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Does the ECB consider the persistence of inflation differentials?

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Abstract

We assess the relevance of the monetary policy of the ECB in the context of persistent inflation differentials among euro area members and ask whether it takes into account this structural difference. Our results reveal that the ECB has adopted an appropriate monetary policy rule to prevent low inflation countries from a deflationary spiral, but that it did not consider the negative effects induced as a consequence on the countries with a higher inflation rate. This raises the question of the ECB monetary policy responsibility in the triggering and the worsening of the euro debt crisis.

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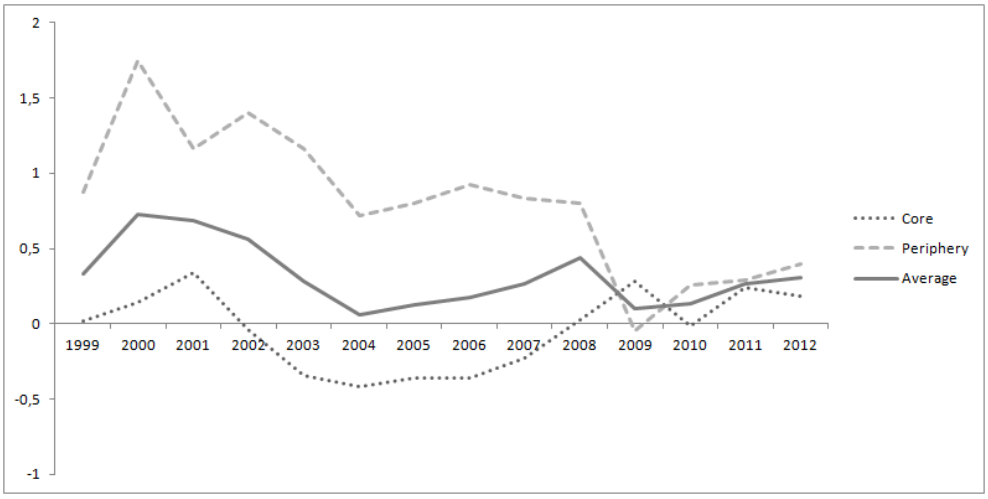
1 Introduction

Despite the convergence criteria required to join the euro area, major differences in the economic fundamentals of the participating countries persist, one of them being inflation differentials. Such differentials can be desirable if they are implied by convergence processes, but they may induce negative effects if the inflation dispersion is amplified by cyclical and structural differences, creating asymmetries across countries and heterogeneous adjustments to macroeconomic shocks. One of these negative effects, in particular, may come from a reluctance of the ECB to implement a restrictive policy if the dispersion of cyclical positions and inflation rates is too large.
Using *ex post* measures of Consumer Price Index (CPI), we calculate annual inflation differentials for each country (x) in the euro area from 1999 until 2012, by subtracting the value of its CPI with the average CPI of the euro area ($ID_{x,t} = CPI_{x,t} - CPI_{average,t}$).

Figure 1: Inflation differentials in the Core and the Periphery of Europe



Source: Eurostat

Figure 1 above shows the evolution of inflation differentials in the countries of the Core[1] and the Periphery[2] of Europe[3]. Inflation differentials remain high the first years of the EMU, although they have decreased when the euro debt crisis was at its peak, they are rising since 2010. It happens that the position of the countries has slightly changed through the years, more precisely, Germany and Austria are the less inflationary countries over the period, while Spain, Greece and Ireland are above the union's average rate of inflation.
Empirical studies suggest that inflation differentials in the euro area are not different in size from the ones observed in the United States. However, the dispersion is more persistent in the EMU (Gregoriou et al., 2007; Zdárek and Aldasoro, 2009; Giannellis, 2010). This

[1]Austria, Belgium, Finland, France, Germany, Italy and Netherlands.
[2]Cyprus, Estonia, Greece, Malta, Portugal, Slovakia, Slovenia, Ireland, Luxembourg and Spain.
[3]The median of the mean of inflation differentials of all countries of the euro area serves as a benchmark to distinguish between countries of the Core and the Periphery.

is due to the adjustment process between regions which takes more time in the euro area than in the United States. The presence of wage and price rigidities and the weakness of inter-regional smoothing mechanisms (e.g. migration and labor mobility) make the adjustment mechanism to last longer, which potentially creates further distortions. The average consumer price duration in the euro area is between four and five quarters, while in the United States it is equal to two quarters (ECB, 2005).

As a consequence, among the EMU members, countries with low inflation rates experience a higher real interest rate, while countries with higher inflation rate have a persistently lower real interest rate. Thus, monetary policy is too loose compared to the one that Peripheral countries would implement if they could still conduct independent monetary policy (Dubois et al, 2007; Drometer et al., 2012). Given that the euro debt crisis has particularly affected these countries, it may be argued that discrepancies in inflation rate have fed important imbalances in the euro area and that they should be taken into account for its sustainability. In this paper, we emphasize the relevance of the monetary policy of the ECB for countries from the Periphery in particular, unlike the empirical literature (Fendel and Frenkel, 2009; Licheron, 2009) which has focused on the consequences of the policy rule adopted by the ECB, only for countries of the Core of Europe.

This paper first details the determinants of inflation differentials in the euro area and discusses the implications of a single monetary policy in an heterogeneous context. Second, it estimates an extended Taylor rule with additional inflation dispersion variables, to check if the ECB takes into account inflation differentials in its decision making process, and how it deals with the low real interest rate countries from the Periphery are facing.

2 Explanation of inflation differentials in a monetary union

The theoretical literature proposes three main hypotheses to explain inflation differentials in a monetary union: the Balassa-Samuelson effect, cyclical divergences, and structural differences.

The Balassa-Samuelson effect is decribed as part of a process of convergence. Countries with low income are in a catching-up process and have a strong productivity growth in the tradable sector, while productivity growth in the non-tradable sector remains stable. Therefore, if there is a gap in labor productivity between the tradable and non-tradable sectors, and if labor mobility between sectors is high, there is an increase in the inflation rate. The Balassa-Samuelson effect expresses the fact that price pressure emerges in the non-tradable sector. MacDonald and Wójcik (2008) emphasize that if inflation dispersion arises from the Balassa-Samuelson effect, it can be considered as an "equilibrium productivity driven phenomenon". They find that productivity shocks are likely to have a less benign effect on inflation differentials in the euro area.

Hofmann and Remsperger (2005), Égert (2007) and Andersson et al. (2009) find no support for this effect in the euro area. They argue that inflation differentials are mainly driven by differences in cyclical positions and fluctuations in the exchange rate. In particular, the Balassa-Samuelson effect represents a small share in the persistence of inflation for countries like Germany, France and Austria.

Focusing on cyclical divergences, Angeloni and Ehrmann (2007) find evidence of demand

and output shocks as the main cause behind inflation differentials. They suggest that the move to stage three of the EMU process for countries with a higher inflation rate caused a decrease of their real interest rate. These countries experienced an increase in domestic demand that puts a high pressure on prices for non-tradable goods. On the other hand, Altissimo et al. (2010) show that asymmetric demand shocks driven by government purchases are an important source of consumer price dispersion as well.
Finally, structural differences that contribute to the persistence of inflation dispersion can come from several sources. Household's preferences[4], fiscal policy (e.g. by modifying the wage mechanism), and the different exposure to exchange rate fluctuations can act as a transmission channel of inflation dispersion. If countries from the monetary union have a different composition of extra-union trade, movements in the exchange rate play an important role by importing inflation from non member-countries. Empirical studies show that countries with a high degree of openness tend to have an important part of their inflation imported (Zdárek and Aldasoro, 2009).
Therefore, it is essential to assess the behavior of the ECB given these persistent asymmetries. For that purpose, we use an augmented forward looking Taylor rule.

3 The Taylor rule

The Taylor rule has become a popular tool for evaluating monetary policy. The initial aim was to describe the monetary policy of the Federal Reserve in the U.S. and concluded to the following formulation:

$$i_t^* = r + \pi_t + \beta(\pi_t - \pi^*) + \gamma y_t \tag{1}$$

where i_t^* is the policy interest rate, r the equilibrium real rate[5], π_t the rate of inflation, π^* the inflation target and y_t the output gap.
Taylor (1993) estimated the value of β and γ, the relative weights associated by the central bank to inflation and output stabilization, respectively, to be equal to 0.5 for the Fed:

$$i_t^* = r + \pi_t + 0.5(\pi_t - \pi^*) + 0.5y_t = (r - 0.5\pi^*) + 1.5\pi_t + 0.5y_t \tag{2}$$

According to Svensson (1999), this rule is the optimal reaction function for a central bank with a backward-looking model. However, a successful stabilization policy needs to be forward-looking. The augmented Taylor rule with forward-looking specification was proposed by Clarida et al. (2000) within a New Keynesian framework. This allows to take into account the prospective behavior of central bankers. Currently considered as an important tool for evaluating the monetary policy, it takes the following form:

$$i_t^* = r + \beta(E_t[\pi_{t+k}] - \pi^*) + \gamma E_t[y_{t+q}] \tag{3}$$

where E_t[-] is the expectation operator conditional on all the information available at time t.

[4]Household's preferences may be different across countries, and different shares in consumption of goods and services can worsen inflation differentials. This is known as the composition effect (ECB, 2005).

[5]Taylor (1993) defined the real interest rate as the difference between the nominal interest rate and the inflation rate.

Moreover, it is considered necessary for the central bank to smooth the variability of its interest rate through time as abrupt changes could induce troubles in financial markets (Woodford, 2003). Hence, the actual short-term nominal interest rate has to be modeled as a weighted average of the lagged interest rate and the policy interest rate:

$$i_t = \rho i_{t-1} + (1-\rho) i_t^* \tag{4}$$

where ρ measures the degree of interest rate smoothing.
If we substitute the eq.3 in the eq.4, we obtain:

$$i_t = \rho i_{t-1} + (1-\rho) r + (1-\rho)\beta(E_t[\pi_{avg,t+k}] - \pi^*) + (1-\rho)\gamma E_t[y_{avg,t+k}] \tag{5}$$

where $\pi_{avg,t+k}$ and $y_{avg,t+k}$ are respectively the average of the expected inflation rate and the expected output gap of the euro area[6], π^* corresponds to the inflation objective set by the ECB (2%).
We also test additional monetary policy rules with variables $\pi_{max,t+k}$ and $\pi_{min,t+k}$, which are the maximum and the minimum expected inflation rate in the euro area.

$$i_t = \rho i_{t-1} + (1-\rho) r + (1-\rho)\delta E_t[\pi_{max,t+k} - \pi^*] + (1-\rho)\eta E_t[\pi_{min,t+k} - \pi^*] + (1-\rho)\gamma E_t[y_{avg,t+k}] \tag{6}$$

where δ and η represent the response of the ECB when coping with an increase of the expected maximum inflation rate and the minimum inflation rate respectively.

4 Empirical estimation

The quarterly data used to estimate the Taylor rule cover the period 1999-2012. The interest rate variable is proxied by the three-month Eonia. The inflation rate is measured by the HICP, the output gap variable is captured by real GDP. Given the relative short time span, we do not consider the possible problem of unit roots in the time series (Levin et al., 2002)[7]. Given that central bankers have prospective behaviors, we use forecasts data. The use of forecasts data seems more reliable as the monetary policy needs some lags to be effective, i.e. it takes several quarters for a policy change to have its full effects on the real economy and actual inflation rates, we follow the literature and consider 6 lags for the expected inflation rate and 6 lags for the expected output gap ($k = 6$). However, as forward-looking variables may be correlated with the error term, we must instrument these variables. We use a constant and the lagged independent variables as instruments. We also consider the lags of some instruments that the ECB may consider in its monetary policy:
-The money growth M3, as the monetary condition in the euro area is explicitly considered as one pillar by the ECB to set its strategy. We use the quarterly percentage change of M3 in the euro area.
-The exchange rate variable is also important, as the ECB targets "long-run inflation", a

[6]We assume that each country is represented equally inside the Governing Council, this implies that each country receives the same weight. This also refers to the so-called "one country, one vote" principle.

[7]For robustness purposes, we test the null hypothesis of non stationarity of our regressors with the ADF test and use first differences in case the null hypothesis is not rejected. The estimations deliver qualitatively the same results.

measure of inflation adjusted to remove effects of exchange rate movements for the open economies in the euro area. Exchange rate variable is measured by the quarterly growth rate of the nominal dollar exchange rate with the euro.

We use the General Method of Moments (GMM) estimator, as it accounts for endogeneity biases and non-spherical errors (Bohl and Siklos, 2009). The condition for the validity of the instruments is their exogeneity with respect to the central bank decisions, hence, their uncorrelatedness with the disturbances. Given that we have more instruments than parameters to estimate, we make a Hansen-Sargan test on over-identifying restrictions (Shea, 1997). The instruments appear to be robust as the null hypothesis of the validity of instruments cannot be rejected[8]. Moreover, as it has been shown that the use of weak instruments can lead to substantial biases, Stock and Yogo (2002) propose a test based on the F-test value to identify the weak instruments. Following the results obtained, the instruments seem to be highly relevant.

The forecasts data (inflation rate and output gap) are extracted from the European Economy publication from the Directorate General for Economic and Financial Affairs (ECFIN) of the European Commission. The interest rate, the exchange rate and the monetary aggregate M3 are extracted from the Eurostat database.

4.1 Full sample results

Table 1 below presents the results of the GMM regression for the period 1999-2012.

Table 1: GMM estimation for the period 1999-2012

Explanatory variable	**Parameter**	**(1)**	**(2)**	**(3)**	**(4)**
c		0.47	-0.43	0.01	-0.27
		(0.27)*	(0.05)***	(0.13)	(0.17)
i_{t-1}	ρ	0.77	0.85	0.87	0.89
		(0.05)***	(0.02)***	(0.02)***	(0.02)***
$E_t[\pi_{avg,t+6} - \pi^*]$	β	1.05	-	-	-
		(0.22)***			
$E_t[y_{t+6}]$	γ	0.13	0.99	0.81	1.13
		(0.35)	(0.09)***	(0.17)***	(0.17)***
$E_t[\pi_{max,t+6} - \pi^*]$	δ	-	0.14	-	0.006
			(0.03)***		(0.04)
$E_t[\pi_{min,t+6} - \pi^*]$	η	-	-	0.18	0.11
				(0.03)***	(0.05)**
No. of observations		52	52	52	52
J-statistic (ρ value)		0.62	0.63	0.67	0.54

GMM estimates */**/*** denote significance at the 10%, 5% and 1% level, standard errors in parenthesis.
Note that we use lags 0 to 3 of the instrumental variables, except for column (1) for which lags 1 to 3 is used.

[8]Results available upon request.

The results of the GMM estimation show that the smoothing parameter ρ has a high value in the four columns, it lies around 0.80 and is highly significant. This means that the ECB smooths the change of its interest rate, possibly to prevent volatility in financial markets.
In the first column (1), the value of the parameter β linked to the inflation gap is slightly higher than 1, i.e. the so-called Taylor principle is fulfilled: the ECB moves the interest rate to accommodate changes in inflation and increase it sufficiently to keep the real interest rate from declining. Concerning the output gap (structural parameter γ), its low and insignificant value reveals that the ECB might not follow an "output stabilization objective", but rather tries to boost the industrial production when considering the average inflation rate in its monetary policy.
In the second column (2), even if the parameter (δ) linked to the maximum expected inflation rate is positive and significant at the 1% level, its value below 1 means that the maximum inflation rate does not serves as a benchmark for preventing a decline of the real interest rate, hence, it reflects the ECB's lack of consideration for the negative effects that a relatively high inflation induces for countries from the Periphery. An increase of the maximum expected inflation rate in the euro area does lead to a rise of the interest rate, but not with a fully proportional reaction in order to thwart this increase and the effects that can emerge from it. Therefore, the real interest rate of countries from the Periphery decreases significantly. This result confirms the weight put by the ECB on the fear of deflation expressed for some countries[9] (ECB, 2003), i.e. this may have impeded the ECB to adapt its monetary policy rule in order to deal with the low real interest rate that countries with a higher inflation rate are facing since the launch of the single currency.
Turning now to the third column (3), The estimation yields parameter values that broadly confirm previous empirical findings (Licheron, 2009). The reaction of the ECB to expected deviations of inflation or output from their target is more limited, since the smoothing parameter ρ is higher (0.87). The implied η coefficient, associated to inflation stabilization, is lower than unity, suggesting that the Taylor principle does not hold. This result reflects the reluctance of the ECB to raise its interest rate when the inflation rate is already low, since it may lead low-inflation countries to a deflation spiral, this obviously refers to the ECB's "fear of deflation". Thus, it seems that the ECB is more hesitant to increase its interest rate when the minimum inflation rate is already low.
Overall, column (4) confirms the relevance of the preceding observations and the statements made by the ECB about the fear of pushing one or several countries into deflation.
To give further robustness to the first findings, we estimate the same regressions for the subperiods 1999-2007 and 2007-2012 in order to get rid of the consequences of the accommodating monetary policy that followed the euro debt crisis.

4.2 Estimation results for the subperiods 1999-2007 and 2007-2012

Table 2 and 3 below presents the results of the GMM regression for the subperiods 1999-2007 and 2007-2012 respectively.

[9]Germany, Austria, The Netherlands and Finland.

Table 2: GMM estimation for the subperiod 1999-2007

Explanatory variable	**Parameter**	**(1)**	**(2)**	**(3)**	**(4)**
c		-0.23	-0.35	-0.25	-0.43
		(0.11)**	(0.15)**	(0.11)**	(0.22)*
i_{t-1}	ρ	0.89	0.94	0.94	0.97
		(0.02)***	(0.02)***	(0.02)***	(0.02)***
$E_t[\pi_{avg,t+6} - \pi^*]$	β	0.27	-	-	-
		(0.08)***			
$E_t[y_{t+6}]$	γ	0.73	0.65	0.66	0.56
		(0.15)***	(0.16)***	(0.18)***	(0.24)**
$E_t[\pi_{max,t+6} - \pi^*]$	δ	-	0.05		0.08
			(0.04)		(0.05)
$E_t[\pi_{min,t+6} - \pi^*]$	η	-	-	0.02	0.01
				(0.01)*	(0.01)
No. of observations		34	34	34	34
J-statistic (ρ value)		0.72	0.75	0.72	0.42

GMM estimates */**/*** denote significance at the 10%, 5% and 1% level, standard errors in parenthesis.
Note that we use lags 0 to 2 of the instrumental variables.

Table 3: GMM estimation for the subperiod 2007-2012

Explanatory variable	**Parameter**	**(1)**	**(2)**	**(3)**	**(4)**
c		0.52	-0.56	0.14	0.52
		(0.67)	(0.23)**	(0.15)	(0.36)
i_{t-1}	ρ	0.77	0.75	0.91	0.83
		(0.09)***	(0.10)***	(0.01)***	(0.03)***
$E_t[\pi_{avg,t+6} - \pi^*]$	β	1.07	-	-	-
		(0.49)**			
$E_t[y_{t+6}]$	γ	0.12	0.41	0.57	0.10
		(1.07)	(0.87)	(0.20)***	(0.23)
$E_t[\pi_{max,t+6} - \pi^*]$	δ	-	1.06		0.16
			(0.41)**		(0.19)
$E_t[\pi_{min,t+6} - \pi^*]$	η	-	-	0.16	0.36
				(0.05)***	(0.12)***
No. of observations		19	19	19	19
J-statistic (ρ value)		0.41	0.68	0.72	0.67

GMM estimates */**/*** denote significance at the 10%, 5% and 1% level, standard errors in parenthesis.
Note that we use lags 0 to 1 of the instrumental variables, except for columns (1) and (2), for which only the last lag is used.

Overall, the results reveal that in the first years of the EMU, the ECB was more concerned about output stabilization (the coefficient γ is significant in all columns of Table 2), while after the economic slowdown of 2008, the estimation shows that the ECB has mainly focused on inflation, relaxing its "output stabilization objective", probably to promote economic recovery in the euro area.

More specifically, the results of the first subperiod (1999-2007) are qualitatively in line with those reached in the first estimation, although the significance is clearly weaker for some coefficients, i.e. the parameter δ associated to the maximum expected inflation rate is no longer significant. While the parameter η is significant at the 10% level in column (3). The minimum inflation rate seems to influence the ECB interest-rate setting, suggesting that the ECB may have tried not to push low-inflation countries towards deflation during this period. Hence, the main conclusions are similar to those reached in the first regression. However, the results of the second subperiod (2007-2012) reveal that the ECB may have changed its priorities following the euro debt crisis. The coefficient δ is now above 1, which means that the ECB, when considering the maximum expected inflation rate in its policy rule, raises its interest rate to curb the decrease of the real rate of countries from the Periphery. But as column (4) shows, when considering the extrema, only the coefficient linked to the minimum inflation rate remains significant.

Therefore, and according the results obtained, the ECB cares about the countries that are threatened by a deflationary spiral and takes the appropriate policy rule to prevent it, but this policy implies a monetary laxity towards countries facing a higher inflation rate, and this is especially true for the period before the economic crunch. The financial turmoil that countries from the Periphery are facing since 2008 may clearly be a consequence of the monetary laxity of the first years of the EMU.

5 Conclusion

The results of this paper reveal a monetary policy trade-off for the ECB. Given the unique interest rate applied for structurally different countries and the fear expressed by the ECB of pushing low inflation countries into a deflation spiral, the adoption of the single currency has provided countries from the Periphery of Europe a persistent low real interest rate. Coupled with the credibility gain of being members of the euro area, this low real interest rate probably reduced the opportunity cost for these countries to increase their debt ratio, thus, feeding the imbalances between member countries in the EMU. Therefore, the euro debt crisis may partially be a consequence of the monetary policy rule adopted by the ECB in the first years of EMU, as a consequence of the persistent inflation differentials. Hence, it is crucial for the sustainability of the euro area that the ECB uses the appropriate policy tools to reduce the discrepancies between member states, and to reconsider its "reluctance" of implementing a restrictive policy when inflation divergence is high.

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