Online Appendix

to

PRICE DISPERSION AND OPTIMAL INFLATION: THE SPANISH CASE

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Submitted December 2010; accepted May 2012

The items of the Spanish CPI, the unit root tests, and the rolling and recursive estimations for unexpected inflation are described here.

A. Items of the Spanish CPI

Table A1 presents the items of the Spanish CPI.

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Table A1. Items of the Spanish CPI

Data description	Average weights[†]	Data description	Average weights[†]
Cereals and by-products	13.837	Footwear for women	7.543
Bread	18.171	Footwear for children and infants	4.252
Bovine meat*	13.360	Repair of footwear	0.515
Sheep meat*	4.845	Rentals for housing	22.127
Swine meat*	7.199	Heating. electricity and water supply*	48.316
Poultry meat*	8.745	Maintenance and repair of the dwelling	41.330
Other meats*	22.167	Furniture and floor coverings	16.097
Fresh and frozen fish*	16.228	Household textiles and decorations	6.295
Seafood and processed fish	12.445	Household appliances including repair	11.146
Eggs*	3.108	Household utensils and tools	4.930
Milk	13.189	Non-durable household goods	17.205
Milk-based products	15.490	Household services	13.100
Oils and fats	8.049	Medical. dental and paramedical services	20.232
Fresh fruit*	15.988	Medical products. appliances and equipment	18.140
Canned and dried fruit	3.182	Personal transport*	164.378
Fresh vegetables*	9.686	Local transport*	5.621
Processed vegetables	5.143	Long-distance transport*	5.352
Fresh potatoes and potatoes preparations	3.494	Communications	27.660
Coffee, cocoa and infusions	3.281	Recreational items	23.874
Sugar	1.352	Printed matter	11.819
Other food products	9.175	Recreational services	14.580
Mineral waters, soft drinks and juices	6.761	Pre-primary and primary education	5.997
Alcoholic beverages	8.729	Secondary education	4.485
Tobacco	22.626	Tertiary education	6.605
Garments for men	27.945	Other educational goods and services	4.328
Garments for women	32.754	Personal effects	21.660
Garments for children and babyclothes	12.954	Tourism. catering and accommodation services	124.893
Clothing accesories and repair of clothing	5.309	Other goods and services	15.420
Footwear for men	6.886	Total	1000

Notes: [†]From 1987 to 2001 the weights are kept constant. Since then, they have changed each year. The table shows the average weights of each product over time. *These items were excluded from the core inflation calculus because they correspond to unprocessed food and energy-related items.

B. Unit roots tests

Table A2 presents the results of the ADF, DF-GLS and PP unit root tests for seasonally adjusted variables.

Table A2. ADF, DF-GLS and PP unit root tests (1987.01–2009.08)

Variable	Criteria to select lags	Constant and trend			Constant			No constant, no trend	
		ADF	DF-GLS	PP	ADF	DF-GLS	PP	ADF	PP
IN_t	Akaike	-3.27*	-2.84*	-11.03***	-1.93	-1.56	-9.78***	-1.24	-3.88***
	Schwarz	-10.69***	-10.32***		-9.11***	-5.08***		-1.24	
CIN_t	Akaike	-3.09	-2.50	-6.68***	-1.06	-0.54	-4.43***	-1.18	-2.41**
	Schwarz	-3.09	-2.50		-1.19	-0.70		-1.13	
RPV_t	Akaike	-1.36	-1.09	-4.61***	-1.57	-0.93	-4.60***	-0.54	-1.01
	Schwarz	-1.36	-1.09		-1.73	-0.93		-0.54	
$CRPV_t$	Akaike	-1.33	-1.09	-3.45**	-0.35	-0.02	-1.90	1.10	0.10
	Schwarz	-2.31	-1.78		-0.95	-0.74		0.22	

Notes:*,**,*** denote rejection of the null at 10%, 5% and 1% level of significance. A Bartlett kernel-based estimator of the frequency zero spectrum is used for the Phillips Perron test.

On the other hand, we check for the existence of a unit root with structural breaks by applying the tests proposed by Vogelsang and Perron (1998). These tests allow us to distinguish two key properties: i) if the break affects the constant, the trend or both of them in the series, and ii) if the rupture impact on the variable is immediate (additional outlier) or gradual (innovational outlier). Taking into account the evolution of *IN* and *RPV*, we consider that additional outlier model must fit better to check structural breaks and unit root, because the entry into the euro affects *IN* and *RPV* once and for all. In turn, we select two models, one includes breaks in the constant and the trend, and the other one considers changes only in the trend.

Following Vogelsang and Perron (1998), testing for a unit root test in the additional outlier framework includes two steps. In the first one, the following equation is estimated:

$$y_t = u + \beta t + v^i DU_t + g^i DT_t + \varepsilon_t, \qquad \text{(A1)}$$

where y_t is the variable under study (in our case inflation and RPV), u is a constant, t is the trend, and DU_t and DT_t are dummies for the constant and the trend respectively. Three models can be distinguished: i) if i=A the break only affects the constant, and $g=0$, ii) i=C indicates a rupture in the trend, and then $v=0$, and iii) i=B corresponds to the case that the rupture is in both the constant and the trend. In turn, calling T_B the breakpoint, $DU_t=1$ and $DT_t=t-T_B$ if $t>T_B$, and zero otherwise.

In a second stage, and from the residuals of the regression of equation (A1), we estimate by OLS (A2) if i=A, B, and (A3) if i=C.

$$\varepsilon_t = \alpha\ \varepsilon^i{}_{t-1} + \sum_{j=0}^{k} DTB_{t-j} + \sum_{j=1}^{k} \Delta\varepsilon^i_{t-j} + u_t\ , \qquad \text{(A2)}$$

$$\varepsilon_t = \alpha\varepsilon^i_{t-1} + \sum_{j=1}^{k} \Delta\varepsilon^i_{t-j} + u_t \qquad ,$$

(A3)

where DTB =1 for t=T_{B+1} and 0 otherwise.

According to Vogelsang and Perron (1998), two data dependent methods can be applied to detect the breakpoints. The first one (method I) selects T_B that minimizes t_α (t-statistics corresponding to the estimated α in equations (A2) and (A3)). In this case, the choice of T_B corresponds to the break date which is most likely to reject the unit root hypothesis. The second method (method II) can be used for model A and B. In this case we pay attention to t_v and t_g (t-statistics associated to v (model A) or g (model B) in equation (A1)). We choose the breakpoint that maximizes (minimizes) the t-statistics when the direction of the break is known *a priori* to be positive (negative) or the absolute value of the t-statistics when the direction of the break is unknown. Once T_B is determined, the corresponding t_α in equation (A2) allows us to accept or reject unit root.

On the other hand, to choose the lag length k of $\varepsilon^i{}_{t-j}$ in (A2) and (A3) we apply two criteria. The first one consists of choosing a fixed value for k, we have considered k =5 (as in Vogelsang and Perron (1998)).The second one is based on selecting a value of k (k =k*) in such a way that in regressions (A2) and (A3) the coefficient corresponding to k* is significant, while it is not significant for k >k*.

Results of applying the above methodology to *IN*, *RPV*, *CIN* and *CRPV* are presented in Tables A3 y A4. These series show a change in the trend during the period, therefore in the paper we have taken into account the results obtained by model C. Nevertheless, we have also included results for model B. Trimming is slightly different in each case but in all of them the first twelve months and the last twenty four months have been removed. As can be seen from Table A3 (model C), the unit root is rejected only for *IN*. With model B results are not conclusive with respect to *IN*, *CIN* and *CRPV*. The unit root cannot be rejected in all cases only for *RPV*.

Table A3. Unit root tests with structural breaks. Method I

Model B: break in trend and constant									
Statistics		*IN* *k*=5	*IN* *k(t-sig)*	*CIN* *k*=5	*CIN* *k(t-sig)*	*RPV* *k*=5	*RPV* *k(t-sig)*	*CRPV* *k*=5	*CRPV* *k(t-sig)*
Min	T_B	1999.03	1997.08	1994.09	1995.03	1996.07	2000.12	2002.01	2002.01
t_α	t_α	-5.084**	-4.820*	-3.493	-4.82**	-3.908	-4.005	-6.396***	-5.008*
Model C: break in trend									
Statistics		*IN* *k*=5	*IN* *k(t-sig)*	*CIN* *k*=5	*CIN* *k(t-sig)*	*RPV* *k*=5	*RPV* *k(t-sig)*	*CRPV* *k*=5	*CRPV* *k(t-sig)*
Min	T_B	1997.07	1997.07	1997.08	1998.02	1997.08	1997.06	1999.01	1998.09
t_α	t_α	-4.748**	-4.070*	-3.052	-4.269	-3.708	-3.630	-3.643	-2.895

Notes: *,**,*** indicate significance at the 10%, 5% and 1% levels respectively. t_α: critical values in Vogelsang and Perron (1998). *k(t-sig):* the lag length *k* of ε^i_{t-j} has been selected (*k*=*k(t-sig)*) in such a way that in regressions (B2) and (B3) (for models B and C respectively) the coefficient corresponding to *k(t-sig)* is significant, while it is not significant for *k* >*k(t-sig)*.

Table A4. Unit root tests with structural breaks. Method II

		Statistics	*IN*	*CIN*	*RPV*	*CRPV*
Model B. Break in trend and constant	Max t_g	T_B	1997.07	1998.06	1998.02	1997.06
		t_g	1.859	3.283	18.783	11.742
		t_α (*k*=5)	-4.771	-3.009	-3.678	-3.643
		t_α (*k(t-sig)*)	-4.698	-4.269**	-3.556	-2.699
Model C: Break in trend	Max t_g	T_B	1997.05	1998.05	1998.05	1998.02
		t_g	1.840	3.270	18.949	10.451

Notes: *,**,*** indicate significance at the 10%, 5% and 1% levels respectively. t_α: critical values in Perron (1997). *k(t-sig):* the lag length *k* of ε^i_{t-j} has been selected (*k*=*k(t-sig)*) in such a way that, in regression (B2), the coefficient corresponding to *k(t-sig)* is significant, while it is not significant for *k* >*k(t-sig)*. Obviously for model C, max t_g gives some information about T_B but it cannot be used to test unit root.

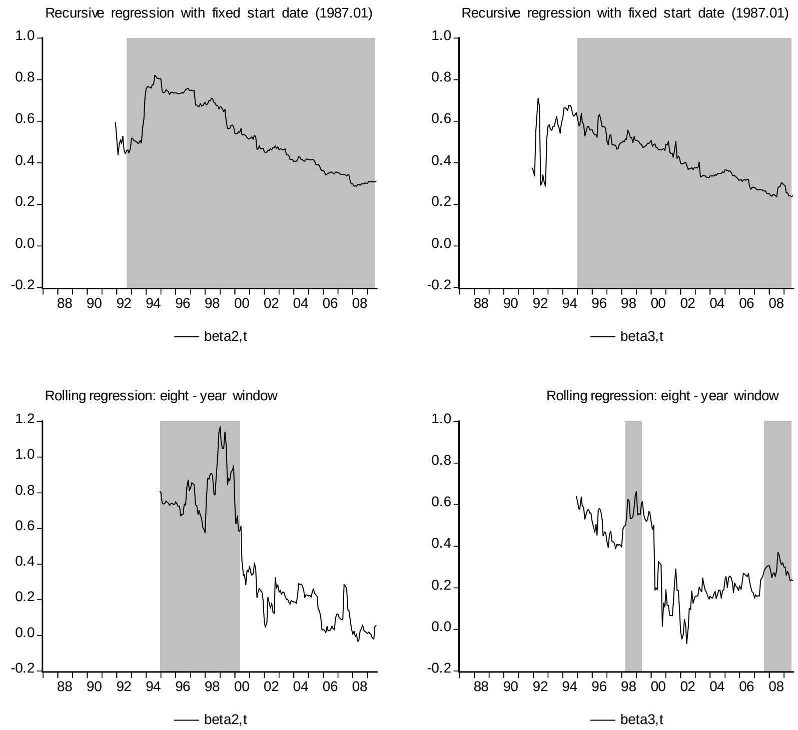
C. Rolling and recursive equations for unexpected inflation

We estimate the following equation for different window sizes:

$$RPV_t = \alpha_t + \beta_{0,t} EIN_t + \beta_{2,t} UIN_t^+ + \beta_{3,t} AUIN_t^- + \beta_{4,t} UN_t + \sum_{k=1}^{12} \lambda_{k,t} RPV_{t-k} + \varepsilon_t \cdot$$

Figure A1 presents the results for $\beta_{2,t}$ and $\beta_{3,t}$. As usual, recursive coefficients have been obtained by successive additions of one month to the 1987.01-1991.12 sub-sample and rolling regressions have been estimated for a window of 8 years. As can be seen from Figure A1, both coefficients decline during the period: $\beta_{2,t}$ seems to be significant in the pre-EMU stage and $\beta_{3,t}$ is more sensitive to the sample considered. Similar results are obtained for windows of 6, 10 and 12 years (they are available from authors upon request).

Figure A1. Recursive and rolling regressions for unexpected inflation



Note: the months for which the coefficients are significant are marked in grey lines (10% significance level). The number of the horizontal axis represent the ending month of each window.

References

Perron, Pierre (1997), Further evidence on breaking trend functions in macroeconomics variables, *Journal of Econometrics* **80**: 355–385.

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