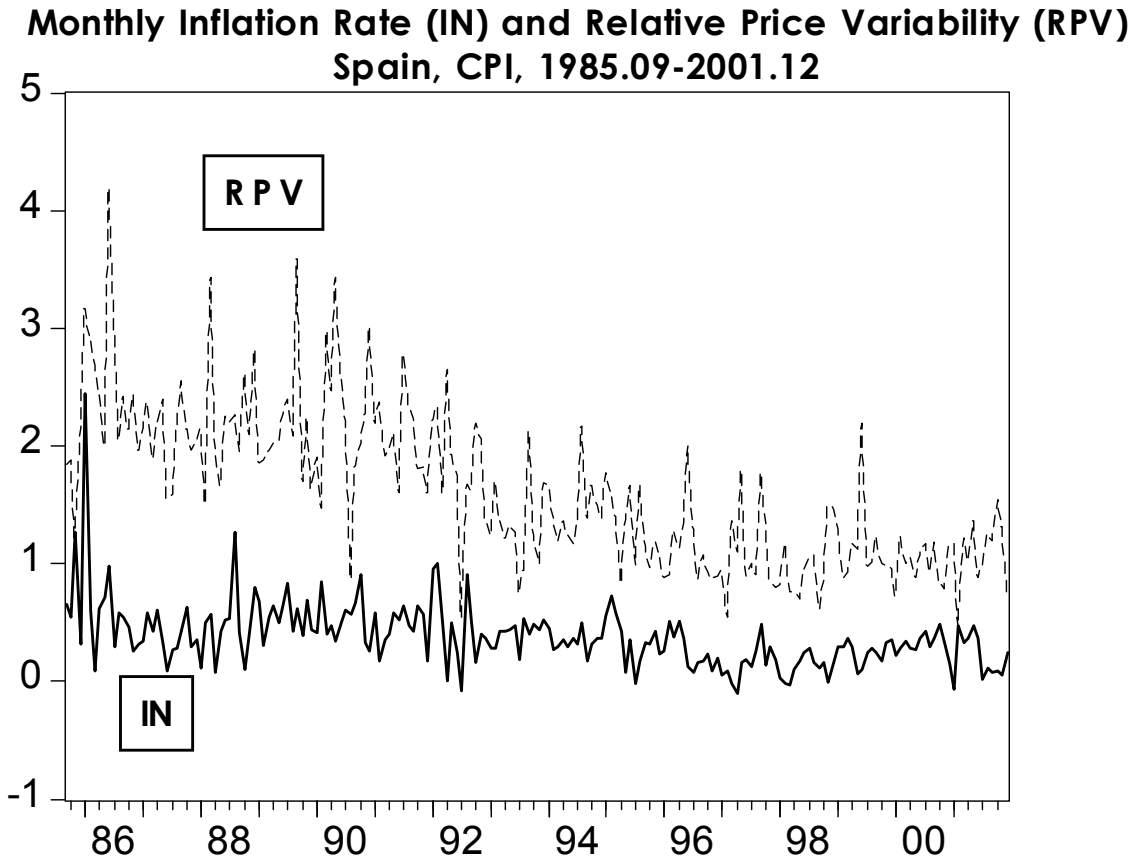

Figure 2

Monthly Inflation Rate (IN) and Relatie Price Variability (RPV), Argentina, WPI, 1960-1993

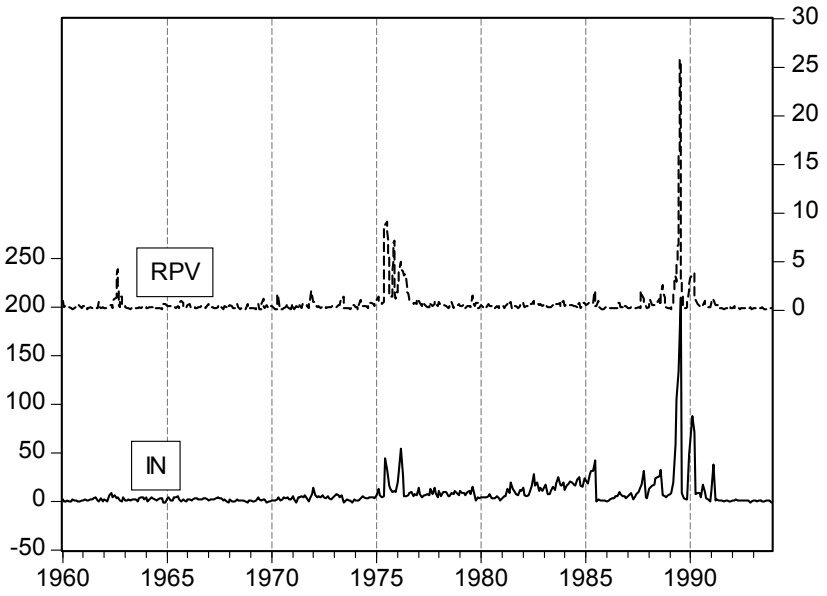

Table 1.A. Average values by regime of inflation

Argentina, WPI, 1960.01-1991.02 and Spain, CPI, 1985.09-2001.12

	Spain		Argentina	
Regimes/ Variables	Higher inflation period (1985.09 1992.03)	Lower inflation period (1992.04 2001.12)	Lower inflation period (1960.01 1975.01)	Higher inflation period (1975.02 1991.02)
IN	0.53	0.27	1.9	14.3
ABDIN	0.30	0.13	1.5	7.3
VARIN	0.19	0.10	1.1	7.1
ABINO	0.36	0.18	1.7	11.1
RPV	2.20	1.17	0.4	1.0

Table 1.B. Average values by regime of inflation

Argentina, WPI, 1960.01-1991.02

Regimes/ Variables	Moderate Inflation	High Inflation	Very High Inflation	Hyper-inflation	July 1989 *
IN	1.4	5.5	18.3	96.8	209.1
ABDIN	1.3	4.6	6.4	36.6	75.6
VARIN	1.0	4.1	5.9	43.2	135.2
ABINO	1.2	2.4	5.9	10.1	16.7
RPV	0.3	0.5	1.2	6.4	25.7

* The highest inflation month of the Argentine hyperinflations.

Table 2.A. Regression results
Argentina: WPI, dependent variable: RPV, independent variables: volatility measures

Total Period : 1960.01-1991.02					
Regression 1		Regression 2		Regression 3	
R^2	0.60	R^2	0.61	R^2	0.65
BG	0.00	BG	0.00	BG	0.00
CONSTANT	0.04 (0.53)	CONSTANT	0.04 (0.55)	CONSTANT	0.05 (0.41)
IN	0.08 (0.00)	IN	0.07 (0.00)	IN	0.05 (0.00)
DIN	-0.01 (0.01)	ABDIN	0.02 (0.00)	VARIN	0.06 (0.00)
Lower Inflation Period : 1960.01-1975.01					
Regression 4		Regression 5		Regression 6	
R^2	0.06	R^2	0.09	R^2	0.08
BG	0.13	BG	0.22	BG	0.31
CONSTANT	0.27 (0.00)	CONSTANT	0.21 (0.00)	CONSTANT	0.22 (0.00)
IN	0.05 (0.00)	IN	0.04 (0.01)	IN	0.04 (0.01)
DIN	-0.00 (0.91)	ABDIN	0.06 (0.01)	VARIN	0.06 (0.02)
Higher Inflation Period : 1975.02-1991.02					
Regression 7		Regression 8		Regression 9	
R^2	0.62	R^2	0.62	R^2	0.66
BG	0.00	BG	0.00	BG	0.00
CONSTANT	-0.20 (0.10)	CONSTANT	-0.18 (0.12)	CONSTANT	-0.16 (0.00)
IN	0.08 (0.00)	IN	0.07 (0.00)	IN	0.06 (0.00)
DIN	-0.01 (0.03)	ABDIN	0.02 (0.00)	VARIN	0.04 (0.00)

Note:
Autocorrelation is due to the existence of outliers in the abrupt increases of inflation rate of 1975 and both hyperinflations. Fortunately, autocorrelation problems in Argentina do not obey to the structure of the residuals.

All regressions were made by means of OLS, the figures within parenthesis contain the p-values of the coefficients, R^2 refers to adjusted R^2 and the BG test has been applied until order 12, the value in tables corresponds to the inclusion of 12 lags(the same is valid for the following tables) .

Table 2.B. Regression results
Argentina: WPI, dependent variable: RPV, independent variables: expected and unexpected inflation

Total Period: 1960.01-1991.02			
Regression 1		Regression 2	
R^2	0.60	R^2	0.55
BG	0.00	BG	0.00
CONSTANT	0.07 (0.27)	CONSTANT	-0.02 (0.81)
INE	0.08 (0.00)	ABINE	0.07 (0.00)
INO	0.08 (0.00)	ABINO	0.05 (0.00)
Lower Inflation Period: 1960.01-1975.01			
Regression 3		Regression 4	
R^2	0.06	R^2	0.08
BG	0.14	BG	0.66
CONSTANT	0.27 (0.00)	CONSTANT	0.18 (0.00)
INE	0.05 (0.03)	ABINE	0.03 (0.18)
INO	0.04 (0.00)	ABINO	0.09 (0.00)
Higher Inflation Period: 1975.02-1991.02			
Regression 5		Regression 6	
R^2	0.61	R^2	0.56
BG	0.00	BG	0.00
CONSTANT	-.013 (0.28)	CONSTANT	-0.29 (0.04)
INE	0.08 (0.00)	ABINE	0.07 (0.00)
INO	0.08 (0.00)	ABINO	0.06 (0.01)

Table 3.A. Regression results
Spain: CPI, dependent variable: RPV, independent variables: volatility measures

Total Period : 1985.09-2001.12					
Regression 1		Regression 2		Regression 3	
R^2	0.56	R^2	0.56	R^2	0.60
BG (*)	0.00	BG (*)	0.01	BG	0.02
CONSTANT	1.72 (0.00)	CONSTANT	1.75 (0.00)	CONSTANT	1.77 (0.00)
RPV(-1)	-0.01	RPV (-1)	-0.01	RPV(-1)	-0.01

	(0.00)		(0.00)		(0.00)
TREND	0.19 (0.00)	TREND	0.20 (0.00)	TREND	0.18 (0.01)
IN	0.42 (0.01)	IN	0.26 (0.06)	IN	0.27 (0.05)
DIN	-0.11 (0.37)	ABDIN	0.14 (0.33)	VARIN	0.47 (0.03)
Higher Inflation Period : 1985.09-1992.03					
Regression 4		Regression 5		Regression 6	
R^2	0.01	R^2	0.01	R^2	0.07
BG	0.47	BG	0.53	BG	0.48
CONSTANT	1.99 (0.00)	CONSTANT	2.06 0.00	CONSTANT	2.04 (0.00)
IN	0.40 (0.13)	IN	0.16 (0.44)	IN	0.14 (0.52)
DIN	-0.13 (0.47)	ABDIN	0.20 (0.30)	VARIN	0.58 (0.07)
Lower Inflation Period : 1992.04-2001.12					
Regression 7		Regression 8		Regression 9	
R^2	0.18	R^2	0.19	R^2	0.20
BG	0.22	BG	0.37	BG	0.44
CONSTANT	1.79 (0.00)	CONSTANT	1.74 (0.00)	CONSTANT	1.72 (0.00)
TREND	-0.01 (0.00)	TREND	-0.01 (0.00)	TREND	-0.01 (0.00)
IN	0.25 (0.29)	IN	0.12 (0.52)	IN	0.18 (0.35)
DIN	-0.15 (0.48)	ABDIN	0.41 (0.10)	VARIN	0.74 (0.05)

Note:
For tables 3A and 3B, lags of the endogenous variable were included when unit root test indicated the possibility of non-stationarity, and to deal with autocorrelation. The tendency term (TREND) was included in the cases in which it was significant according to that test. Following the parsimony principle we just include the lowest number of lags that we consider necessary in each case.
(*) There is not autocorrelation for a lower number of lags (lower than 10) when we apply the BG test.

Table 3.B. Regression results
Spain: CPI, dependent variable: RPV, independent variables: expected and unexpected inflation

Total Period: 1985.09-2001.12			
Regression 1		Regression 2	
R^2	0.57	R^2	0.56
BG (*)	0.00	BG (*)	0.00
CONSTANT	1.84 (0.00)	CONSTANT	1.82 (0.00)
RPV(-1)	0.23 (000)		0.21 (0.00)
TREND	-0.00 (0.00)	RPV (-1)	-0.01 (0.00)
INE	-0.02	ABINE	-0.07

	(0.84)		(0.57)
INO	0.37 (0.00)	ABINO	0.51 (0.00)
Higher Inflation Period: 1985.09-1992.03			
Regression 3		Regression 4	
R^2	0.04	R^2	0.02
BG	0.00	BG (**)	0.00(**)
CONSTANT	2.13 (0.00)	CONSTANT	2.05 (0.0)
INE	0.01 (0.92)	ABINE	-0.02 (0.92)
INO	0.38 (0.04)	ABINO	0.49 (0.08)
Lower Inflation Period : 1992.04-2001.12			
Regression 5		Regression 6	
R^2	0.18	R^2	0.20
BG	0.19	BG	0.45
CONSTANT	2.01 (0.00)	CONSTANT	1.93 (0.00)
TREND	-0.00 (0.00)	TREND	-0.00 (0.00)
INE	-0.21 (0.33)	ABINE	-0.25 (0.26)
INO	0.01 (0.97)	ABINO	0.43 (0.11)

Note:
(*) There is not autocorrelation until 6 lags.
(**) There is not autocorrelation until 2 lags.

Table 4: Structural change
Dependent variable: RPV

Regressions/Regimes	Argentina Lower to higher inflation (1960.01-1975.01 to 1975.02-1991.02)	Spain Low to Moderate Inflation (1985.09-1992.03 to 1992.04-2001.12)
RPV=f(IN)	1	1
RPV=f(IN, DIN)	1	1
RPV=f(IN,ABDIN)	1	1
RPV=f(IN,VARIN)	1	1
RPV=f(INE,INO)	1	1
RPV=f(ABINE,ABINO)	1	1

Note:
1: structural change was verified at the 1% level.