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Nominal Uncertainty and Inflation: The Role of European Union Membership

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Abstract

Using a GARCH model we provide evidence that higher inflation uncertainty leads to higher inflation in the new European Union (EU) member states and candidate countries only prior to EU accession. During EU accession and entry inflation uncertainty has no effect on mean inflation. This result supports the consideration of policy regime shifts in assessing the nominal uncertainty-average inflation relationship.

Keywords: Inflation; Inflation uncertainty; EU membership; GARCH

JEL Classification: C22; E31

1. Introduction

The relationship between nominal uncertainty and inflation has received substantial attention in the last two decades (see Grier and Perry, 1998; Fountas, 2001; Bredin and Fountas, 2009; Daal et al., 2005; Chen et al., 2008; Thornton, 2008). The issue, however, of how could this relationship be influenced in the presence of policy regime shifts has not been considered.[1] This paper addresses this issue by investigating the causal impact of inflation uncertainty on average inflation for the new member states and candidate

[1] A notable recent exception is Caporale and Kontonikas (2009) who examine the effect of inflation on short-run and steady-state inflation uncertainty in the pre- and post-Euro periods of 12 European Monetary Union member states during 1973-2004.

countries of the European Union (EU) by assessing the effect before and after EU accession. Given that upon accession to the EU, member states are obliged to pursue price stability as their primary objective of monetary policy (Ecofin, 2000), this policy regime shift may influence the way inflation uncertainty impacts upon inflation.

The impact of inflation uncertainty on inflation has been modelled by Cukierman and Meltzer (1986) in a game-theoretic model of central bank behavior according to which higher inflation uncertainty raises the average inflation rate. Using the Barro-Gordon model, where agents face uncertainty about both the rate of money supply growth (and hence inflation) and the policy-maker's objective function, they show that an increase in uncertainty about money growth and inflation raises the optimal average inflation rate because it provides an incentive to the policymaker to create an inflation surprise in order to stimulate output growth. Thus the lack of a commitment mechanism to control the inflation rate produces an inflationary bias in equilibrium. By contrast, Holland (1995) argues that inflation uncertainty has a negative impact on the inflation rate owing to the central bank's stabilizing policy. With an independent central bank and a clear commitment to long-run price stability, monetary authorities when faced with more inflation uncertainty apply tight monetary policy, and hence reduce average inflation, in order to minimize the real costs of inflation uncertainty.

According to both these studies, the commitment of monetary authorities to price stability is essential for the sign of the effect running from inflation uncertainty to inflation. Given that EU accession offers a commitment mechanism for controlling the inflation rate, we use the timing of the EU admission process to test for the sign of the effect. One would expect the effect to be potentially positive before EU accession when a commitment mechanism against inflationary biases may not be in place and then, at the very least, to diminish in size as a country progresses through the EU accession stages. Our empirical findings corroborate this intuition as we offer strong evidence in favor of the Cukierman-Meltzer hypothesis prior to EU accession but a largely zero effect during EU accession and entry for the large majority of the countries that underwent this transition. The rest of the paper is outlined as follows. Section 2 describes the data and the model, section 3 presents the results, and section 4 offers our conclusions.

2. Data and Methodology

We use seasonally adjusted data of the monthly consumer price index (CPI) for the twelve new member and two candidate states of the EU.[2] Inflation is defined as the annualized monthly difference in the logarithm of the CPI [$\pi_t = log(CPI_t/CPI_{t-1})*1200$]. The source is the International Financial Statistics of the IMF. Summary statistics for the series are given in Table 1 with the significant Ljung-Box statistics of the squared deviations of the inflation rate indicating the existence of ARCH effects. Unit root tests (based on ADF and Phillips-Perron) with an intercept and a deterministic linear trend indicate stationarity in first differences of the log of CPI (i.e. inflation) for all countries at 1% significance level (not reported).

A GARCH-in-mean (GARCH-M) model has been widely used to test the Cukierman-Meltzer and Holland hypotheses (see Grier et al., 2004).[3] To capture the causal impact of inflation uncertainty on inflation and its potential difference during the EU accession period, we augment a simple GARCH-M model with (up to) four EU-related dummy variables. These enter multiplicatively to the volatility variable and represent the periods before the country embarks upon negotiations for entry into the EU, the beginning of the negotiations (stage 1), the conclusion of the negotiations (stage 2), and after which admission has been granted (stage 3).[4]

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[2] The new member states are Bulgaria, Cyprus, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Rep., and Slovenia while Croatia and Turkey are candidate countries. Note that Macedonia FYR even though a candidate for EU accession since 2005, as it submitted its membership application in 2004, is not officially a candidate country as EU accession negotiations have not yet began. On the other hand, Iceland has only recently (July 2009) applied for EU membership. The data cover different periods depending on availability with the shortest time period applying to Bulgaria (1998:1 – 2010:2) and the longest to Malta (1957:1-2010:2) – see Table 1 for details.

[3] An alternative approach is to use a two-step methodology where in the first step one estimates GARCH models to generate a measure of inflation uncertainty and in the second carry out Granger causality tests (see Grier and Perry, 1998). Pagan (1984) however criticizes this two-step procedure for its misspecifications due to the use of generated variables from the first stage as regressors in the second stage. It follows then that the simultaneous conditional mean and variance estimation within a GARCH-M model is more efficient than a two-step approach. For this reason we opt to use this technique.

[4] The dates for each stage are available at the EU website http://europa.eu/abc/history and are as follows. All new member states except Bulgaria and Romania began their negotiations in March of 1998, concluded

$$\pi_t = \phi_0 + \sum_{i=1}^{k} \phi_i \pi_{t-i} + \sum_{n=1}^{4} \psi_n (h_t * dum_n) + \varepsilon_t;\ E(\varepsilon_t / I_{t-1}) = 0;\ \text{Var}(\varepsilon_t / I_{t-1}) = \sigma_t^2, \quad (1)$$

$$\sigma_t^2 = \omega_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (2)$$

where π_t is the rate of inflation, ϕ_i (i=1,…,k) describes the significance of lagged inflation and ψ_n (n=1,2,3,4) represents the effects of inflation uncertainty on average inflation at each of the four periods.[5] dum_1 denotes the pre-negotiations period, dum_2 stage 1 of negotiations, dum_3 stage 2 of negotiations, and, finally, dum_4 stage 3 of EU acceptance. An estimated positive (negative) and significant ψ_n is interpreted as evidence in favor of the Cukierman-Meltzer (Holland) argument. Restricted versions of the model (where inflation uncertainty is assumed to have a uniform effect on average inflation and where the effect for stages 1-3 is considered to be invariant) are also estimated. Finally, ω_0, α_1 and β_1 satisfy the restrictions of the GARCH specification and I_{t-1} is the information set available at time t-1.[6]

3. Results

As our goal is to test for the impact of nominal uncertainty on average inflation in the fourteen newly EU-affiliated countries, we focus our attention on the statistical significance and signs of ψ_n (n=1,2,3,4). Table 2 presents the estimation results of the three model specifications described by equations (1) and (2). Panel A reports the findings of the restricted model where we do not distinguish for separate effects of nominal uncertainty related to the EU admission process. Panels B and C do take into account this process, first by assuming that all three stages of the accession process bear

their negotiations in December of 2002, and became full members in May of 2004. For Bulgaria and Romania the related dates are December of 1999, April of 2005, and January of 2007 respectively. For the candidate countries of Croatia and Turkey the admission process is in stage 1 as of October 2005.

[5] The lag order is defined using the Schwartz Information Criterion. Maximum lag order is set to 12.

[6] We have also experimented with a model where the EU-related dummies (dum_n) were directly incorporated in equation (1) on top of the interaction terms to control for possible misspecification bias as EU accession may have had a direct effect on mean inflation. The estimation revealed that none of the dummies had a statistically significant effect on mean inflation justifying the use of the parsimonious model in equation (1). Results are available upon request.

the same effect on inflation (Panel B) and then by considering each stages' marginal impact (Panel C).

Panel A illustrates the uniform effect of inflation uncertainty on mean inflation to be positive for five of the countries (Croatia, Hungary, Lithuania, Slovenia, Turkey), thereby offering weak support to the Cukierman-Meltzer hypothesis. For most of the countries there does not seem to be any statistically significant effect running from nominal uncertainty to inflation. Support of this positive effect has been largely established in the literature for a wide number of countries in the G7 (Grier and Perry, 1998), the EU-15 (Bredin and Fountas, 2009), East Asia (Chen et al., 2008), and the ASEAN-5 (Jiranyakul and Opiela, 2010).

The estimation of the model presented in Panel A, however, may suffer from a misspecification bias as it ignores the "EU effect", namely the change in policy regime these countries underwent as part of their accession process and admission to the EU. As upon accession to the EU, member states are required to pursue price stability as their main objective of monetary policy, their negotiation and admission periods could have affected the impact of inflation uncertainty on inflation. This likelihood is explored in Panel B where we make no distinction for the potentially different effect of each of the three accession stages.

Now we obtain a different picture compared to Panel A as the Cukierman-Meltzer hypothesis is substantiated in eleven of the fourteen countries (exceptions are Bulgaria, Cyprus and Malta) during the pre-EU accession period. During EU negotiations and entry the positive effect is supported only for Croatia and the Slovak Republic, while the sign switches to negative for Poland in favor of the Holland hypothesis. For the rest of the eleven countries, EU accession bears no effect of inflation uncertainty on inflation corroborating the presence of an EU effect. This nonlinear impact of inflation uncertainty on mean inflation is further supported by a likelihood ratio (LR) test of coefficient equivalence before and after EU accession.[7]

Panel C takes the argument a step further and examines whether each stage of the admission process leads to a dissimilar effect of nominal uncertainty on inflation. This is shown to be the case only for Poland and the Slovak Republic where in the first the effect remains negative for each of the three stages and in the second the smaller positive impact is restricted in stage 2 of the process. Other than these, there is no evidence of separate effects at each stage of the admission process.[8] The standardized residual diagnostic tests at the bottom of the table suggest that the model is well specified.

4. Conclusions

This study examines the causal impact of inflation uncertainty on inflation for the new EU member states and candidate countries using a GARCH-M model. The innovation lies in the use of dummy variables related to the dates of EU accession to capture the existence of non-linear effects in this relationship. Once we control for this 'EU effect', we find evidence that inflation uncertainty increases inflation in the majority of the countries in the pre-EU accession period but bears no effect during EU accession and entry. Our findings corroborate the importance of controlling for shifts in (monetary) policy regimes.

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[7] Even for the two countries for which the effect remains positive (Croatia and Slovak Rep.), it is statistically smaller in magnitude upon EU admission.
[8] Results are robust to the exclusion of the period after which the Euro has been introduced as the national currency in Cyprus and Malta (January 2008), the Slovak Rep. (January 2009), and Slovenia (January 2007).

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Table 1
Summary statistics for consumer price inflation

	Bulgaria	*Croatia*	*Cyprus*	*Czech Rep.*	*Estonia*	*Hungary*	*Latvia*	*Lithuania*	*Malta*	*Poland*	*Romania*	*Slovak Rep.*	*Slovenia*	*Turkey*
Mean	5.736	3.386	3.286	4.679	7.966	11.292	7.313	23.426	3.091	30.720	39.795	6.484	10.123	38.635
Median	5.314	2.899	3.081	3.898	5.571	8.939	5.545	4.880	3.044	8.555	23.204	5.734	6.707	41.688
Maximum	37.148	19.948	22.185	31.051	89.003	49.819	32.596	499.412	89.277	569.428	280.974	60.945	127.287	219.436
Minimum	-25.117	-16.967	-14.771	-7.243	-10.453	-23.806	-7.598	-10.017	-70.147	-1369.400	-103.070	-11.335	-9.893	-42.454
Std. Dev.	9.205	5.150	6.151	5.262	11.134	10.105	8.140	66.905	9.913	133.759	53.507	6.845	17.064	29.195
Skewness	0.223	0.179	0.131	1.196	2.993	0.851	0.887	4.858	0.754	-3.323	1.949	2.929	4.704	0.998
Kurtosis	5.145	4.518	3.325	7.352	17.985	4.453	3.556	29.314	18.204	51.104	7.868	22.767	29.459	7.356
LB^2	40.57	21.48	82.70	82.04	88.11	895.58	662.96	228.00	201.19	81.80	239.46	57.90	241.54	185.07
	(0.000)	(0.044)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Period	1998:1-2010:2	1994:1-2010:3	1988:1-2010:1	1993:1-2010:3	1994:1-2010:2	1988:1-2010:2	1994:1-2010:2	1992:5-2010:3	1957:1-2010:2	1988:1-2010:2	1991:5-2010:2	1993:1-2010:2	1991:12-2010:2	1986m1-2010m3

Notes: LB^2 is the Ljung-Box test for serial correlation in the squared deviations of the inflation rate from its sample mean, where the 12^{th} order test statistic is reported (results are qualitatively the same when we use the 4^{th} order). Values in parenthesis are p-values.

Table 2

Estimates of inflation uncertainty on mean inflation

	Bulgaria	*Croatia*	*Cyprus*	*Czech Rep.*	*Estonia*	*Hungary*	*Latvia*	*Lithuania*	*Malta*	*Poland*	*Romania*	*Slovak Rep.*	*Slovenia*	*Turkey*
Panel A														
ψ uniform	-0.914	**0.860**	0.061	0.213	0.286	**0.761**	0.478	**0.559**	0.017	-0.110	0.238	0.249	**0.900**	**0.479**
	(0.234)	**(0.007)**	(0.430)	(0.330)	(0.195)	**(0.012)**	(0.110)	**(0.053)**	(0.448)	(0.155)	(0.106)	(0.117)	**(0.049)**	**(0.026)**
Log-likelihood	-518.40	-574.62	-844.67	-586.37	-602.47	-1185.45	-576.84	-666.50	-2131.76	-800.19	-846.07	-610.85	-657.44	-1222.81
Panel B														
ψ_1	-0.752	**0.907**	0.060	**1.531**	**1.082**	**0.627**	**0.651**	**0.535**	-0.043	**0.667**	**0.239**	**1.166**	**0.814**	**0.483**
	(0.462)	**(0.003)**	(0.431)	**(0.039)**	**(0.000)**	**(0.029)**	**(0.074)**	**(0.049)**	(0.395)	**(0.002)**	**(0.099)**	**(0.001)**	**(0.048)**	**(0.022)**
ψ_{2-4} uniform	0.503	**0.690**	-0.186	0.318	0.124	0.438	0.394	0.119	-0.130	**-0.369**	0.303	**0.405**	0.306	0.221
	(0.475)	**(0.023)**	(0.307)	(0.354)	(0.327)	(0.274)	(0.182)	(0.381)	(0.310)	**(0.028)**	(0.163)	**(0.042)**	(0.279)	(0.236)
Log-likelihood	-517.37	-571.60	-842.77	-574.28	-594.22	-1183.47	-574.06	-664.44	-2131.50	-796.55	-844.63	-605.41	-653.34	-1220.85
LR test of $\psi_1 = \psi_{2-4}$	2.06	6.04	3.80	24.18	16.50	3.96	5.56	4.12	0.52	7.28	2.88	10.88	8.20	3.92
	(0.151)	(0.014)	(0.051)	(0.000)	(0.000)	(0.047)	(0.018)	(0.042)	(0.471)	(0.007)	(0.090)	(0.001)	(0.004)	(0.048)
Panel C														
ψ_1	-0.910	**0.907**	0.058	**1.437**	**1.065**	**0.558**	**0.559**	**0.490**	-0.059	**0.716**	**0.354**	**1.155**	**0.824**	**0.483**
	(0.332)	**(0.003)**	(0.431)	**(0.048)**	**(0.000)**	**(0.045)**	**(0.085)**	**(0.044)**	(0.362)	**(0.000)**	**(0.052)**	**(0.001)**	**(0.042)**	**(0.022)**
ψ_2	-0.764	**0.690**	-0.149	0.253	0.129	0.449	0.090	-0.123	-0.197	**-0.287**	0.371	0.315	0.557	0.221
	(0.352)	**(0.023)**	(0.332)	(0.374)	(0.347)	(0.244)	(0.441)	(0.370)	(0.249)	**(0.073)**	(0.130)	(0.126)	(0.147)	(0.236)
ψ_3	-0.681		-0.147	0.136	-0.187	0.427	0.285	-0.098	-0.059	**-0.677**	0.171	**0.625**	0.184	
	(0.370)	-	(0.355)	(0.439)	(0.320)	(0.277)	(0.320)	(0.419)	(0.427)	**(0.019)**	(0.359)	**(0.015)**	(0.386)	-
ψ_4	-0.718		-0.232	0.199	0.087	0.251	0.301	0.162	-0.140	**-0.609**	-0.085	0.330	0.050	
	(0.358)	-	(0.287)	(0.403)	(0.380)	(0.337)	(0.258)	(0.319)	(0.291)	**(0.005)**	(0.428)	(0.118)	(0.462)	-
Log-likelihood	-516.54	-571.60	-841.00	-574.18	-593.44	-1182.15	-573.49	-662.96	-2131.33	-792.86	-842.45	-601.70	-649.68	-1220.85
LR test of $\psi_2 = \psi_3 = \psi_4$	1.66		3.54	0.20	1.56	2.64	1.14	2.96	0.34	7.38	4.36	7.42	7.32	
	(0.436)	-	(0.170)	(0.905)	(0.458)	(0.267)	(0.566)	(0.228)	(0.844)	(0.025)	(0.113)	(0.024)	(0.026)	-
Diagnostics														
LB(4): p-value	0.832	0.216	0.118	0.967	0.442	0.165	0.622	0.854	0.745	0.114	0.123	0.111	0.250	0.296
$LB(4)^2$: p-value	0.762	0.816	0.110	0.620	0.739	0.666	0.636	0.920	0.744	0.855	0.983	0.106	0.976	1.000
LB(12): p-value	0.158	0.113	0.827	0.962	0.361	0.107	0.890	0.280	0.569	0.050	0.141	0.182	0.343	0.084
$LB(12)^2$: p-value	0.975	0.498	0.756	0.627	0.160	0.847	0.858	0.986	0.574	0.667	0.207	0.207	0.866	0.999
LM(1): p-value	0.709	0.132	0.723	0.357	0.188	0.920	0.073	0.982	0.993	0.843	0.221	0.963	0.551	0.999

Notes: p-values in parenthesis. Coefficients in bold type represent significance at least at the 10% level. LR is the likelihood ratio test for $\psi_1 = \psi_{2-4}$ of Chi-square(1) (critical value at 5% significance level is 3.84). LR tests for $\psi_2 = \psi_3 = \psi_4$ of Chi-square(1) (critical value for 5% significance level is 5.99). LB (.) and $LB(.)^2$ are the Ljung–Box statistics for 4^{th} and 12^{th} order serial correlation in the residuals and squared residuals respectively. LM(1) is Engle's LM test statistic of Chi-square(1) testing for remaining ARCH effects.