

# Nominal rigidities, relative prices and skewness

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## Nominal rigidities, relative prices and skewness \*

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### RESUMEN

El modelo de costes de menú de Ball y Mankiw (BM)(1994,1995) predice una relación positiva entre la inflación y la asimetría de la distribución de los cambios de precios. En este trabajo analizamos si este resultado se mantiene en diferentes contextos inflacionarios: España (1975-2002) y Argentina (1960-1989). En ambos países se observa la existencia de una correlación positiva entre la inflación y la asimetría en los periodos de baja inflación, a pesar de que la tasa anual de inflación promedio fue muy distinta: 2,2% en España y 23% en Argentina. Este resultado indica que las predicciones del modelo de costes de menú se verifican si la tasa de inflación está por debajo de un cierto límite y que dicho límite se determina endógenamente dependiendo de la experiencia inflacionaria de cada economía. De hecho, en los periodos de inflación más alta la asimetría no es significativa en ningún caso, lo que sugiere que el modelo de costes de menú no es aplicable más allá de cierto umbral de inflación.

**Palabras clave:** costes de menú, asimetría, precios relativos, regímenes inflacionarios

### ABSTRACT

The menu costs model developed by Ball and Mankiw (BM)(1994,1995) predicts that inflation is positively related to the skewness of price changes distribution. We test this prediction in different inflationary contexts: Spain (1975-2002) and Argentina (1960-1989). We find a positive inflation-skewness relationship in both countries at low inflation, even though the mean annual inflation rates were very different: 2,2% for Spain and 23% for Argentina. Therefore, the threshold of *low* inflation under which the menu costs model is suitable is determined endogenously, and it depends on the inflationary experience of each economy. In the higher inflation periods skewness is not significant. Finally, our results suggest that the menu-costs model is not suitable beyond certain threshold of inflation.

**Keywords:** menu costs, skewness, relative prices, inflation regimes

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## 1. Introduction

In a flexible price framework changes in relative prices should not affect average inflation and, therefore, the prediction is that there is no relationship between inflation and the higher moments of the relative price changes distribution. But empirical evidence does not support this result. On the contrary, inflation and the second and third moments of the relative price changes distribution appear to be positively correlated. However, there is no consensus about the causal mechanism underlying that relationship. On one hand, there is a vast empirical literature studying the relation between inflation and the second moment, the relative price variability (*RPV*), finding that causation runs from inflation to *RPV*. This strand of work dates back to Mills (1927), and since the contributions of Vining and Elwertowski (1976) and specially Parks (1978), a lot of empirical work has been done.

On the other hand, a second line of research proposed by Ball and Mankiw (BM)(1994,1995) shows that inflation is influenced by the skewness<sup>1</sup>. They argue that, in presence of nominal rigidities, due to the fact that firms face menu costs, changes in the price level and skewness are positively correlated. This paper is focused on this approach, and tries to check if the skewness-inflation relationship holds for different inflationary contexts. More precisely, our goal is to show that there is a threshold of the inflation rate under which the BM approach is suitable, and furthermore that such threshold is determined endogenously in each economy. The hypothesis is that this threshold depends on the inflationary experience of each country.

We test out that statement in two economies with very different inflationary history: Spain, for the 1975-2002 period, and Argentina, for the 1960-1989 period. The first economy has been historically stable in the last fifty years in comparison with Argentina: along the period studied in this paper the monthly inflation rate moved in a range between -1% and 4%. On the contrary, Argentina shows a very rich inflationary history, with sundry inflationary regimes: in the last forty years its monthly inflation rate fluctuated from -1.7% to 54%.

Our results show that the predictions of menu costs model hold for the lower inflation period in both countries, even though the mean inflation rate in each period differs strongly across them. In fact, the mean annual inflation rate in Argentina along the low

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<sup>1</sup> Usually menu costs model has been used to explain nominal price rigidity, which implies that demand policies may be effective. BM move away from the traditional approach: they propose a theory of supply shocks. As they argue, supply shocks are changes in certain relative prices and they assert that menu costs model is a plausible framework to explain why those changes affect the price level.

inflation period was around 20%, higher than the inflation rate of Spain in the high inflation period. Nonetheless, in neither of them such approach is suitable at high inflation.

The paper is organized as follows. Section 2 summarizes the theoretical framework and the main empirical evidence. Section 3 presents the price data, variables and equations used in the empirical analysis. Section 4 shows the empirical results concerning the inflation-*RPV*-skewness relationship. Finally, section 5 concludes.

## 2. Theoretical framework and empirical literature

BM(1994,1995) use a menu costs model to explain how the economy responds to shifts in relative prices that, in a flexible price setting, would leave the price level unchanged. Within a menu costs framework, price adjustments are costly. Hence, when firms experience a shock to their desired relative prices, they only change their prices if the profit from the adjustment is larger than the menu cost. These menu costs give rise to a band of inaction in response to relative prices shocks. In that framework, a relationship between the inflation rate and the higher moments of the distribution of the desired price changes arises. The features of that relationship depend on the inflationary context.

On one hand, BM(1995) state that in an economy with no trend inflation, the average inflation rate is positively related to the skewness of the distribution of relative price changes. The intuition behind this result is illustrated in figures 1.a to 1.c<sup>2</sup>, presented in appendix I. Those figures show how the skewness of the distribution of desired price changes influences the price level. As it was aforementioned, the presence of menu costs implies that firms have a range of inaction in response to shocks to their desired prices. If there is no trend inflation, such range is assumed to be symmetric around zero and it is between the upper ( $U$ ) and the lower ( $L$ ) cutoff prices. In figure 1.a the distribution of desired price changes is symmetric. In this case, if the desired changes are in the upper tail of the distribution –i.e., above  $U$ - firms will raise their prices, and if the desired changes are in the lower tail –i.e., under  $L$ -, firms will lower their prices. As the distribution is symmetric, both tails are equal and the net effect of the shock on the average inflation is zero. In figure 1.b the distribution of desired changes is skewed to the right (but still has mean zero); thus, the upper tail is larger than the lower tail. In this case, more prices rise than fall, so that the overall price level increases. In figure 1.c the distribution of shocks is skewed to the left, so the lower tail is bigger than the upper tail, which implies that more firms are lowering prices than raising them and the price level falls.

Moreover, a larger *RPV* will magnify the effects of skewness: if the distribution of shocks is symmetric, an increase in the variance of shocks increases the size of both tails by the same amount, so the price level remains unchanged. However, if the distribution is skewed to the right (left), a larger variance increases both tails, but the absolute increase in the upper (lower) tail is larger. Therefore the price level increases (decreases) by a larger amount. In short, *RPV* has no independent effect on inflation, but it interacts positively with skewness: a larger *RPV* is inflationary when the distribution is skewed to the right and deflationary when it is skewed to the left.

On the other hand, BM(1994) examine the effects of changes in relative prices in presence of a positive trend inflation, given a symmetric distribution of the desired price changes, concluding that price adjustments become asymmetric. In this context, when firms face a negative shock, they can either pay the menu cost and lower their prices or let inflation erodes their relative prices until the desired level. The higher the inflation, the faster the erosion process and the less likely the firms will pay menu costs. Therefore, a positive trend inflation will reduce the lower tail of the distribution, i.e., the size of the zone in which firms pay menu costs and lower their price. On the contrary, a positive shock implies that if the firm does not pay the menu cost, the gap between current and optimal price will widen. The firms are more likely to pay menu costs and raise their prices, increasing the upper tail of the distribution. Therefore, in a positive trend inflation framework, downward price rigidity appears. In other words, a positive trend inflation moves the range of inaction to the left (see figure 2.a). Finally, figure 2.b shows that an increase in *RPV* moves the distribution to the dotted line; hence, in absolute values the upper tail increases in relation to the lower one, so that inflation increases even if the distribution is symmetric<sup>3</sup>.

As for some periods, both for Argentina and Spain, the features of inflation and the higher moments of the relative price changes distribution do not fit the aforementioned assumptions, we have to consider some additional cases:

**1. Negative trend inflation and a symmetrical distribution of the desired price change:** In this context, upwards rigidity appears and therefore the range of inaction moves to the right –see figure 3.a-, due to analogous reasons to those explained in an economy with positive trend inflation. Figure 3.b shows the impact of an increase in *RPV*. Such increase magnifies the lower tail of the distribution, which implies a negative relation between inflation and *RPV*.

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<sup>2</sup> These figures are based on BM(1995).

<sup>3</sup> Figures 2.a and 2.b are based on Amano and Macklem(1997).

2. Positive trend inflation and a distribution of desired price changes with positive skewness<sup>4</sup>: As it has been pointed out, a positive trend inflation moves the range of inaction to the left, thus the upper tail will be bigger and the effects of an increase in *RPV* will be magnified –see figures 4.a and 4.b-.

3. Negative trend inflation and a distribution of desired price changes with positive skewness: In this case, the band of inaction moves to the right and, therefore, the right skewness might balance the impact of an increase in *RPV*, so that the negative inflation-*RPV* relationship can even disappear (see figures 5.a and 5.b).

Table 1 summarizes the testable implications of menu costs model under the different assumptions considered in this section.

**TABLE 1: TESTABLE IMPLICATIONS OF MENU COSTS MODEL\***

**A) NO TREND INFLATION  
BM(1995)**

**DISTRIBUTION OF DESIRED PRICE CHANGES**

<b>SYMMETRICAL</b>	<b>SKEWED TO THE RIGHT</b>	<b>SKEWED TO THE LEFT</b>
No <i>RPV</i> - $\pi$ relation	Positive <i>S</i> - $\pi$ relation Positive <i>RPV</i> - $\pi$ relation <i>RPV</i> magnifies effect of <i>S</i>	Positive <i>S</i> - $\pi$ relation Negative <i>RPV</i> - $\pi$ relation <i>RPV</i> magnifies effect of <i>S</i>

**B) TREND INFLATION**

<b>POSITIVE</b>		<b>NEGATIVE</b>	
<b>DISTRIBUTION OF DESIRED PRICE CHANGES</b>		<b>DISTRIBUTION OF DESIRED PRICE CHANGES</b>	
<b>SYMMETRICAL BM(1994)</b>	<b>SKEWED TO THE RIGHT</b>	<b>SYMMETRICAL</b>	<b>SKEWED TO THE RIGHT</b>
Positive <i>RPV</i> - $\pi$ relation	Positive <i>S</i> - $\pi$ relation Positive <i>RPV</i> - $\pi$ relation <i>S</i> magnifies effect of <i>RPV</i>	Negative <i>RPV</i> - $\pi$ relation	Weak negative <i>RPV</i> - $\pi$ relation Effect of <i>RPV</i> can be balanced by <i>S</i>

\*  $\pi$  denotes inflation and *S* denotes skewness

The empirical evidence in this area is mixed. In general positive inflation-skewness and inflation-*RPV* relationships are supported by the data, but results are not conclusive about which relation is stronger in different inflationary contexts. On one hand, there are studies showing that in low inflation contexts the inflation-skewness relationship is stronger than the inflation-*RPV* relationship. In this sense, Lourenco and Gruen (1995), for Australia, show that for periods with an annual inflation rate lower (higher) than 4%-5%, the inflation-skewness relation is stronger (weaker) than the inflation-*RPV* one. Studies for periods under that limit show similar results: Ball and Mankiw (1995), for the US, Amano and

<sup>4</sup> BM(1995) argue that if we combine the asymmetries in the distribution of the desired price changes with the asymmetric price adjustment derived endogenously by BM(1994) in an economy with trend inflation, we expect that skewness still have a direct effect on inflation but there is also a direct effect of variance, however they do not specify the sign and relevance of such effects.

Macklem (1997), for Canada, Aucremanne *et al.* (2002), for Belgium and Caraballo and Usabiaga (2004a,b) for Spain, among others, find a positive inflation-skewness association stronger than the inflation-*RPV* one. However, as an exception to this general result, Assarsson (2004) finds that in Sweden both relationships are positive and strong, and neither of them is stronger than the other.

On the other hand, for studies covering periods with changing inflation rate, the evidence is mixed. For example, Hall and Yates (1998), for the 1975-1996 period in the United Kingdom, find a weaker inflation-skewness relationship than the inflation-*RPV* one. Döpke and Pierdzioch (2003), for the 1969-2000 period in Germany, find that both relations are positive, but none of them is stronger. Finally, Raftai (2004) for Hungary shows that there is a positive association between inflation and skewness along a period of an annual inflation rate moving from 15% to 30%.

In short, it seems that recent empirical evidence supports the existence of a positive association between inflation and the higher moments of price change distribution. Nevertheless, it is clear that the features of such relation change depending on the different rates of inflation. In order to give a wider evidence on that relationship, as it has been said, this paper analyses the relation between inflation and the higher moments of price change distribution in two different inflationary contexts: Spain and Argentina.

### **3. Price data and empirical methodology**

#### **3.1. Price data<sup>5</sup>**

We use monthly price data for both countries. For Argentina, price series have been extracted from the statistical bulletins of the Instituto Nacional de Estadísticas y Censos, from January 1960 to March 1989. 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-March 1989 period.

For Spain we use 24 categories of disaggregated price data of the Producer Price Index (PPI). They were extracted from the Instituto Nacional de Estadística for the January

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<sup>5</sup> As BM(1995) point out, one limitation of the theoretical framework explained in previous section is that it concerns the distribution of the *desired* price changes, which is unobservable. In order to give empirical content to their predictions, they use the distribution of *actual* price changes in place of the unobserved distribution of desired price changes. Following those authors, we also use the distribution of actual price changes.

1975-December 2002 period<sup>6</sup>. Along this period inflationary and deflationary processes can be found. There was a stagflation peaked in 1977 with 26% of annual inflation, while since 1986 the adjustment process, required for admission into the European Economic Community, was associated with a lower annual inflation (which was under 4%-5%).

For Argentina, the WPI price data do not present seasonality problems, because most of prices, and specially the prices of industrial and imported products, do not have a seasonal component. On the contrary, for the Spanish case, PPI price data present a seasonal component, which has been removed by means of the TRAMO-SEATS method. Thus, all the results of the estimations presented along the paper are referred to non-seasonal variables for Argentina and seasonally adjusted variables for Spain.

### 3.2. Empirical methodology

As it is common in this strand of the literature, we use the second and third moment of the price changes distribution:  $RPV$  and the skewness ( $S$ ). The expressions of both variables are the following:

$$RPV_t = \left[ \sum_{i=1}^n w_i (\pi_{it} - \pi_t)^2 \right]^{0.5} \quad [1]$$

$$S_t = \frac{\sum_{i=1}^n w_i [\pi_{it} - \pi_t]^3}{(RPV_t)^3} \quad [2]$$

where  $w_i$  is the weight of price  $i$  in the price index<sup>7</sup>,  $\pi_{it}$  is the inflation rate of price  $i$  in period  $t$  and  $\pi_t$  is the inflation rate in period  $t$ .

For Argentina we use a slight variation of  $RPV$ , because in a high inflation economy expression [1] can be spuriously correlated with the mean of the distribution, i.e. the inflation rate. To avoid such problem, we use a coefficient of variations, as follows:

$$RPV_t = \frac{\left[ \sum_{i=1}^n w_i (\pi_{it} - \pi_t)^2 \right]^{0.5}}{(1 + \pi_t)^2} \quad [3]$$

<sup>6</sup> We have used WPI for Argentina and PPI for Spain because similar price indexes for both countries are required in order to compare results. Nonetheless, as the degree of disaggregation of price data is clearly different, we have checked if this fact could affect the results. In this sense, we have done the same empirical work performed in this paper using the Spanish CPI and comparing the results obtained for two different levels of disaggregation: 57 and 110 categories. The conclusions achieved for both cases are quite similar. These data and results are available from the authors upon request.

<sup>7</sup> For the Spanish PPI, weights are calculated according to the importance of the branches of activity and the products in 1990, with the help of information provided by the Industrial Survey. For Argentina,  $w_i$  denotes

Following BM(1995), we estimate four equations to analyse the relationships among variables:

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \varepsilon_t \quad [4]$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 RPV_t + \varepsilon_t \quad [5]$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_3 S_t + \varepsilon_t \quad [6]$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 RPV_t + \beta_3 S_t + \varepsilon_t \quad [7]$$

All the regressions include lagged inflation to capture persistence.

Before running the regressions we have tested out the stationarity of the series applying the ADF test (see appendix II)<sup>8</sup>. In turn, both for Argentina and Spain, price data present a deterministic trend, which is positive for the former and negative for the latter. These features of the data have been included in the regressions.

On the other hand, given that the explanatory variables are the higher moments of the price change distribution, a problem of multicollinearity could appear. In order to tackle this issue, the correlation coefficients between *RPV* and *S* have been calculated. As their values are under 0.3 -see appendix III-, we have considered that both variables can be included jointly in the regressions.

#### 4. Inflation, *RPV* and Skewness

In this section we present the main empirical results. The regressions are estimated by ordinary least squares (OLS)<sup>9</sup>. As usual, the value of the t-statistic (in brackets in the tables) is corrected of heteroscedasticity by means of the White method. The p-value of Breusch-Godfrey (BG) test for first order autocorrelation is also presented. We run the regressions specified in equations (4) to (7). Table 1 shows the results for the total period in Argentina and Spain.

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the average expenditure share of the  $i^{\text{th}}$  good in the price index. As usual, weights are nonnegative and sum to one.

<sup>8</sup> For Spain the unit root test has been applied to the seasonally adjusted series. The methods of adjustment for seasonality introduce persistence, reducing the power of the test, in a way that tests are not able to reject non-stationarity. According to Ghysels (1990), this problem arises when seasonality is stochastic, therefore this problem should not affect our data -see Ghysels and Perron (1993) for literature related to the unit root test applied to seasonally adjusted series-.

**TABLE 1. TOTAL PERIOD**

	ARGENTINA (1960:01-1989:03)*				SPAIN (1975:02-2002:12)*			
<b>Constant</b>	-0.32 (0.31)	-1.34 (0.00)	-0.60 (0.04)	-1.43 (0.00)	0.64 (0.00)	0.22 (0.00)	0.59 (0.00)	0.21 (0.00)
$\pi_{t-1}$	0.63 (0.00)	0.49 (0.00)	0.62 (0.00)	0.49 (0.00)	0.46 (0.00)	0.36 (0.00)	0.45 (0.00)	0.36 (0.00)
$RPV_t$		2.06 (0.02)		2.01 (0.03)		0.41 (0.00)		0.39 (0.00)
$S_t$			0.18 (0.01)	0.07 (0.31)			0.02 (0.00)	0.01 (0.01)
Adjusted $R^2$	0.56	0.61	0.57	0.61	0.49	0.65	0.51	0.65
BG p-value	0.65	0.00	0.58	0.00	0.39	0.61	0.16	0.68

\* A deterministic trend has been included in all regressions

In both countries the values of adjusted  $R^2$  suggest that  $RPV$  appears to be more significant than  $S$  to explain the inflation rate. Moreover, in Argentina when both variables are included jointly in the regression (fourth column) skewness is not significant.

As our goal is to show that, under certain threshold of the inflation rate, menu costs model could be suitable even in high inflation economies, the next step is to test the stability of the coefficients along the whole period. In order to do that, we have obtained recursive residuals and the recursive coefficients estimates for the total period estimations. Once a break point is detected, we apply the Chow test to check the results<sup>10</sup>.

On one hand, we have obtained the recursive residuals for those estimations in table 1 including the higher moments of the distribution as regressors<sup>11</sup> (i.e., equations [5] to [7]). Results show a structural change for Argentina in February 1975, and for Spain in January 1986 -see figures 1 and 4 in appendix IV for Argentina and Spain respectively-. On the other hand, the recursive coefficients estimates have been calculated for the estimations in table 1 including both  $RPV$  and skewness (i.e., equation [7]). Results show that coefficients are not stable: In both countries the coefficient of  $RPV$  is higher in the period with a higher mean inflation and the coefficient of skewness is higher in the lower inflation period –see figures 2 and 3 for Argentina and figures 5 and 6 for Spain in appendix IV-.

The results of the Chow breakpoint test for the total period are presented in table 2. As it can be seen, they verify the structural change found previously.

<sup>9</sup> As it is well known, if the lagged endogenous variable is not correlated with the error term, the properties of the OLS estimators hold. To prove that there is no correlation, we have estimated the model with OLS and we have verified that there is not autocorrelation in the residuals.

<sup>10</sup> In further researches we will check these preliminary results by means of the tests for parameter instability and structural change with unknown change point performed by Andrews(1993,2003) and Andrews and Ploberger(1994).

<sup>11</sup> Appendix IV includes the figures corresponding to estimations including both  $RPV$  and  $S$  as regressors. Results for estimations including only one of those two variables are very similar -they are disposable from the authors upon request-.

**TABLE 2. CHOW BREAKPOINT TEST**

REGRESSIONS	ARGENTINA		SPAIN	
	BREAKPOINT: February, 1975		BREAKPOINT: January, 1986	
	F-statistic (p-value)	Log likelihood ratio (p-value)	F-statistic (p-value)	Log likelihood ratio (p-value)
$\Pi_t = F(\text{Constant}, \Pi_{t-1}, RPV_t)$	0.11	0.11	0.00	0.00
$\Pi_t = F(\text{Constant}, \Pi_{t-1}, S_t)$	0.02	0.01	0.00	0.00
$\Pi_t = F(\text{Constant}, \Pi_{t-1}, RPV_t, S_t)$	0.00	0.00	0.00	0.00

#### 4.1. Inflation regimes

Our results do suggest the existence of structural changes in the estimations. The intuition behind these results is that the changes in the coefficients of the estimations shown by the recursive residuals and the recursive coefficient estimates correspond to a significant change in the inflation regime. This section is focused on this issue.

In order to determine the inflation regimes, we analyse the inflation series of each country by applying the same procedure as in Caraballo et al.(2005). This method captures only persistent changes, disregarding transitory variations in inflation levels. As the inflationary experiences of Argentina and Spain are very different, we have used different criteria to classify the inflation regimes. For Argentina we follow a slight variation of Leijonhufvud (1990)'s criterion -which was used previously in Dabús (2000)-. According to that criterion, an economy is considered to be in a moderate inflation regime when monthly inflation rate is under 2%. High inflation corresponds to the 2%-10% range and very high inflation to the 10%-50% range. In turn, as in Spain the range of the inflation, and inflation rate itself, is substantially lower than in Argentina, we have considered a low inflation period when annual inflation rate is under 5%, and high inflation regimes otherwise. We have chosen this threshold for Spain because the empirical literature finding clear conclusions about positive relationship inflation-skewness is related with economies moving around that rate of inflation –see, for example, Ball and Mankiw (1995), Lourenco and Gruen(1995), Amano and Macklem(1997), Aucremanne *et al* .(2002) and Caraballo and Usabiaga(2004a,b)-.

According to these criteria and by applying the method mentioned above, we have obtained two main regimes in each country. In Argentina, the most relevant break is observed in February 1975. Therefore, two main regimes can be distinguished: a moderate inflation period from January 1960 to January 1975 and a high and very high inflation period from February 1975 to March 1989. In Spain, the most relevant break in the inflation series is observed in January 1986, so we can distinguish a high inflation

period from January 1975 to December 1985, and a low inflation period from January 1986 to December 2002. These results imply that the changes in the coefficients of the estimations shown by the recursive residuals and the recursive coefficient estimates correspond to a change in the inflation regime.

Once the two inflation regimes for both countries were distinguished, we analyse the main features of the variables into these regimes. First, we have applied the ADF test to the inflation rate. This test shows a positive deterministic trend for the Argentinean high inflation period and a negative deterministic trend for the Spanish high inflation period, while for both countries low inflation periods have no trend inflation<sup>12</sup>.

As far as for the moments of the distribution is concerned, they show similar features in both countries. On one hand, *RPV* is higher and the range of oscillation is wider in high inflation periods than in low inflation periods. On the other hand, the distribution of price changes is clearly skewed to the right for both regimes in Argentina and for the high inflation period in Spain. On the average, skewness is lower and the range of oscillation is wider in low inflation than in high inflation periods. These features and the predictions of the menu costs model given such features are summarized in table 3.

**TABLE 3. SUMMARY STATISTIC**

COUNTRY		ARGENTINA		SPAIN	
INFLATION REGIME		LOW INFLATION NO TREND	HIGH INFLATION POSITIVE TREND	LOW INFLATION NO TREND	HIGH INFLATION NEGATIVE TREND
ANNUAL INFLATION ( $\pi$ )	MEAN	23%	162%	2.2%	14%
	MIN.	21%	46%	-0.7%	7.9%
	MAX.	58%	602%	6.4%	20.1%
MONTHLY INFLATION ( $\pi$ )	MEAN	1.95%	10.95%	-0.17%	1.08%
	MIN.	-1.70%	0.94%	-1%	0.0%
	MAX.	13.70%	54.05%	1.6%	4.5%
<i>RPV</i>	MEAN	0.36	0.78	0.73	1.24
	MIN.	0.04	0.06	0.25	0.37
	MAX.	4.16	9.12	3.67	5.76
SKEWNESS ( <i>S</i> )	MEAN	1.67	2.64	0.16	1.62
	MIN.	-8.35	-5.18	-16.79	-3.95
	MAX.	8.72	8.12	18.57	9.22
	% RIGHT*	75%	89%	60%	89%
	% LEFT*	25%	11%	40%	11%
PREDICTIONS OF THE MENU COSTS MODEL		<ul style="list-style-type: none"> <li>▪ Positive <math>S-\pi</math> relation</li> <li>▪ Positive <math>RPV-\pi</math> relation <ul style="list-style-type: none"> <li>▪ <math>S-\pi</math> relation stronger than <math>RPV-\pi</math> relation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Positive <math>S-\pi</math> relation</li> <li>▪ Positive <math>RPV-\pi</math> relation</li> <li>▪ <math>RPV-\pi</math> relation stronger than <math>S-\pi</math> relation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Positive <math>S-\pi</math> relation</li> <li>▪ Positive <math>RPV-\pi</math> relation</li> <li>▪ <math>S-\pi</math> relation stronger than <math>RPV-\pi</math> relation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Negative <math>RPV-\pi</math> relation</li> <li>▪ No prediction for <math>S-\pi</math> relation</li> <li>▪ Weak <math>RPV-\pi</math> relation, it can be balanced by <math>S</math></li> </ul>

\* Percentage of months in which the distribution of price changes is skewed to the right or to the left

<sup>12</sup> Given that the deterministic trend appears only for the high inflation period for both countries, we have estimated again the regressions in table 1 taking this new result into account. We have not included them in this paper because there are no relevant changes.

Taking these features into account, we can have a look again to table 2, the results of the Chow breakpoint test are showing a structural change between the low and high inflation regimes in both countries. Interestingly, such changes are more significant when skewness is included as an explanatory variable of the inflation rate. These results support our hypothesis: skewness is relevant mainly in the lower inflation periods, even in two economies with very different inflationary experiences.

The next step is to check if the predictions of the model hold in both periods. This leads us to estimate equations [4] to [7] for the two inflation regimes. Table 4 presents the results.

**TABLE 4. LOW INFLATION REGIME**

	ARGENTINA (1960:01-1975:01)				SPAIN (1986:01-2002:12)			
<b>Constant</b>	0.90 (0.00)	0.59 (0.00)	0.58 (0.00)	0.36 (0.06)	0.09 (0.00)	0.11 (0.03)	0.08 (0.00)	0.12 (0.01)
$\Pi_{t-1}$	0.54 (0.00)	0.51 (0.00)	0.44 (0.00)	0.42 (0.00)	0.46 (0.00)	0.46 (0.00)	0.47 (0.00)	0.47 (0.00)
$RPV_t$		1.00 (0.02)		0.75 (0.09)		-0.02 (0.72)		-0.04 (0.50)
$S_t$			0.30 (0.00)	0.29 (0.00)			0.02 (0.00)	0.02 (0.00)
Adjusted $R^2$	0.28	0.31	0.50	0.51	0.21	0.21	0.28	0.28
BG $p$ -value	0.83	0.45	0.04	0.07	0.14	0.21	0.06	0.06

In both cases results change drastically in comparison to those obtained in table 1. According to the adjusted  $R^2$ ,  $S$  seems to be much more relevant than  $RPV$ , and when both variables are included in the regressions  $RPV$  is not significant at 5% level. Thus, BM (1995) approach holds for low and stable inflation periods. In turn, the threshold under which menu costs model is suitable differs according to the inflationary history of each country.

Table 5 shows the results for the high inflation regimes.

**TABLE 5. HIGH INFLATION REGIME**

	ARGENTINA (1975:02-1989:03)*				SPAIN (1975:02-1985:12)*			
<b>Constant</b>	3.86 (0.02)	1.56 (0.23)	4.83 (0.02)	3.31 (0.08)	0.91 (0.00)	0.25 (0.04)	0.79 (0.00)	0.30 (0.01)
$\Pi_{t-1}$	0.61 (0.00)	0.47 (0.00)	0.61 (0.00)	0.46 (0.00)	0.31 (0.00)	0.17 (0.01)	0.03 (0.00)	0.17 (0.00)
$RPV_t$		2.33 (0.03)		2.45 (0.02)		0.55 (0.00)		0.58 (0.00)
$S_t$			-0.24 (0.40)	-0.46 (0.17)			0.06 (0.04)	-0.04 (0.07)
Adjusted $R^2$	0.36	0.44	0.36	0.44	0.12	0.62	0.14	0.63
BG $p$ -value	0.55	0.00	0.52	0.00	0.39	0.08	0.99	0.05

\*A deterministic trend has been included for all regressions

Table 5 shows that in both cases the inflation-*RPV* relationship seems to be stronger than the inflation-skewness one. The contribution of *RPV* to the adjusted  $R^2$  is larger than the contribution of *S*. In turn, in Spain the latter is not significant when both of them are included in the regression, meanwhile in Argentina only *RPV* is significant at a level of confidence of 5%. On one hand, results for Argentina do not corroborate the predictions obtained by BM(1994): although the inflation-*RPV* relationship is stronger than the inflation-skewness relation<sup>13</sup>, skewness is not significant to explain the inflation rate. Results for Spain do not support menu costs predictions either. *RPV* coefficients were expected to be negative but they are positive; and *RPV*-inflation relation was expected to weaken once skewness were included, while table 5 shows that the coefficient is positive and *RPV* is still significant when skewness is included.

The intuition is that nominal rigidities tend to disappear in higher inflation periods, so that the mechanisms underlying such approach (i.e. menu costs) are only suitable in low inflation periods. Therefore, there seems to be an upper limit of the rate of inflation from which nominal rigidities disappear.

To sum up, the menu costs model holds for low inflation in Argentina when annual inflation is around 20%, while it is not suitable for the Spanish higher inflation period, even though the average inflation rate was only around 14%. These results are favourable to our hypothesis: it seems that there is a threshold of inflation under which the predictions of menu costs model hold, and such limit depends on the inflationary history of each economy. In particular, menu costs approach is suitable in the low inflation periods of two countries with very different inflationary experiences, even though their inflation rates in such periods were substantially different.

#### 4.2 Alternative measures of skewness

Results obtained in previous section point out that skewness is more relevant than *RPV* to explain inflation rate in low inflation regimes. In this section we test this result by means of alternative measures of skewness defined by BM(1995). They relate inflation

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<sup>13</sup> In order to check these results in another high inflation country, we have done a similar analysis for Peru. We used 168 individual prices from the CPI for the January 1980-April 1994 period. By applying the criterion used for Argentina, the Peruvian economy presents two periods of high inflation with a mean monthly inflation rate higher than 5%, and a very high inflation period with a monthly inflation rate of 44%, on the average. Our results show that *RPV* is significant to explain inflation for the total period, and the adjusted  $R^2$  increases from 0.18 to 0.91 when that variable is included in the regression, while *S* is not significant. In turn, BM approach is not suitable in the Peruvian 1991-1994 high inflation period (even though this is the lower inflation period of Peru between 1980 and 1994): *RPV* is significant, but the contribution to the adjusted  $R^2$  is smaller and *S* is not

with the size of the tails of the price changes distribution; therefore, it seems more accurate to define a variable to measure the tails and also to capture the magnifying effect of *RPV* on skewness. Specifically, for a cut-off  $X$  chosen arbitrarily,  $SX_t$  is defined as:

$$SX_t = \sum_{i=1}^n w_i (\pi_{it} - \pi_t) D_i^- + \sum_{i=1}^m w_i (\pi_{it} - \pi_t) D_i^+ \quad [8]$$

where  $D_i^-$  and  $D_i^+$  are dummy variables. The former term takes the value one when  $i_{th}$  industry's relative price change falls in the lower  $X$  per cent of the distribution and zero otherwise, and the latter term is one when  $i_{th}$  industry's relative price change falls in the upper  $X$  per cent of the distribution and zero otherwise. Therefore,  $SX_t$  subtracts the mass in the upper tail of the distribution of prices changes from the mass in the lower tail. This variable is zero for a symmetrical distribution of relative price changes and positive (negative) when the right (left) tail is larger than the left (right) tail. Moreover, for a given skewness, the larger the *RPV* the larger the tails; thus the same variable combines the effects of skewness with its interaction with *RPV*. As the choice of  $X$  is arbitrary, we have chosen  $X=10$  and  $X=25$  in order to compare our results with those of Ball and Mankiw (1995) and Amano and Macklem (1997).

Finally, instead of giving full weight to the price changes above a cut-off and zero weight otherwise, as we have done with  $SX_t$ , BM(1995) define a new variable which increases the weights linearly with the size of the adjustment, as follows:

$$Q_t = \sum_i w_i |\pi_{it} - \pi_t| (\pi_{it} - \pi_t) \quad [9]$$

Expression [9] implies that  $Q_t$  is a weighted average of the product of each relative price change and its own absolute value, and it has the same properties of  $SX_t$ : it is zero for a symmetrical distribution, positive for a right skewed distribution, and negative for a left skewed distribution. In turn, its value is magnified with a larger *RPV*.

We estimate the following equations:

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_4 S10_t + \varepsilon_t \quad [10]$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_5 S25_t + \varepsilon_t \quad [11]$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_6 Q_t + \varepsilon_t \quad [12]$$

Following the same methodology that in previous section, we carry out the estimations for the total period and test the stability of the parameters. Finally, we estimate equations [10] to [12] for the two inflation regimes. Tables 6 and 7 show the results for

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significant. Hence, these results point out that there is also a limit from which BM approach doesn't work. In particular, it is not suitable beyond certain thresholds of inflation.

Argentina and Spain, respectively, and table 8 presents the results of Chow test applied to estimations for total period.

**TABLE 6. ALTERNATIVE MEASURES OF SKEWNESS. ARGENTINA\***

	TOTAL PERIOD			LOW INFLATION PERIOD			HIGH INFLATION PERIOD		
	<b>Constant</b>	2.12 (0.00)	2.29 (0.00)	2.41 (0.00)	0.68 (0.00)	0.98 (0.00)	0.85 (0.00)	3.33 (0.06)	3.61 (0.02)
$\Pi_{t-1}$	1.62 (0.00)	0.65 (0.00)	0.62 (0.00)	0.56 (0.00)	0.51 (0.00)	0.50 (0.00)	0.60 (0.00)	0.63 (0.00)	0.60 (0.00)
$S10_t$	0.02 0.08			0.01 (0.00)			0.02 (0.17)		
$S25_t$		0.01 (0.23)			0.01 (0.03)			0.01 (0.17)	
$Q_t$			0.11 (0.39)			1.18 (0.00)			0.05 (0.67)
<i>Adjusted R<sup>2</sup></i>	0.58	0.57	0.56	0.34	0.31	0.37	0.38	0.38	0.36
<i>BG p-value</i>	0.12	0.39	0.61	0.00	0.87	0.07	0.23	0.35	0.54

\* A positive deterministic trend for the high inflation period has been included for all regressions

**TABLE 7. ALTERNATIVE MEASURES OF SKEWNESS. SPAIN\***

	TOTAL PERIOD			LOW INFLATION PERIOD			HIGH INFLATION PERIOD		
	<b>Constant</b>	0.58 (0.00)	0.64 (0.00)	0.56 (0.00)	0.09 (0.00)	0.03 (0.35)	0.09 (0.00)	0.83 (0.00)	0.90 (0.00)
$\Pi_{t-1}$	0.39 (0.00)	0.46 (0.00)	0.44 (0.00)	0.42 (0.00)	0.41 (0.00)	0.47 (0.00)	0.20 (0.02)	0.31 (0.00)	0.29 (0.00)
$S10_t$	1.83 (0.00)			0.97 (0.04)			2.19 (0.00)		
$S25_t$		-0.03 (0.88)			0.34 (0.00)			-0.68 (0.40)	
$Q_t$			1.36 (0.00)			3.91 (0.03)			1.47 (0.00)
<i>Adjusted R<sup>2</sup></i>	0.56	0.49	0.55	0.25	0.26	0.27	0.30	0.13	0.25
<i>BG p-value</i>	0.73	0.39	0.52	0.13	0.11	0.10	0.64	0.73	0.42

\* A negative deterministic trend for the high inflation period has been included for all regressions

**TABLE 8. CHOW BREAKPOINT TEST**

REGRESSIONS	ARGENTINA		SPAIN	
	BREAKPOINT: February, 1975		BREAKPOINT: January, 1986	
$\Pi_{t=}$ F(Constant, $\Pi_{t-1}$ , $S10_t$ )	0.13	0.12	0.00	0.00
$\Pi_{t=}$ F(Constant, $\Pi_{t-1}$ , $S25_t$ )	0.02	0.01	0.00	0.00
$\Pi_{t=}$ F(Constant, $\Pi_{t-1}$ , $Q_t$ )	0.08	0.07	0.00	0.00

In general the results boost the conclusions obtained previously. On one hand, results shown in tables 6 and 7 show that the three alternatives measures of skewness are

significant in the low inflation period for both countries. This implies that skewness is significant in low inflation and its effect is magnified by *RPV*. In turn, for the Argentinean high inflation periods none of the variables is significant, which implies that menu costs model is not suitable.

On the other hand, no clear conclusions arise for total and high inflation periods in Spain. The fact that for those two periods  $S10_t$  is significant and  $S25_t$  is negative and non-significant is implying that the choice of the cut-off may be relevant in order to explain inflation, against conclusions obtained by Ball and Mankiw (1995) and Amano and Macklem (1997).

Finally, table 8 suggests the existence of significant structural change between the lower and higher inflation periods in both countries. This result is also compatible with our previous findings obtained with the traditional measures of skewness (see table 2 and appendix IV).

## 5. Conclusions

This paper analyses the relevance of menu costs models, performed by BM (1994,1995), in two countries with very different inflationary experiences: Argentina and Spain. For low and stable inflation periods, BM (1995) approach predicts a strong positive relation between inflation and skewness, which can be magnified by *RPV*. Our results show that such relation holds in the lower inflation periods of both countries, even though their inflation rates are very different. Therefore, these results seem to verify our hypothesis: the limit of *low* inflation differs in order to apply BM framework. For Spain, that barrier could be 4%-5% of annual inflation rate, whereas for Argentina it reaches 20%. The intuition is that such limit depends on the inflationary experience of the economy.

For high inflation periods both countries present a deterministic trend. In this context BM (1994) assert that both *RPV* and skewness are significant but *RPV* is more significant than skewness in order to explain inflation. Our results show that the inflation-*RPV* relationship is stronger than the inflation-skewness one in both countries, but skewness is not significant in any of them. Such results suggest the relevance of inflation regime in explaining both relationships and states that nominal rigidities disappear at high inflation. In short, beyond an upper threshold menu costs model is not suitable, and that limit seems to be endogenous to the inflationary history of the economy.

Finally, for further research there are some interesting extensions of this issue. A first extension is to take a higher number of countries, with different inflationary

experiences, in order to determine if our results hold in an expanded sample of cases. Finally, a second extension could be to analyse how the frequency of the data affects the results, because, intuitively, nominal rigidities as menu costs should be more relevant at higher frequency of price data.

APPENDIX I. THEORETICAL FRAMEWORK  
FIGURE 1. NO TREND INFLATION

FIGURE 1.a: SYMMETRIC DISTRIBUTION

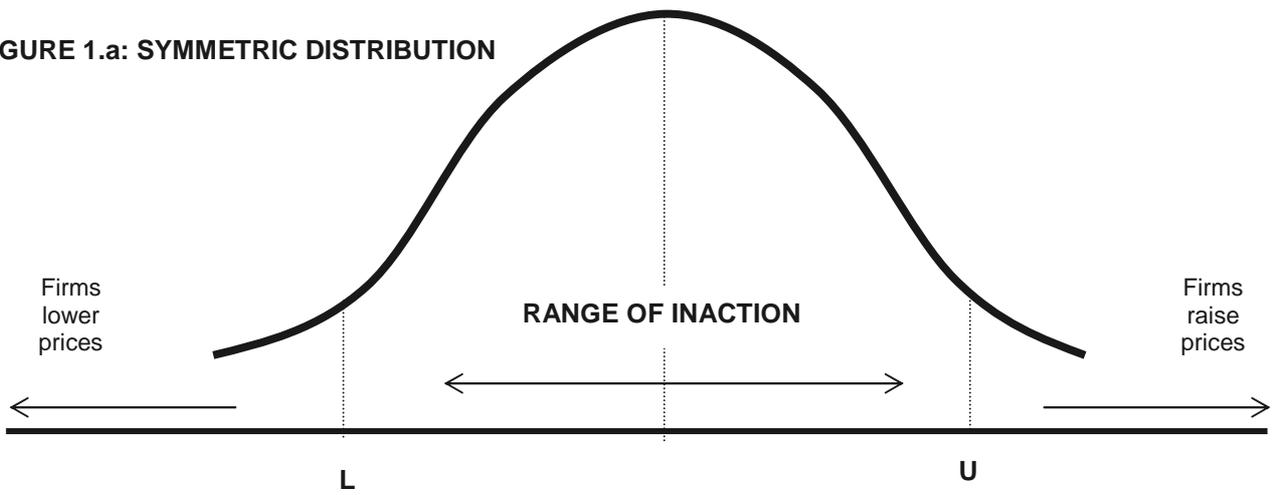


FIGURE 1.b: SKEWED TO RIGHT

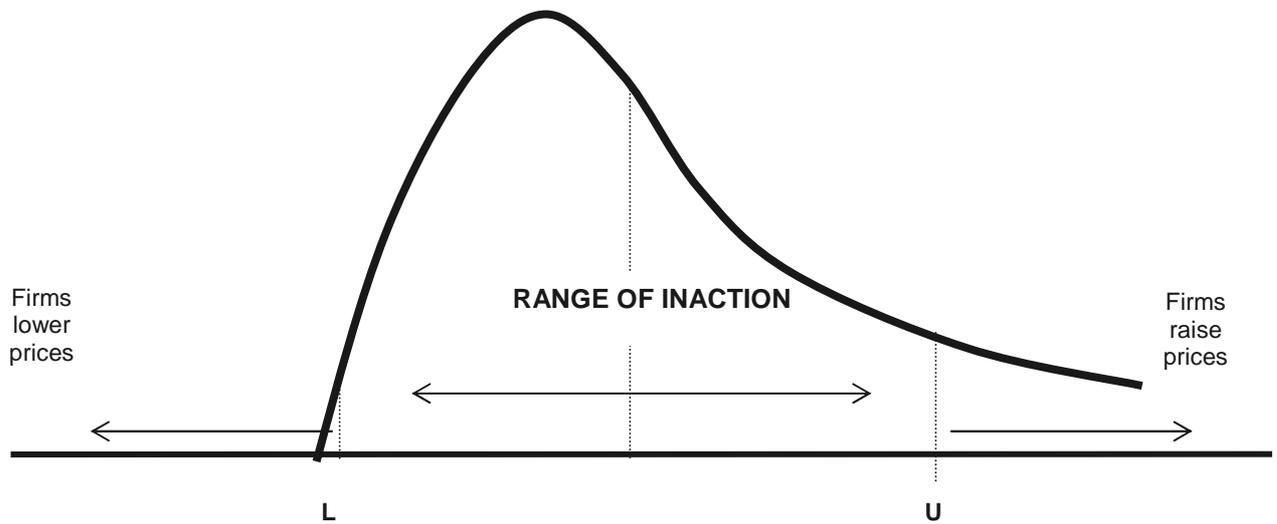


FIGURE 1.c: SKEWED TO LEFT

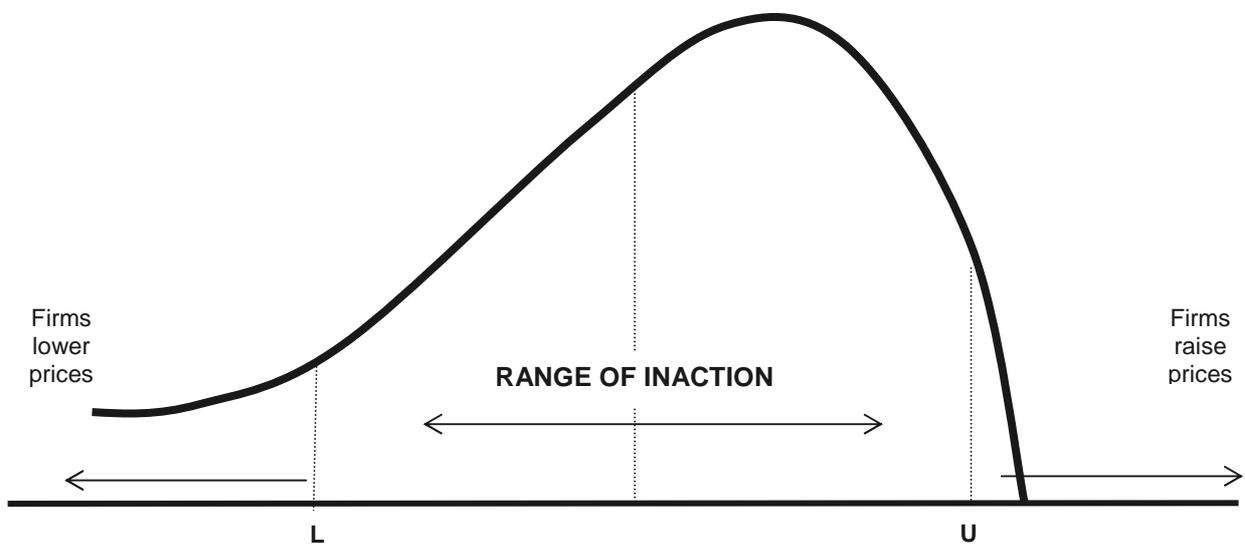


FIGURE 2 . POSITIVE TREND INFLATION. SYMMETRIC DISTRIBUTION

FIGURE 2.a

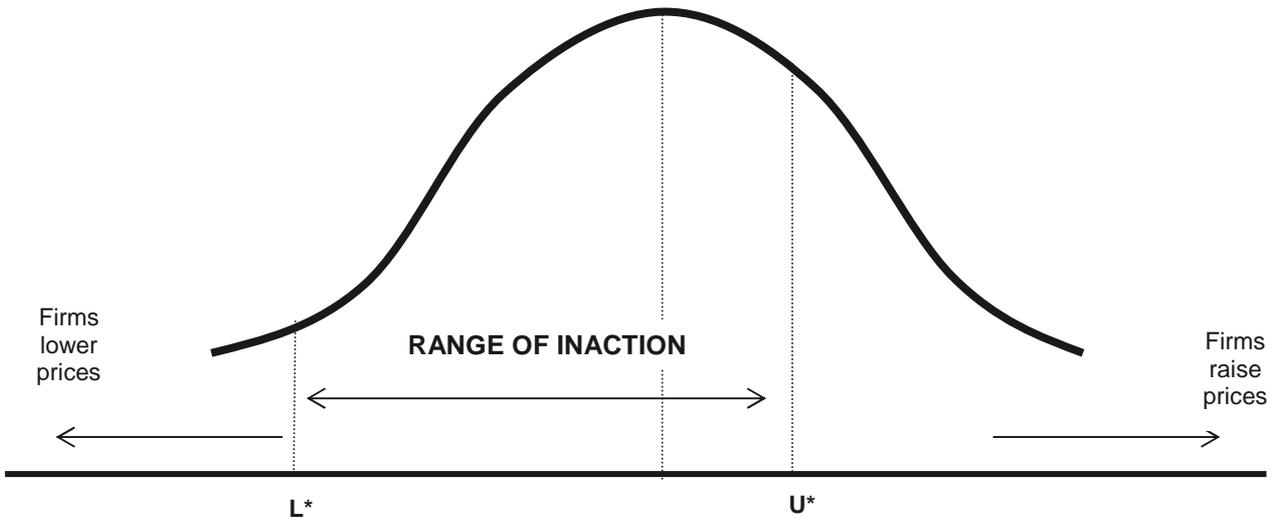


FIGURE 2.b

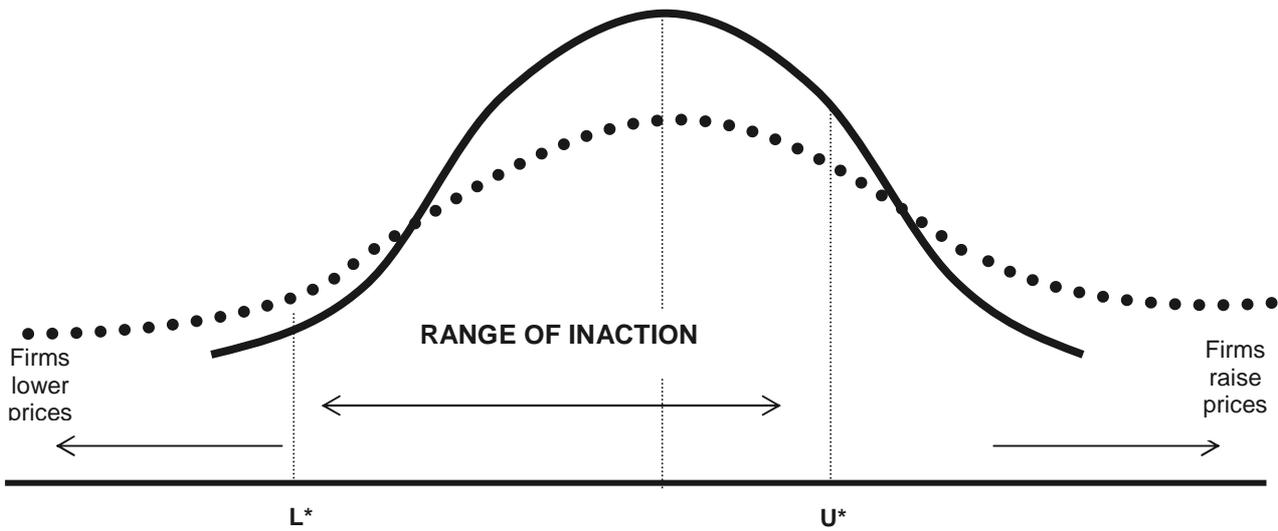


FIGURE 3 . NEGATIVE TREND INFLATION. SYMMETRIC DISTRIBUTION

FIGURE 3.a

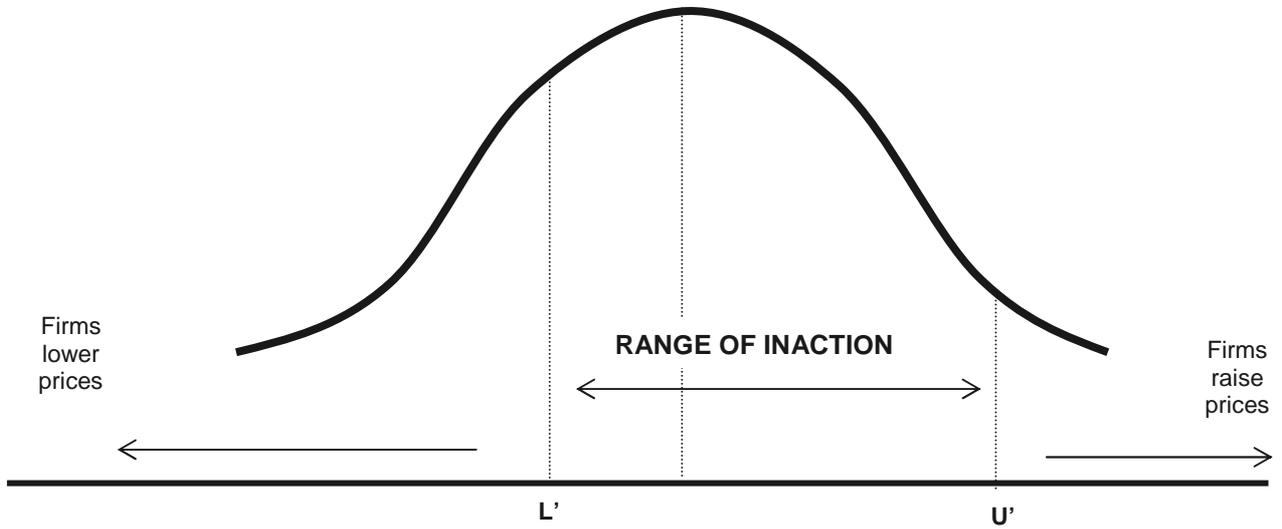


FIGURE 3.b: EFFECTS OF AN INCREASE IN RPV

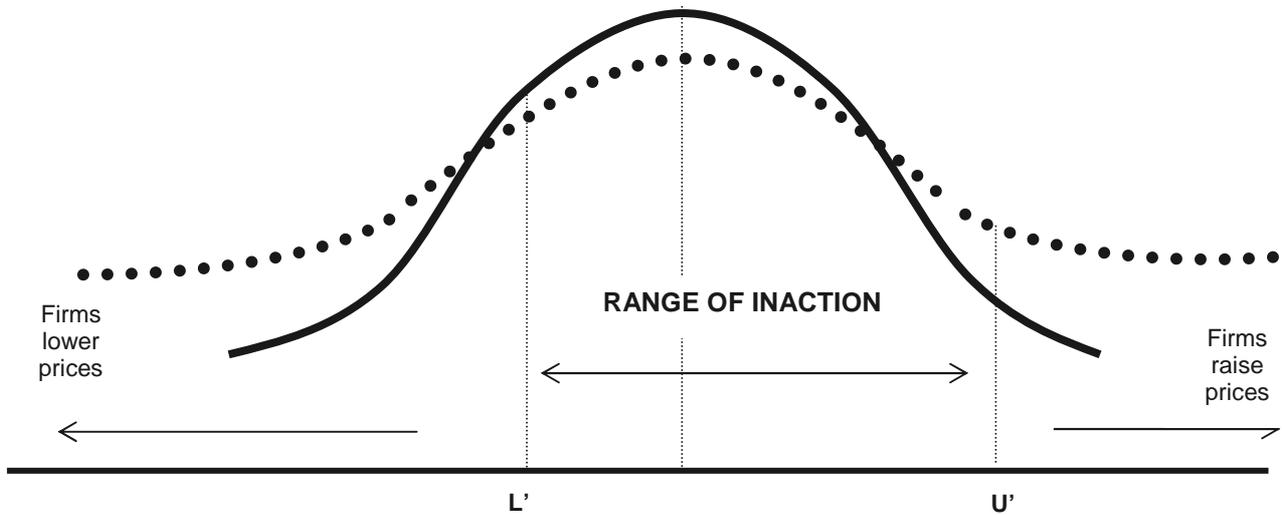


FIGURE 4. POSITIVE TREND INFLATION. RIGHT SKEWED DISTRIBUTION

FIGURE 4.a

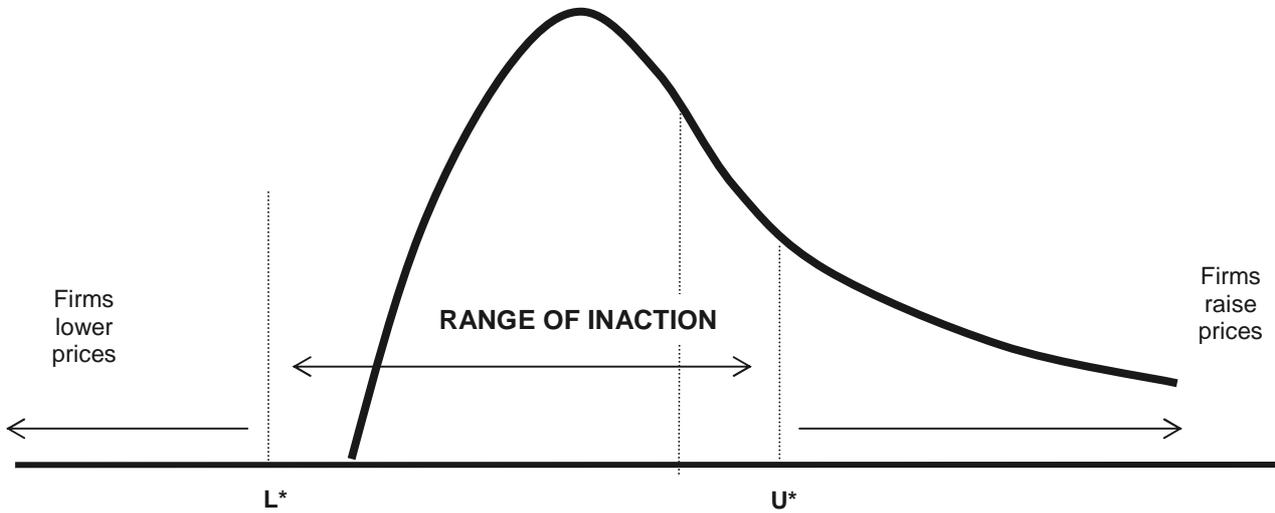


FIGURE 4.b: EFFECT OF AN INCREASE IN RPV

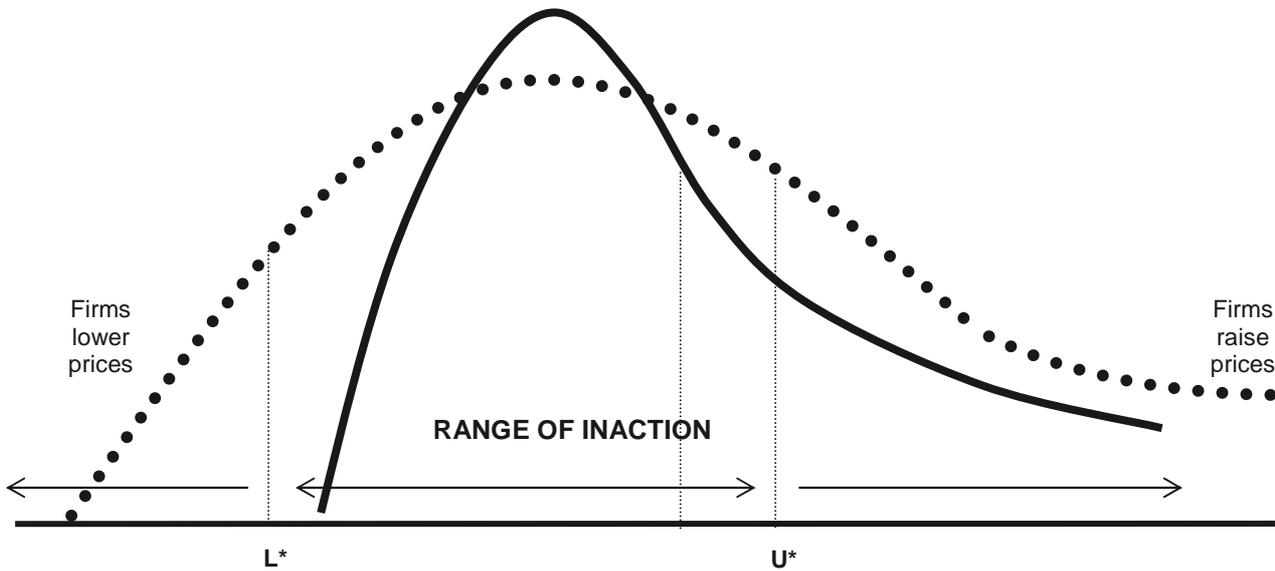


FIGURE 5. NEGATIVE TREND INFLATION. RIGHT SKEWED DISTRIBUTION

FIGURE 5.a

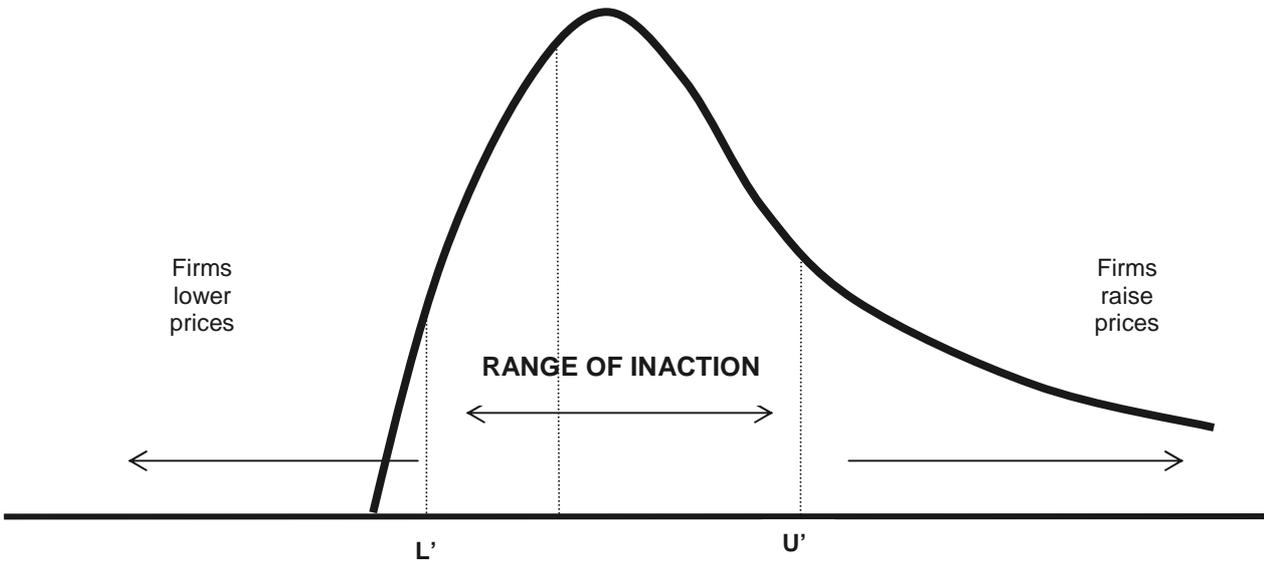
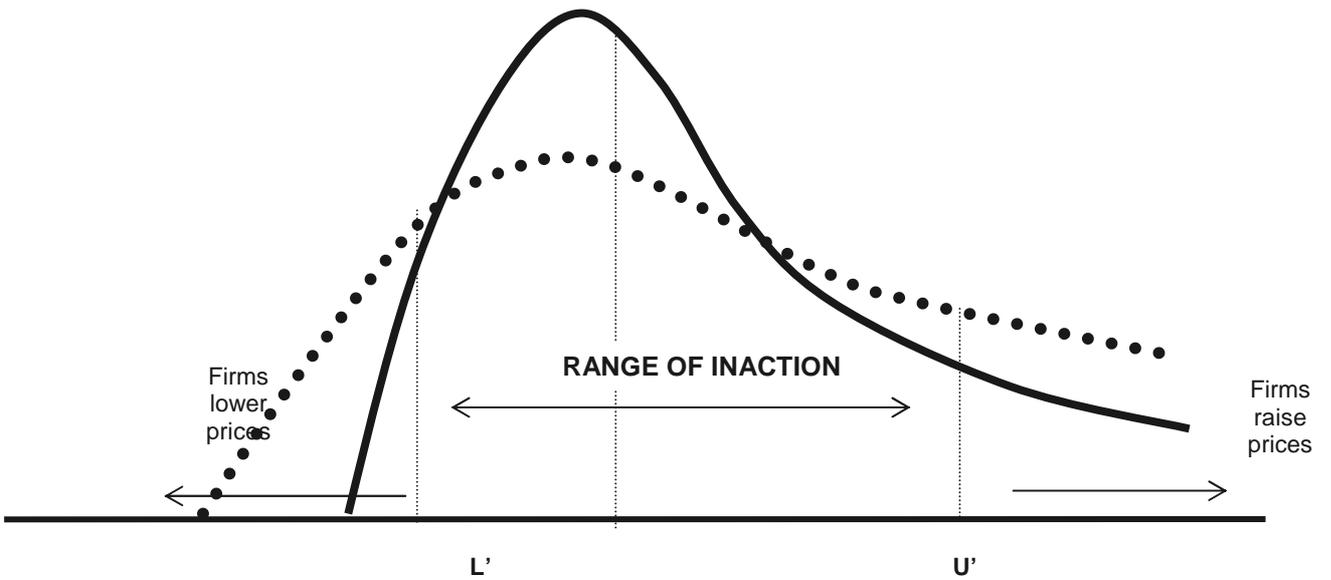


FIGURE 5.b: EFFECT OF AN INCREASE IN RPV



## APPENDIX II. UNIT ROOT TEST

The specific testing procedure adopted is the Augmented Dickey-Fuller test with Akaike Information criterion used for selecting the number of lags included in the ADF regressions. Moreover, results have been checked using Schwartz criterion. By default, the maximum number of lags allowed in the tests is 12. For both countries a deterministic trend appears for the total period, but when the inflation series is divided by periods the deterministic trend disappears for the low inflation period. We show the results for the total period (results for each period are disposable from the authors upon request).

### Unit root test. Spain. Total period.

Variable	Number of lags	Constant	Trend	ADF statistic	p-value
$\Pi_t$	6	yes	yes	-4.14	0.00
$RPV_t$	9	yes	yes	-3.69	0.02
$S_t$	2	yes	yes	-8.25	0.00
$S10_t$	2	yes	yes	-6.59	0.00
$S25_t$	2	no	yes	-3.12	0.01
$Q_t$	0	yes	yes	-6.43	0.00

### Unit root test. Argentina. Total period

Variable	Number of lags	Constant	Trend	ADF statistic	p-value
$\Pi_t$	11	no	yes	-3.73	0.02
$RPV_t$	6	yes	no	-3.74	0.03
$S_t$	12	yes	no	-3.53	0.00
$S10_t$	2	yes	no	-9.32	0.00
$S25_t$	11	no	no	-4.42	0.00
$Q_t$	4	no	no	-4.32	0.00

## APPENDIX III

### CORRELATION COEFFICIENTS BETWEEN $RPV_t$ AND $S_t$

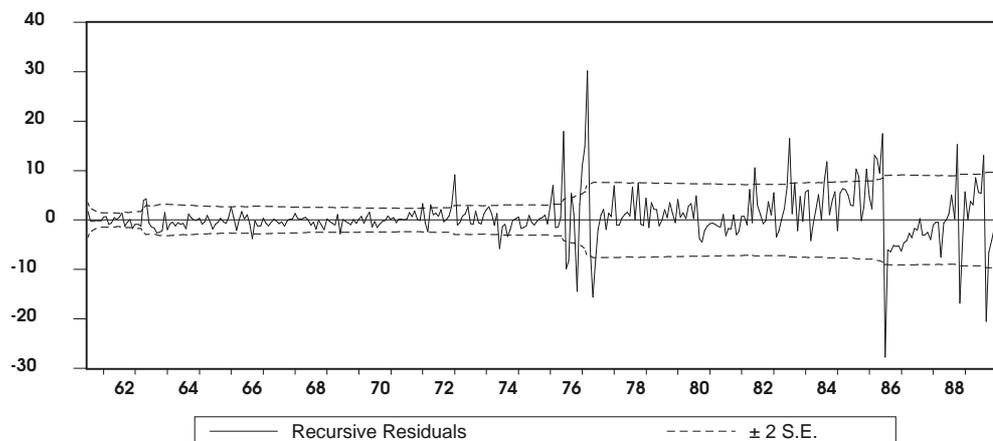
	TOTAL PERIOD	HIGH INFLATION PERIOD	LOW INFLATION PERIOD
<b>ARGENTINA</b>	0,12	0,19	0,03
<b>SPAIN</b>	0,20	0,30	0,08

## APPENDIX IV. TEST OF STRUCTURAL CHANGE.

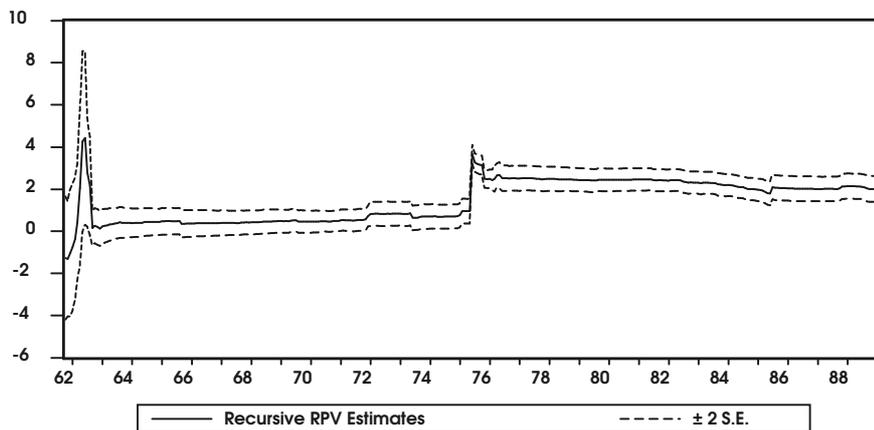
We present the results for recursive residuals for estimation in fourth column of table 1 and 2, i.e. the estimations of equation (7), for Argentina and Spain respectively. Residuals outside the standard error bands suggest instability in the parameters of the equation.

# ARGENTINA

### FIGURE 1. RECURSIVE RESIDUAL



### FIGURE 2. RECURSIVE COEFFICIENTS. $RPV_t$



### FIGURE 3. RECURSIVE COEFFICIENTS. $S_t$

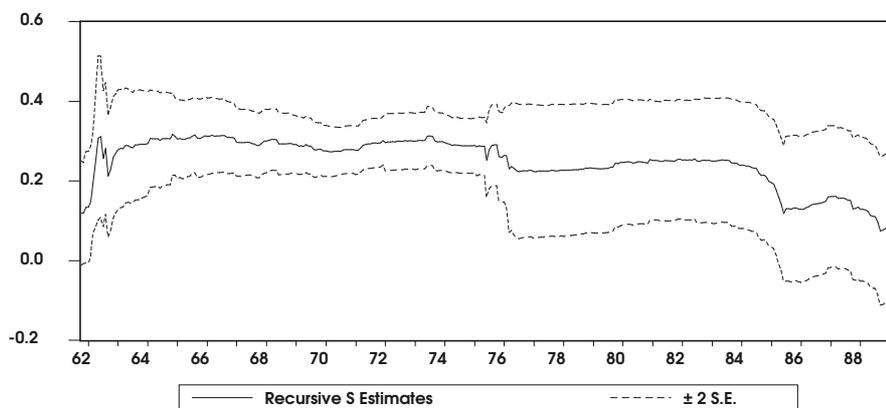


FIGURE 4. RECURSIVE RESIDUALS

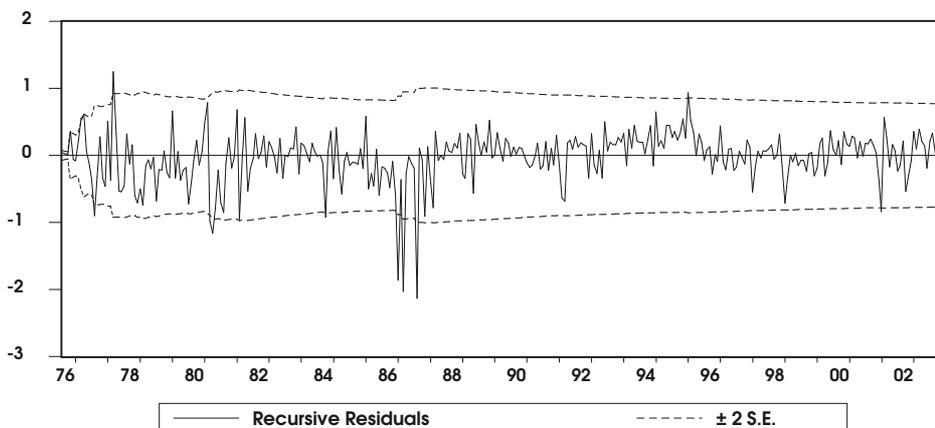


FIGURE 5. RECURSIVE COEFFICIENTS.  $RPV_t$

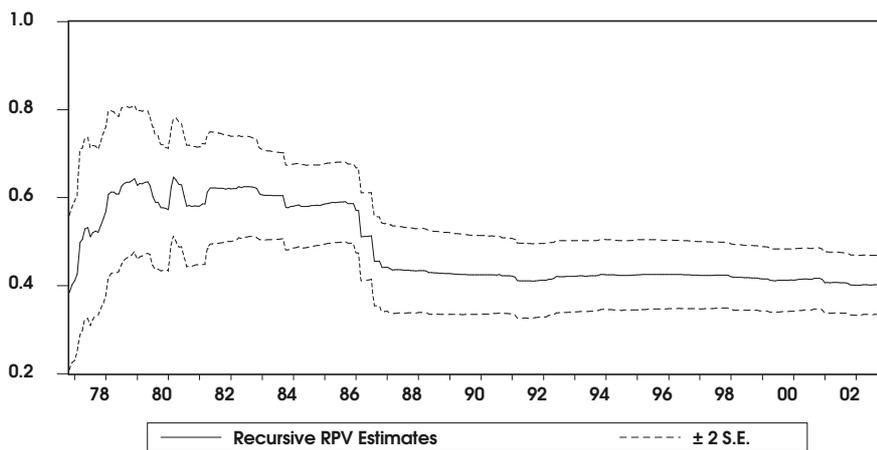
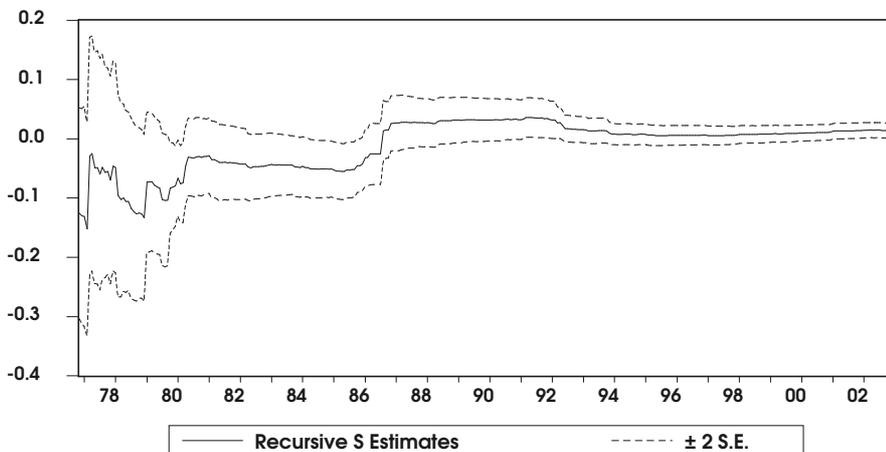


FIGURE 6. RECURSIVE COEFFICIENTS.  $S_t$



## References

- Amano, R.A. and Macklem, R. (1997): "Menu Costs, Relative Prices, and Inflation: Evidence for Canada", Bank of Canada, Working Paper 97-14.
- Andrews, D.W.K.(1993): "Test for Parameter Instability and Structural Change with Unknown Change Point", *Econometrica*, 61(3), pp. 821-856.
- Andrews, D.W.K.(2003): "Test for Parameter Instability and Structural Change with Unknown Change Point: A Corrigendum", *Econometrica*, 71(1), pp. 395-398.
- Andrews, D.W.K. and Ploberger, W.(1994): "Optimal Tests when Nuisance Parameter is Present under the Alternative", *Econometrica*, 62(6), pp. 1383-1414.
- Assarsson, B. (2004): "Inflation and Relative-Price Changes in the Swedish Economy", *Sveriges Riksbank Economic Review*, 3, pp. 43-62.
- Aucremanne, L., Brys, G., Hubert, M., Rousseeuw, P.J. and Struyf, A. (2002): "Inflation, Relative Prices and Nominal Rigidities", National Bank of Belgium, Working Paper 20.
- Ball, L. and Mankiw, N.G. (1994): "Asymmetric Price Adjustment and Economic Fluctuations", *Economic Journal*, 104 (423), pp. 247-261.
- Ball, L. and Mankiw, N.G. (1995): "Relative-Price Changes as Aggregate Supply Shocks", *Quarterly Journal of Economics*, 110 (1), pp. 161-193.
- Carballo, M.A., Dabús, C. and Usabiaga, C.(2005): "Relative Prices and Inflation: New Evidence from Different Inflationary Contexts", *Applied Economics*, forthcoming.
- Carballo, M.A. and Usabiaga, C. (2004a): "Análisis de la Estructura de la Inflación de las Regiones Españolas: La Metodología de Ball y Mankiw", *Investigaciones Regionales*, 5, pp. 63-86.
- Carballo, M.A. and Usabiaga, C.(2004b): "Inflation and Relative Prices: Empirical Evidence for the Spanish Economy". *Problems and Perspectives in Management. Chapter 1: Macroeconomic Processes and Regional Economies Management*, 3, pp. 59-71.
- Dabús, C. (2000): "Inflationary Regimes and Relative Price Variability: Evidence from Argentina", *Journal of Development Economics*, 62 (2), pp. 535-547.
- Döpke, J. and Pierdzioch, C. (2003): "Inflation and Skewness of the Distribution of Relative Price Changes: Empirical Evidence for Germany", *Jahrbücher für Nationalökonomie und Statistik*, 223 (2), pp. 136-159.
- Ghysels, E. (1990): "Unit Root Tests and the Statistical Pitfalls of Seasonal Adjustment: the Case of U.S. Postwar Real Gross National Product", *Journal of Business and Economic Statistics*, 8 (2), pp. 145-152.
- Ghysels, E. and Perron, P. (1993): "The Effect of Seasonal Adjustment Filters on Tests for a Unit Root", *Journal of Econometrics*, 55, pp. 57-98.
- Hall, S. and Yates, A. (1998): "Are There Downward Nominal Rigidities in Product Markets?", Bank of England, Working Paper Series, 80.
- Leijonhufvud, A. (1990): *Extreme Monetary Instability: High Inflation*, Lecture, University of Hoheneim (Germany), mimeo.
- Lourenco, R.D.A. and Gruen, D. (1995): "Price Stickiness and Inflation", Reserve Bank of Australia, Research Discussion Paper 9502.
- Mills, F. (1927): *The Behaviour of Prices*, Arno, New York.
- Parks, R.W. (1978): "Inflation and Relative Price Variability", *Journal of Political Economy*, 86 (1), pp. 79-95.
- Raftai, A.(2004): "Inflation and Relative Price Asymmetry", European Central Bank, Working Paper Series, n° 301.
- Vining, D.R. and Elwertowski, T.C. (1976): "The Relationship between Relative Prices and General Price Level", *American Economic Review*, 66 (4), pp. 699-708.