DIVERGENT OPTIMAL INFLATION RATES IN EURO AREA COUNTRIES OR "DOES ONE SIZE FIT ALL?"

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Abstract

The aim of this paper is to derive the optimal inflation rate for the Euro Area (EA) countries from the relationship between aggregate inflation and relative price variability (RPV). In order to achieve this goal, we have utilized monthly data for the Harmonized Index of Consumer Prices between January 1997 and October 2010 for the first twelve EA countries and for the EA aggregate. In a first stage, parametric and semiparametric estimations allow us to find that the inflation-RPV relationship shows a U-shaped functional profile for the majority of the countries. In a second stage, within this benchmark and using both kinds of estimations, we obtain the optimal inflation rate defined as the one that minimizes RPV. Moreover, we test the sensitiveness of our results to the time period and, for semiparametric estimation, to the bandwidth selected.

For EA individual countries and for EA aggregate, it is formally shown that although the European Central Bank's "below but close to 2%" inflation target is (almost) optimal for the EA average, it is not close to the optimum inflation rate for most of the individual EA countries.

Keywords: Euro Area, monetary policy, relative price variability, optimal inflation.

JEL classification: E31, C23

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1. Introduction

Since the idea of a common currency for Europe was first introduced, the issue of homogeneity (or lack of) member country inflation rates has been constantly revisited in the academic literature. In particular, an issue that is often examined is whether there is a common optimal inflation rate across the Euro Area (EA) countries[1]. If the answer is negative then complications arise for the conduction of a common monetary policy, to the extent to question the rationale of the existence of a monetary union for the group of countries under examination.

There are many criteria for the determination of the optimal rate of inflation, such as the one that maximizes growth or minimizes unemployment. For example, Leigh (2009) analyses how the inflation rate impacted Japan's growth rates. Moreover, Blanchard *et al.* (2010) examine the relationship between growth and inflation, and argue that central banks should target a 4% inflation rate during periods of positive economic growth to allow for nominal rate decreases during recessions.

Following a particular strand of the literature, in this paper we focus solely on the optimal rate of inflation as the one that minimizes costs for consumers. The usual approach in this literature is to determine whether a link exists between Relative Price Variability (RPV) and aggregate inflation (IN). We shall denote this relationship by IN-RPV. If an increase of inflation leads to a dispersion of prices (RPV), then consumer search costs increase, thus a welfare loss occurs. Therefore, one may characterize the optimum inflation rate as the one that minimizes the RPV.

The theoretical literature usually finds (or it is *ad-hoc* assumed) that there is a monotonic positive IN-RPV relationship, eg. Hercowitz (1981) and Cukierman (1983). In this case, the optimal rate of inflation would be zero. However, empirical evidence does not confirm these findings. While earlier works concluded that there is a positive linear IN-RPV relationship (eg. Vining and Elwertowski, 1976; Parks, 1978), recent papers find evidence in favour of a non-linear relationship. On the one hand, Caglayan and Filiztekin (2003), Caraballo *et al.* (2006 and 2009) and Nautz and Scharff (2012) show that the nexus between IN and RPV depends on the inflationary context. On the other hand, Fielding and Mizen (2008) use non-parametric regression techniques for a long series of US expenditure data and obtain an optimal inflation rate of around 5%, while Bick and Nautz (2008) argue that the rate of inflation that minimizes RPV in the USA is in the range of 1.8%-2.8%. Choi (2010) and Caraballo and Dabús also find a U-shaped IN-RPV profile, the former for

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[1] For a review of the literature on this issue see Beck *et al.* (2009).

both the USA and Japan and the latter for Spain. The exact functional profile of the IN-RPV relationship has important implications for the design of monetary policy. A U-shaped relation could imply that the optimal inflation rate (i.e., the inflation rate that minimizes RPV) is non-zero and, thus, reducing the inflation rate beyond the minimum of the U-shaped function will result in welfare losses for consumers (Bruno and Easterly, 1998).

To investigate the IN-RPV relationship for the first twelve Euro Area (EA) countries and the Euro Area as a whole, we consider a data set for the period 1997-2010. Parametric and semiparametric methods are used to obtain the functional form and optimal inflation. Robustness studies are also conducted. More precisely, we focus on the sensitivity of results to the selected time period and to the choice of bandwidth for semiparametric method. They show that the qualitative results remain valid.

We find that for nine countries and for the EA the IN-RPV relationship is U-shaped, for Italy it is W-shaped, in Portugal it is monotonically decreasing, while a “bell-shaped” relation arises for Netherlands. For the nine countries where it is U-shaped, we calculate the optimal inflation, and we find three categories of countries: low, medium and high optimal inflation countries. In particular, (some) countries can be placed in one of these categories regardless the method used. Thus, the inflation rate that minimizes RPV differs across EA countries which creates challenges for the conduction of (the common) monetary policy.

The remainder of the paper is organized as follows. Section 2 describes the data and the variables. In Section 3 the optimal inflation rate for each country is obtained through the estimation of the IN-RPV relationship shape. Section 4 discusses if results are sensitive to the time period selected. Section 5 concludes.

2. Data and variables

To find the optimal inflation rate, we utilize monthly Harmonized Indices of Consumer Prices (HICP) as they have been constructed specifically to reflect pure inflation as they control for differences (or changes in) cross-country consumer behaviors.[2] Furthermore, as the ECB conducts a common monetary policy for the whole monetary union, it uses (targets) the EA HICP to assess price stability.

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[2] In the context of this paper HICPs are preferred to Consumer Price Indices (CPI), as the former are specifically designed for comparisons between EA countries.

All data are from Eurostat and cover the EA as a whole (changing composition), and the first twelve individual EA country for the period from January 1997 to October 2010 (monthly data)[3]: Austria (AT), Belgium (BE), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Portugal (PT), and Spain (ES).

The analysis is carried out for a 3 digit level disaggregation, i.e. 37 subcategories.[4] The inflation rate is calculated as the annual log-difference of the HICP. RPV is a measure of the non-uniformity of the variations of individual prices, relative to the average inflation rate. To obtain the RPV, a modified version of the coefficient of variation (CV) is implemented using the weighted sum of individual prices inflation rate. At time *t*, the *RPV* can be defined as follows:

$$RPV_t = \frac{\left(\sum_i w_{it} (IN_{it} - IN_t)^2 \right)^{1/2}}{\left| 1 + IN_t \right|} \tag{1}$$

where w_{it} is the weight of price *i* in the price index, IN_{it} the inflation rate of group *i*, and IN_t the overall inflation rate at time *t*. Expression (1) is preferred to the simple variance or standard deviation because it is not spuriously correlated with the mean of the distribution, that is, the inflation rate. Furthermore, this alternative can be defined when inflation is close to zero or in periods of deflation, which is important as the sample used includes countries with low rates of inflation (e.g. Germany). The traditional formula of CV would not be appropriate as it implies that when inflation is near zero, *RPV* tends to infinity.[5] Table 1 shows summary statistics on average inflation and RPV for each country.

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[3] Although Eurostat provides HICP data from 1995, there were missing observations for many countries. Therefore, our sample starts from 1997.

[4] See Appendix A for the subcategories of HCPI.

[5] This technical detail regarding the CV formula may drive the negative inflation-*RPV* relationship found in some studies (e.g. Reinsdorf, 1994 and Silver and Ioannidis, 2001).

TABLE 1. SUMMARY STATISTICS

	IN				RPV			
	Mean	**Max.**	**Min.**	**Std. Dev.**	**Mean**	**Max.**	**Min.**	**Std. Dev.**
EA	0.0186	0.0397	-0.0065	0.0077	0.0008	0.0014	0.0004	0.0002
AT	0.0162	0.0397	-0.0043	0.0082	0.0009	0.0023	0.0000	0.0003
BE	0.0190	0.0573	-0.0176	0.0116	0.0011	0.0026	0.0000	0.0005
DE	0.0144	0.0348	-0.0074	0.0078	0.0009	0.0021	0.0004	0.0003
ES	0.0263	0.0519	-0.0133	0.0120	0.0009	0.0019	0.0000	0.0003
FI	0.0167	0.0461	-0.0044	0.0098	0.0011	0.0019	0.0000	0.0003
FR	0.0162	0.0395	-0.0079	0.0085	0.0009	0.0014	0.0000	0.0003
GR	0.0343	0.0645	0.0069	0.0112	0.0011	0.0036	0.0000	0.0005
IE	0.0239	0.0587	-0.0305	0.0200	0.0013	0.0029	0.0008	0.0005
IT	0.0215	0.0415	-0.0009	0.0067	0.0008	0.0012	0.0004	0.0002
LU	0.0236	0.0564	-0.0150	0.0137	0.0010	0.0024	0.0000	0.0004
NL	0.0208	0.0531	-0.0014	0.0114	0.0045	0.0067	0.0000	0.0021
PT	0.0237	0.0501	-0.0181	0.0129	0.0009	0.0018	0.0000	0.0003

3. Estimating optimal inflation

Prior to obtain the optimal inflation, we investigate the form of the IN-RPV relationship. In general, we can define the relationship as follows:

$$RPV_t = g(IN_t) + \sum_{t=1}^{i} \lambda_i IN_{t-i} + \sum_{t=1}^{j} \delta_j RPV_{t-j} \qquad (2)$$

where $g(IN_t)$ captures the effect of inflation on RPV and thus determines the functional form of the IN-RPV relationship. The main goal of this paper is to estimate $g(IN_t)$ for all EA-12 countries and EA aggregate. This task is approached using various econometric techniques. At first, we use a parametric model where the $g(IN_t)$ function is a quadratic function. Afterwards, we proceed to complement the standard parametric estimation of the RPV function with a semiparametric model. This is done so as to eliminate any bias that would occur from (necessary) *ad-hoc* assumptions as to the functional form of the IN-RPV relationship.

3.1. Parametric regression analysis

In this section, $g(IN_t)$ in equation (2) is defined as a quadratic function, therefore our basic regression equation takes the following form:

$$RPV_t = \alpha + \beta_1 IN_t + \beta_2 IN_t^2 + \sum_{t=1}^{i} \lambda_i IN_{t-i} + \sum_{t=1}^{j} \delta_j RPV_{t-j} \qquad (3)$$

Equation (3) is estimated using OLS. [6] Based on the results of the Akaike criteria, the optimal lag lengths (i,j) for the EA are selected, which are used for all countries in order to make results comparable. Equation (3) is important to determine whether the functional form for each country is linear or quadratic. In particular, if we find that β_2 is not significant, then the IN-RPV relationship is linear with a slope given by β_1. However, if β_2 is significant and positive and β_1 is significant but negative, then the IN-RPV relationship exhibits a U-shape. In this case, the optimal rate of inflation (IN*) is the minimum point of the U-shaped fuction (the minimum rate for RPV). As Choi *et all* (2011) point out, the minimum point can be estimated as $IN^* = -\beta_1/(2\beta_2)$. The results from the OLS regression for each country are provided in Table 2.

TABLE 2. RESULTS OF OLS REGRESSIONS

	β_1	β_2	R^2		β_1	β_2	R^2
EA	-4.3175 (-1.5735)	166.3242^{*} (2.2750)	0.8914	**GR**	-52.5612^{***} (-2.7811)	805.2161^{***} (2.8548)	0.5041
AT	-6.3880 (-0.6916)	434.6639 (1.4181)	0.3575	**IE**	-3.6374^{**} (-1.9843)	34.9573 (0.8035)	0.7807
BE	-24.3886^{***} (-4.3191)	624.5275^{***} (4.8782)	0.7311	**IT**	-9.1393^{**} (-1.9883)	219.7503^{**} (2.1425)	0.7891
DE	-5.1125^{*} (-1.8103)	239.8897^{**} (2.4932)	0.8655	**LU**	-29.4916^{***} (-3.1647)	656.8223^{***} (3.4126)	0.6783
ES	-22.2329^{**} (-2.0162)	420.3528^{*} (1.9626)	0.5354	**NL**	7.0041 (0.1511)	-252.8303 (-0.3558)	0.8760
FI	-19.9654^{**} (-2.4620)	518.5233^{**} (2.6044)	0.6947	**PT**	-7.3132^{***} (-3.3034)	92.9132^{*} (1.9435)	0.6601
FR	-9.1405 (-1.6018)	433.7205^{**} (2.3728)	0.5670				

Notes: t-statistics in parenthesis. Asterisks ***, **, * denote that the coefficients are significant at 1%, 5% and 10% levels respectively.

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[6] The stationarity of all series was examined using the ADF test. The results are available upon request.

From Table 2 we can conclude that for the majority of countries the signs of the β_1 and β_2 are consistent with a U-shaped IN-RPV functional form at a 5% (or even 1%) significance level. However, for AT, IE and PT we have weak evidence for a U-shaped IN-RPV functional form as, although coefficients have the proper signs, β_2 is not significant at the 5% level. Furthermore, the signs of the coefficients for NL suggest that the IN-RPV relationship is “bell-shaped”, but they are clearly not significant.

For all countries, except NL, we will calculate the optimal inflation using the expression $IN^* = -\beta_1 / (2\beta_2)$. Figure 1 displays the results. From this Figure, we can separate the results into three categories: a) countries with low optimal inflation rates which are EA (0.0129), AT (0.00734), DE (0.01) and FR (0.01), b) countries with an optimal inflation rate around 2% which are BE (0.019), FI (0.019), IT (0.02), and LU (0.022), and finally c) countries with relatively high optimal inflation rates which are ES (0.027), GR (0.032), IE (0.05) and PT (0.039).

3.2. Semiparametric regression analysis

We proceed to estimate $g(IN_t)$ through a semiparametric approach, which combines the features of both parametric and nonparametric models. In particular, we estimate the following model:[7]

$$RPV_t = \theta_1 RPV_{t-1} + \theta_2 IN_{t-1} + g(IN_t) + \varepsilon_t \tag{4}$$

where $g(IN_t)$ is an unknown smooth differential function that attempts to capture the non-linear impact of inflation on RPV at time t. Therefore, the goal is to estimate $g(IN_t)$ in (4). The $g(IN_t)$ function is estimated semi-parametrically in two stages. In the first stage, the parameters λ_k are estimated from the regression equation:

$$RPV_t = \lambda_1 \overline{RPV}_{t-1} + \lambda_2 \overline{IN}_{t-1} + \eta_t \tag{5}$$

where $\overline{RPV}_{t-1}$ and $\overline{IN}_{t-1}$ are the residual series from a non-parametric regression of RPV_{t-1} and IN_{t-1} on IN_t respectively. In the second stage, the $g(IN_t)$ function is estimated non-parametrically from the regression:

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[7] This methodology is similar to that of Fielding and Mizen (2008), Caraballo and Dabús (2010) and Choi (2010).

$$\hat{\eta}_t = g\left(IN_t\right) + v_t \tag{6}$$

where $\hat{\eta} = RPV_t - \lambda_1 \overline{RPV}_{t-1} - \lambda_2 \overline{IN}_{t-1}$

In both stages, the regressions are estimated using kernel regressions which are non-parametric techniques that aim to find non-linear relationships between two random variables. In particular, the conditional expectation of random variables is estimated. For the purposes of this paper, the Nadaraya-Watson kernel regression estimator is implemented. As the results of non-parametric regression are very sensitive to the set value of the bandwidth parameter (b), which behaves as a smoothing parameter, this parameter is selected using a Mean Squared Forecast Error (MSFE) criterion. We have used an outlier-robust Epanechnikov kernel, which is the most common kernel function used in the relevant literature. Moreover, a number of authors note that it is not the choice of the kernel function that is important, but rather the choice of the bandwidth parameter. As a robustness exercise we have examined the sensitiveness of the results to the bandwidth parameter. The results are presented in a latter Section. The above methodology is applied for all countries except NL, given the results for this country obtained in above section.

We estimate $g(IN_t)$ for all countries. For Portugal this relationship seems to be decreasing, while Italy exhibit a W-shape function.[8] Therefore we have excluded both countries, and we continue our paper with nine countries and the EA. Having estimated $g(IN_t)$, the next step is to calculate the derivative of the $g(IN_t)$ function, as it captures the sensitivity of the *RPV* to marginal increases in inflation. If $g'(IN_t)>0$ ($g'(IN_t)<0$), then RPV is increasing (decreasing) with inflation, while the optimal inflation rate, i.e., the one that minimizes RPV, is given by $g'(IN_t)=0$. For our sample, we calculate the optimal inflation rates corresponding to the optimal bandwidth for the EA and to the optimal bandwidth for each country (Table 3).

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[8] $g(IN_t)$ results are presented in Appendix B.

TABLE 3. RESULTS FROM SEMIPARAMETRIC MODEL

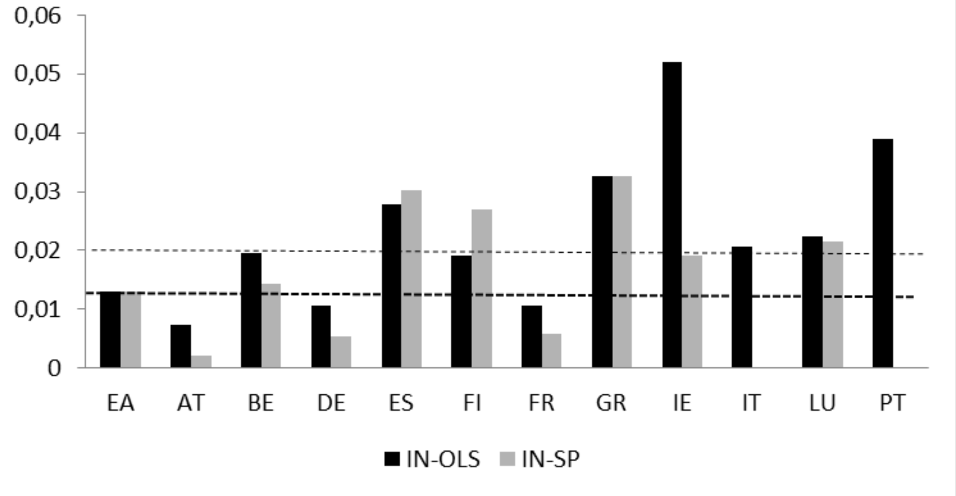
	IN-EA	IN*	MSFE-EA	b*	MSFE*
EA	0.0129		0.0309	0.0015	
AT	0.002	0.0019	0.0803	0.0009	0.0732
BE	0.0144	0.0142	0.0779	0.0009	0.0736
DE	0.0054	0.0054	0.0842	0.001	0.0838
ES	0.0303	0.0303	0.0387	0.0012	0.0375
FR	0.0058	0.0059	0.037	0.0013	0.0365
FI	0.0277	0.0284	0.0575	0.0009	0.0546
GR	0.0322	0.0327	0.1286	0.0009	0.1163
IE	0.0191	0.0186	0.0558	0.0018	0.0552
LU	0.0214	0.0149	0.0623	0.0012	0.0592

IN-EA: inflation rate that minimizes *RPV* using the optimal bandwidth obtained for the EA.
IN*: inflation rate that minimizes *RPV* using the optimal bandwidth for each country.
b*: optimal bandwidth for each country.
MSFE*: mean squared forecast error for optimal bandwidth for each country.
MSFE-EA: mean squared forecast error using the optimal bandwidth for EA.
MSFE is multiplied by 10^6.

Regarding the optimal inflation rate as reported in Table 3, there is a discrepancy among countries. The results show that the ECB’s “below, but close to 2%” target is appropriate for EA, Belgium, Ireland and Luxemburg. However, this target is too low for Finland, Greece and Spain and too high for Austria, France and Germany. Therefore, although the ECB’s target is indeed optimal for the EA as a whole, it may be hurtful for some countries. However, it is interesting to note that for the countries with higher than 2% optimal inflation rates (Finland, Greece and Spain), the actual average inflation rate for the period in question was very close (within a 0.5% deviation) to the optimal inflation rates. Furthermore, the actual average inflation rates for the countries with lower than 2% optimal inflation rates (Austria, Germany and France) were actually closer to the 2% target set by the ECB.

In Figure 1, we compare the results obtained with OLS and semiparametric estimations.

Figure 1. Optimal Inflation



Notes: IN-OLS and IN-SP denote the optimal inflation rates derived from OLS and semiparametric estimations respectively.

From the above Figure, it seems that there are significant differences between the two estimation methods. In particular, we find that in the low inflation countries (AT, DE and FR) the optimal inflation estimated using OLS are quite higher. This is consistent with the known problems that OLS estimation runs into when dealing with outliers. This thesis is reinforced by the result for IE, another outlier. Thus, one would expect that the semiparametric estimation would yield more accurate results.

As mentioned earlier, optimal inflation could be sensitive to both the selected bandwidth parameter and the time period under investigation. As a robustness test, in Figure 2, we examine the sensitiveness of optimal inflation to the selection of the bandwidth parameter in the semiparametric estimation. As can be seen, excluding very low bandwidth, the optimal inflation rates are very stable. Thus, our results are robust to the bandwidth parameter selected.

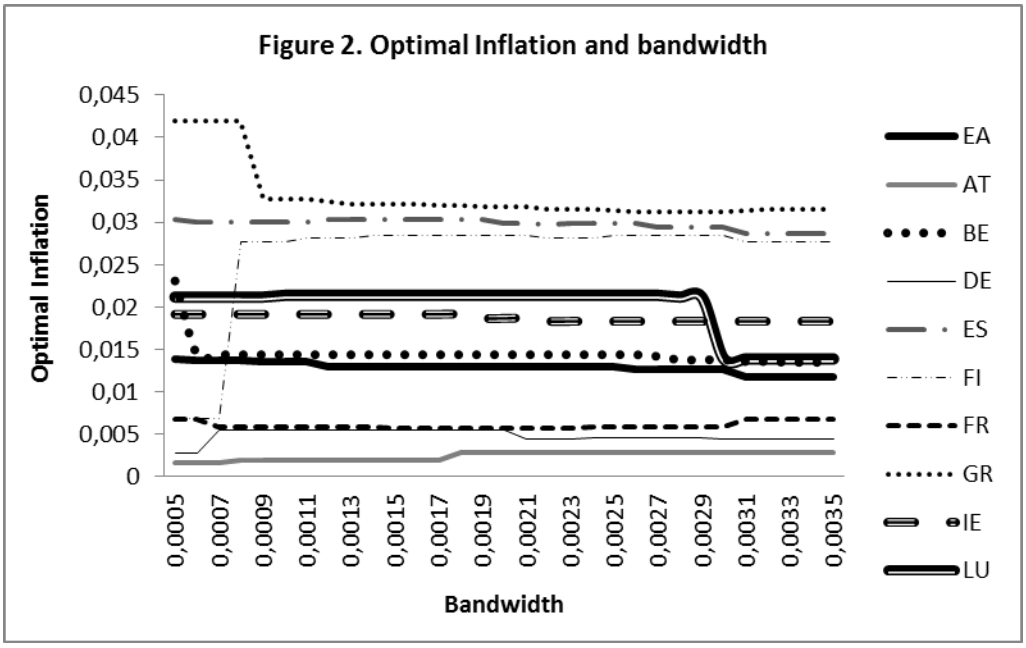


Figure 2. Optimal Inflation and bandwidth

Finally, we compare the parametric and semiparametric models (Table 4) and find that the significant parametric components of our semiparametric model are very similar to those in the quadratic model. In fact, Wald test cannot reject that the two coefficients are equal.

TABLE 4. COMPARISON OF PARAMETRIC AND SEMIPARAMETRIC MODELS

	EA	**AT**	**BE**	**DE**	**ES**
RPV_{t-1}	0.8898^{***} (29.2575)	0.4535^{***} (6.4787)	0.5751^{***} (9.6544)	0.9142^{***} (30.4466)	0.4775^{***} (7.0958)
$\overline{RPV}_{t-1}$	0.9603^{***} (2.7278)	0.4164^{*} (1.6566)	0.5844^{*} (1.7738)	0.9862^{***} (3.9391)	0.6159^{*} (1.8152)
Wald test H_0: $\delta_1 = \lambda_1$	0.0397	0.0202	0.0007	0.0814	0.1601
	FI	**FR**	**GR**	**IE**	**LU**
RPV_{t-1}	0.6998^{***} (13.9581)	0.5980^{***} (9.7423)	0.5239^{***} (7.5057)	0.7945^{***} (16.0572)	0.5816^{***} (11.0831)
$\overline{RPV}_{t-1}$	0.6689^{*} (1.9470)	0.5886^{*} (1.6506)	0.5560^{**} (2.1556)	0.8327^{**} (2.0406)	0.8010^{***} (2.9631)
Wald test H_0: $\delta_1 = \lambda_1$	0.0079	0.0006	0.0144	0.0086	0.6346

Notes: t-statistics in parenthesis. Asterisks ***, **, * denote that the coefficients are significant at 1%, 5% and 10% levels respectively. The statistics of the Wald test is distributed as a $\chi 2(1)$

4. Sensitiveness of optimal inflation to time period

Having previously shown that for the semiparametric estimation the qualitative results are robust to the changes in the bandwidth parameter, we conduct a further robustness exercise to test the sensitiveness of optimal inflation to the time period for both parametric and semiparametric estimations.

4.1. Parametric estimation

Regarding the parametric estimation, we estimate equation (3) for rolling samples for windows of six, seven, eight and nine years and derive the corresponding optimal inflation. Furthermore, we estimate recursive coefficients, starting with the sample 1997:01-2002:12 and adding a month each time, and again, we calculate the changes in optimal inflation.

Our robustness test relies on the β_2 coefficient. In particular, if β_2 is not significant then using Choi's expression for the calculation of the optimal inflation rate would not yield meaningful results. Therefore, in Table 5 we summarize the results for the β_2 coefficient for the various time periods in question. In particular, the numbers in Table 5 represent the ending year of each sample, for example for six-year window 2005:12 means that the β_2 coefficient is significant for the subsample 2000:01-2005:12. For a nine-year window, if in the Table we have 08:01-08:05, that means that β_2 is significant for the following samples 1999:02 to 2008:01, 1999:03 to 2008:02, 1999:04 to 2008:03, 1999:05 to 2008:04, 1999:06 to 2008:05.

It is evident from Table 5 that there is not a common pattern for all countries. Nor do we see structural breaks. Apparently, for most cases (excluding the two or three first years of the sample) the IN-RPV relationship is U-shaped.

TABLE 5. SENSITIVENESS OF OPTIMAL INFLATION TO THE TIME PERIOD

	SIX	SEVEN	EIGHT	NINE	RECURSIVE
EA	From 09:03	From 09:01	From 09:01	From 08:03	From 08:01
AT	07-07-07:10 09:06-09:10 From 10:06	From 09:06	From 09:06	08:01-08:05 From 09:06	08:01-08:07
BE	From 04:01	always	always	always	From 03:12
DE	07:06-08:06 From 09:07	07:09-08:07 From 09:07	08:03-08:07 From 09:03	07:11-08:07 From 09:07	From 07:10
ES	From 06:01	From 06:05	From 07:07	From 08:02	From 08:01
FI	From 04:03	From 04:03	always	always	From 04:03
FR	05:09-07:12 From 09:03	06:09-08:01 From 09:03	07:06-08:01 From 09:02	06:01-06:02 From 09:01	06:01-08:01 From 09:01
GR	02:12-04:02 08:02-10:08	03:12-05:02 06:06-07:05 From 08:10	04:12-05:05 06:06-07:05 From 08:12	05:12-10:03	always
IE	03:03-03:07 06:11-08:11	07:11-08:11 09:04-09:06	08:11-08:12	09:04-09:09	09:04-09:10
IT	07:02-07:12 From 09:06	Only 08:03 Only 08:10 From 09:06	08:07-08:12 09:06-09:10 From 09:12	07:10-07:12 From 08:07	08:07-08:08 From 09:05
LU	All except 06:10-08:12	All except 06:10-07:02, 07:05-08:12	All except 07:08-08:11	All except 08:07-08:11	always
PT	03:10-04:02 05:06-09:02	03:12-04:03 04:10-04:12 05:07-05:12 06:12-09:07	05:06-06:01 07:08-09:03	05:12-07:01 08:12-09:09	03:10-04:09 05:06-08:06 From 08:11

In Figure 3 we show how the optimal inflation rate varies over different time periods. In particular, the results for the whole period and the recursive methodology for EA (from 09:03), BE (from 04:01) and FI (from 04:03) are presented as the β_2 coefficient is significant for these countries for the relative time periods. For example, in Figure 3 optimal inflation in 2009:01 implies the optimal inflation calculated for the following samples: 2003:02-2009:01 (six year window), 2002:02-2009:01 (seven year window), 2001:02-2009:01 (eight year window), 2000:02-2009:01 (nine year window) and 1997:01-2009:01 for the recursive method.

Figure 4 displays the results for the optimal rate of inflation using recursive estimations for EA, BE, DE, ES, FI, GR, LU from 2007:01 (i.e., the first result for optimal inflation has been calculated for the sample 1997:01-2007:01).

Figure 3. Optimal inflation. Rolling and recursive estimations

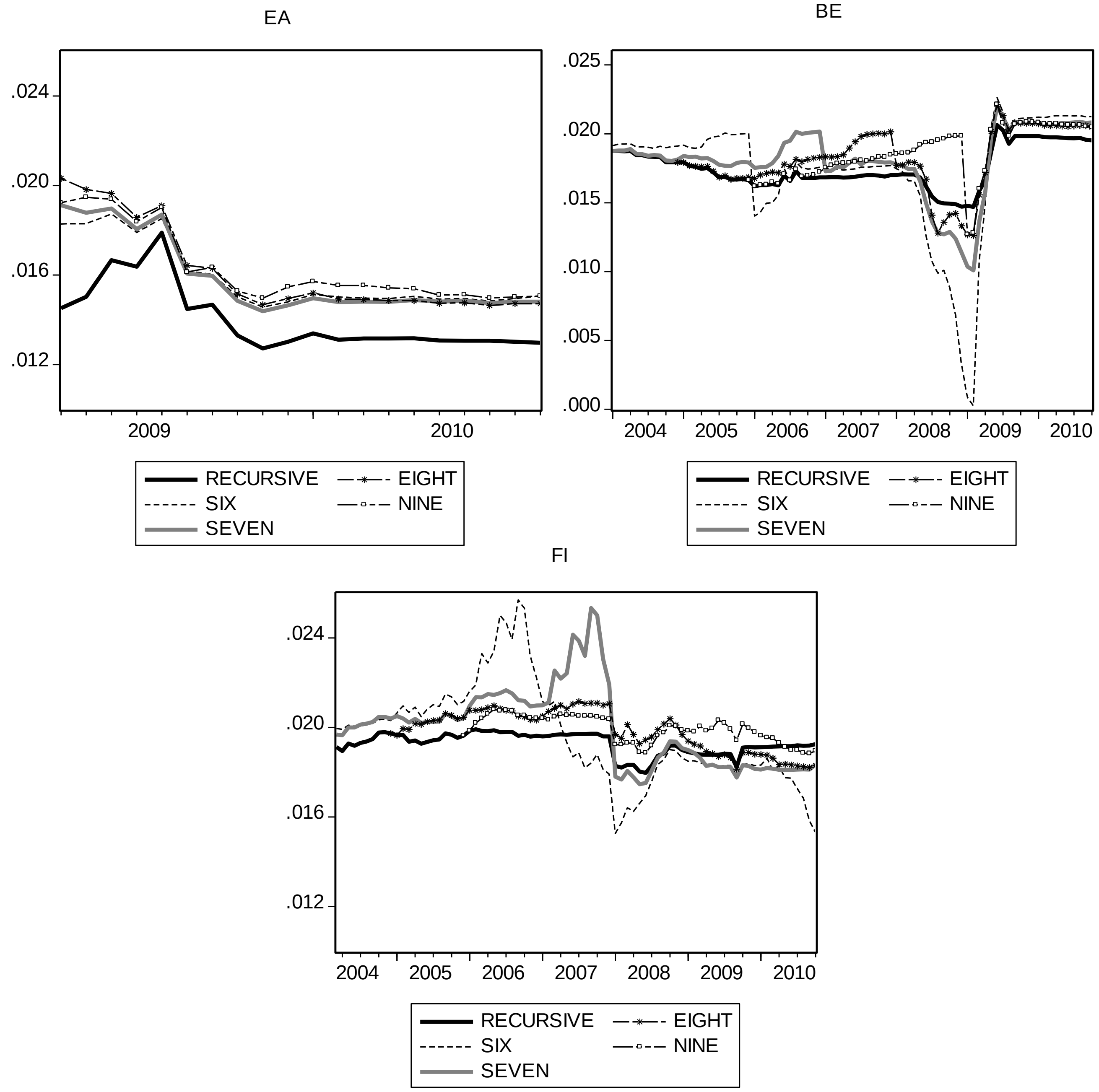
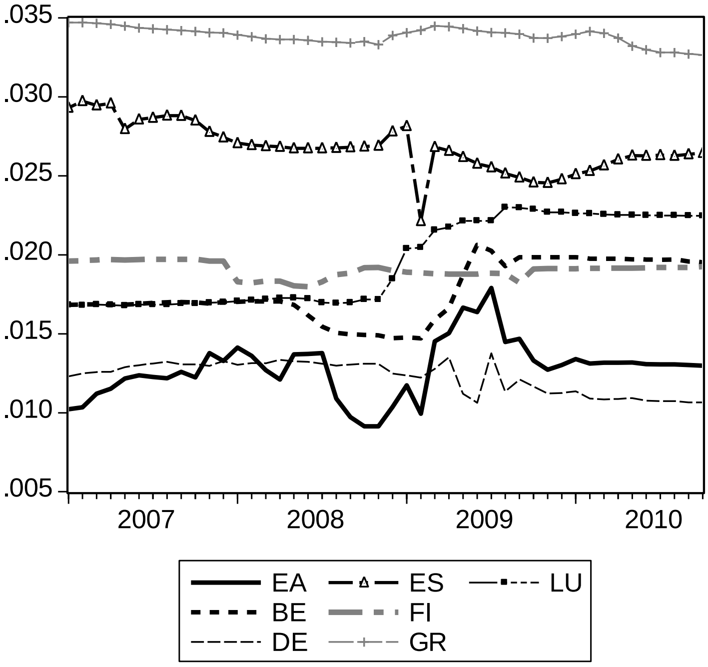


Figure 4. Optimal inflation. Recursive regressions

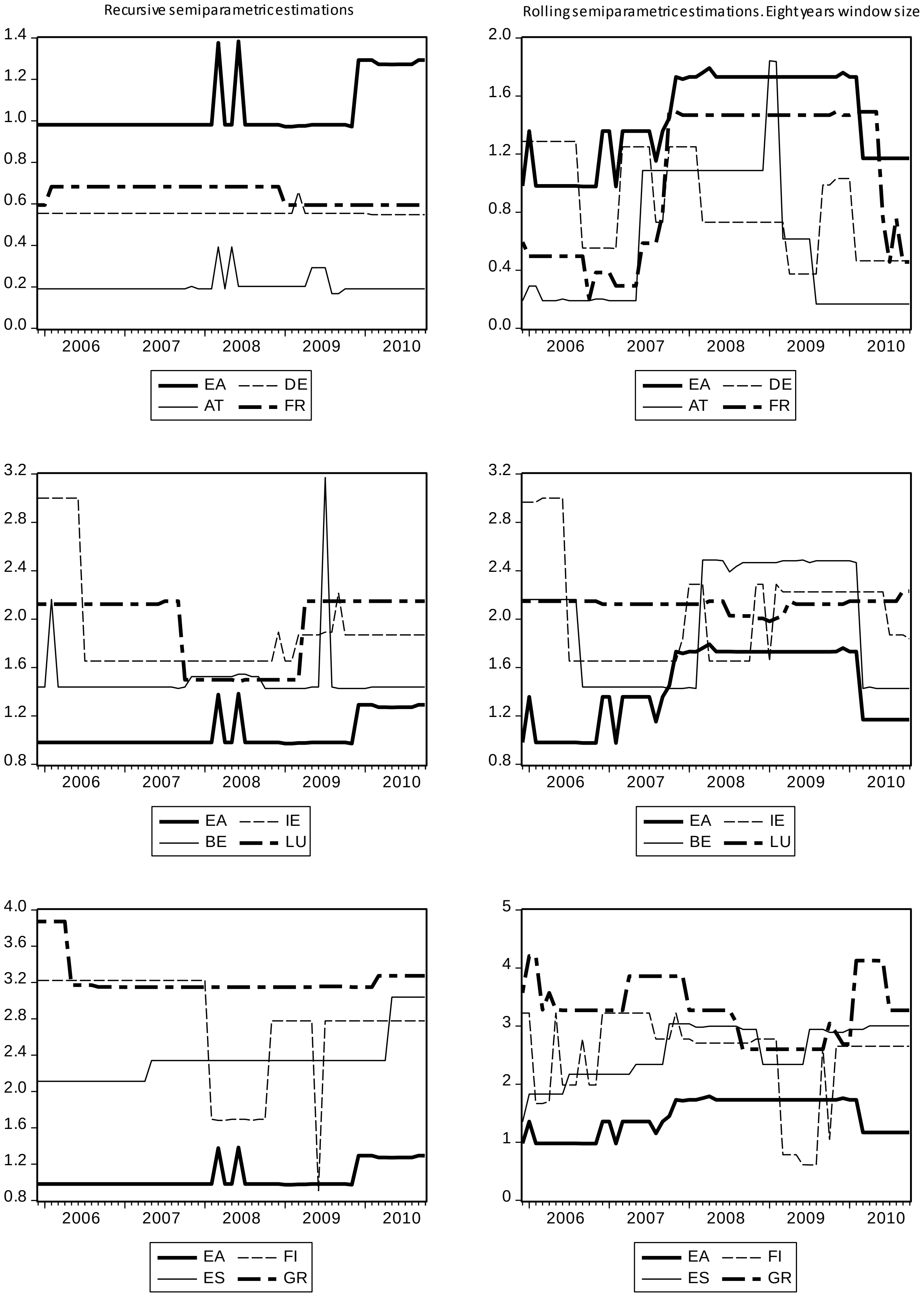


As before, we have high optimal inflation countries (ES and GR), medium ones (LU, FI and BE) while DE has a relatively low optimal inflation rate. The optimal inflation rate for the EA is also very low.

4.2. Semiparametric approach

This section analyses the sensitiveness of the derived optimal inflation rate when calculated using semiparametric methods. As before, we use rolling regressions for windows of different sizes and recursive regressions. The results are depicted in Figure 5 where the nine countries have been grouped into the three categories according to their (relative) inflation levels: low (AT, DE and FR), medium (BE, IE and LU) and high (ES, FI and GR). In particular, the estimations start from 2005:12, that is, the data for 2005:12 corresponds to the period 1997:01-2005:12. The graphs in the left column refer to results from the recursive estimation, while the graphs in the right column provide the results from rolling regressions for eight year windows, i.e. the first data corresponds to the estimation for the period 1998:01-2005:12. To make comparisons easier we have included the results for the EA in all graphs. From Figure 5 we can conclude that the optimal inflation rate is more sensitive to time periods than to bandwidth parameters, specially for fixed size windows, but the results differ across the three country groups.

Figure 5. Optimal inflation. Recursive and rolling semiparametric estimations



Note: the inflation rates are in percentage.

5. CONCLUSIONS

In this paper, we examined the IN-RPV relationship using both parametric and semi-parametric methods for the EA as a whole and individual member countries. For the majority of countries, we find that this relationship exhibits a U-shape and thus we can calculate the optimal inflation rate as the one that minimizes RPV. However, there are three outliers: NL, where the IN-RPV relationship exhibits a “bell-shape”; PT, where the relation is always decreasing and IT, where it shows a W-shape.

Based on the results, the countries in question can be split into three categories based on the optimal inflation rate: low (lower than 1.5%, AT, DE and FR), medium (1.5%-2.5%, BE, and LU) and high (over 2.5%, ES and GR). However, the derived optimal inflation rate for IE and FI depends on the method selected and they can be considered as countries with either medium or high optimal inflation rate. Robustness analysis show that the qualitative results are not dependent on the bandwidth parameter selection for the semiparametric or the time period selected.

For the EA as a whole, the optimal inflation rate is near 2% which would imply that the ECB's (official) target is indeed optimal. However, as previously shown, this inflation rate is not optimal for the majority of the EA member countries. In this sense, our results indicate a possible need to revise the EA-wide common inflation target goal.

A possible extension of the analysis developed in this paper is the choice of a method to select the appropriate length of the time period for calculating the optimal inflation rate.

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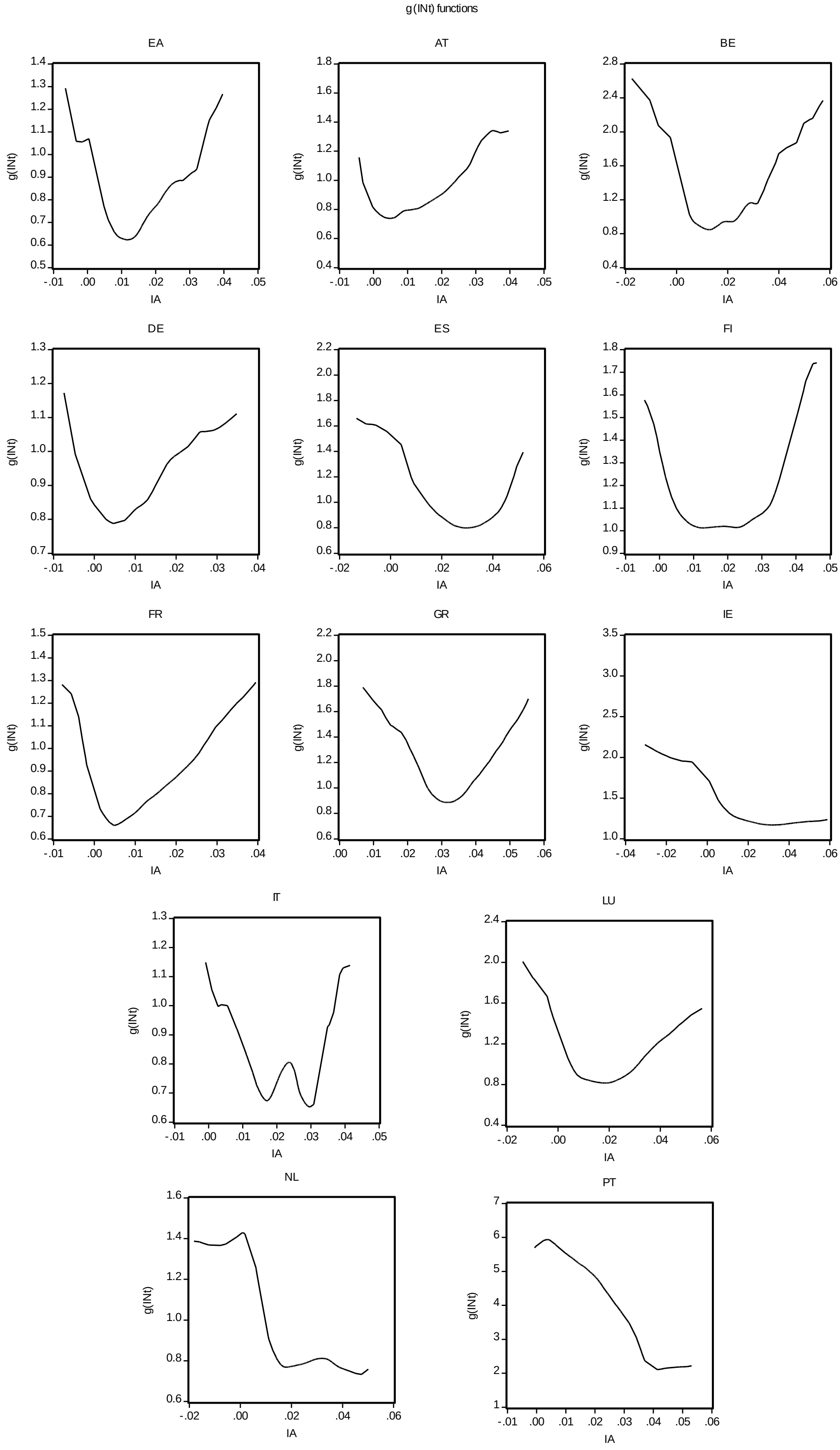
APPENDIX A

COICOP 3 digit subcategories

CP011	Food
CP012	Non-alcoholic beverages
CP021	Alcoholic beverages
CP022	Tobacco
CP031	Clothing
CP032	Footwear including repair
CP041	Actual rentals for housing
CP043	Maintenance and repair of the dwelling
CP044	Water supply and miscellaneous services relating to the dwelling
CP045	Electricity, gas and other fuels
CP051	Furniture and furnishings, carpets and other floor coverings
CP052	Household textiles
CP053	Household appliances
CP054	Glassware, tableware and household utensils
CP055	Tools and equipment for house and garden
CP056	Goods and services for routine household maintenance
CP061	Medical products, appliances and equipment
CP062	Out-patient services
CP063	Hospital services
CP071	Purchase of vehicles
CP072	Operation of personal transport equipment
CP073	Transport services
CP081	Postal services
CP082	Telephone and telefax equipment
CP083	Telephone and telefax services
CP091	Audio-visual, photographic and information processing equipment
CP092	Other major durables for recreation and culture
CP093	Other recreational items and equipment, gardens and pets
CP094	Recreational and cultural services
CP095	Newspapers, books and stationery
CP096	Package holidays
CP121	Personal care
CP123	Personal effects n.e.c.
CP124	Social protection
CP125	Insurance
CP126	Financial services n.e.c.
CP127	Other services n.e.c.

Note: COICOP = United Nations Classification of individual consumption by purpose
Source: Eurostat

APPENDIX B



Note: the inflation rates are in percentage.