Inflation and Unemployment, new insights during the EMU accession

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Abstract

In the process of EU integration, toward the EA accession, we try to understand, how changes in exchange rate regime, attributed to the switch through the ERM-II and to the EA accession, influence the dynamic between inflation and unemployment, i.e., shock on the Phillips curve coefficient. We look at a panel of countries, in the CEECs over the last twenty years, using a recent work from McLeay and Tenreyro (2020), to clarify the impact of loosing the monetary autonomy. Being under a pegged regime is not associated with a flattened Phillips curve. However, after the EA accession, the Phillips curve coefficient becomes not significant. This result is confirmed, looking at other small EA countries; while "economic leaders" tend to maintain a significant trade-off between inflation and unemployment, inside the EA.

Keywords:

Phillips curve; European Monetary Union; Panel.

JEL codes:

C33, E32, E52.

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The usual disclaimers apply.

1 Introduction

During Summer 2020, Bulgaria and Croatia engaged in the ERM-II as the *last step* before entering the Euro area (EA). For at least two years, theses two countries are engaged in a convergence process; they have to maintain the exchange rate closed to the pivot, defined by the time of their ERM-II entry. [1]

Entering the EA is followed by the loss of the monetary policy autonomy. According to Jorda et al. (2018), the Phillips curve is an interesting empirical way to assess the monetary policy counterfactual. In light of the Phillips curve, we expect such a shock to provoke changes in the existing link between the nominal and the real economy.

For a decade, unemployment and inflation rates, in the CEECs, tend to converge to low level. [2] The transition of the CEECs, toward market economies were initially hit by huge pressure on both inflation and unemployment. A quarter of century later, inflation rates seems to be under control. However, the relatively high economic recovery, observed in the CEECs, in the most recent years, after the economic and sovereign debt crisis, is expected to lead to inflationary pressure. By the same time, some of the CEECs, namely Baltic states, Slovenia and Slovakia entered the EA. They switch from different exchange rate regimes, toward the loss of their monetary autonomy.

1. According to the July, 10th 2020 Press release, the central rate of the Bulgarian lev is set at 1 euro = 1.95583 leva and the central rate of the Croatian kuna is set at 1 euro = 7.53450 kuna. A standard fluctuation band is set at plus or minus 15 percent around the central rate. Bulgaria unilaterally decided to maintain during the overall ERM-II period a currency board regime.

2. This is specifically the case in Czech Republic, Hungary and Poland; to a lesser extent in Bulgaria, Croatia and Romania where the HICP index in the last years is on a higher trend.

In the context of the EU, where the EA, as a monetary union, is characterized, by a single monetary policy, we question whether we observe a significant Phillips curve in peripheral countries. As the EA monetary policy reacts to the global EA labour market, does the EA accession represent a shock to explain potential change, in the inflation/unemployment behaviours?

To answer this question, we refer to recent work, on the Phillips curve, from McLeay and Tenreyro (2020) and Jorda et al. (2018), using a panel approach to tackle the identification strategy issues. According to McLeay and Tenreyro (2020), to justify the panel dimension, the central bank, from a monetary union, uses weighted average of the different "regions". Following Jorda et al. (2018), small open economies with fixed exchange rate regime import the monetary policy. Based on this identification strategy, we are able to consider the CEECs, in the ERM-II and in the EA, within a panel dimension.

To our knowledge, there is a scarce literature, on the impact of the EA accession process, regarding the monetary policy transmission toward the real economy. Even if the Phillips curve, in itself, represents more a result of monetary policy counterfactual than a monetary tool, the evaluation of the inflation/unemployment relationship may help policymakers, in small open economies to apprehend how monetary institution may influence their own decision.

Under the usual New Keynesian Phillips Curve (NKPC) à la Coibion and Gorodnickenko (2015) and McLeay and Tenreyro (2020), we use quarterly data on inflation and unemployment, to detail the Phillips curve, in different group of countries from inside the EU-28. Drawing a comparison between sub-periods and

sub-groups, we found a significant Phillips curve coefficient in the EA; even in the CEECs, while they belong to the ERM-II. However, their EA accession seems to be accompanied by the loss of both monetary autonomy and the significant Phillips curve. This result is robust to change in variables definition and is not influenced by the contemporaneous economic and sovereign debt crisis. To corroborate our result, we highlight that the "leader" economies, of the EA, still have a significant inflation/unemployment relationship. This comes closed to the idea, that entering a monetary union may have heterogeneous effects, given the size of such economy.

The paper is organized as follows: the section 2 presents the literature concerning the recent Phillips curve development and some empirical issues to be tackled. Section 3 & 4 describe the model and the way we empirically implement it. Data are analysed in section 5 while section 6 detail our results and their implication in terms of monetary & budgetary policy. Last, section 7 concludes our paper.

2 Literature review

In the debate, around the inflation behaviours, in the aftermath of the 2008 crisis, the literature highlights the lack of a Phillips curve, as inflation changes were weak compared to what has been actually expected (Blanchard et al., 2015; Blanchard, 2016; Ciccarelli and Osbat, 2017).

Among the multiple solution proposed to deal with this phenomenon, Barnichon and Mesters (2020b) conclude that the anchoring of inflation expectations is an important driver to explain the new relationship that exist between inflation and unemployment.

The role of rational inflation expectation provides evidence in the NKPC (Ball and Mazumder, 2011, 2019).[3] This is, to some extent, thanks to particularly anchored inflation expectation, that unconventional monetary measures, from the ECB's, in the European context, allow to tackle risks around price stability (Ciccarelli and Osbat, 2017). According to Ball and Mazumder (2019), expected inflation, measured by surveys of forecasters, explains fluctuations in core inflation. However, no significant effect, of ECB's unconventional announcements, has been found by Enders et al. (2019), using firms' surveys, upon their inflation expectations. The issue arises from the expectation measure. Coibion and Gorodnickenko (2015) suggest that the role of firms' expectation, if anchored to households, justify the missing disinflation between 2009-2011, while oil prices increased at the same time, increasing households expectations. Coibion et al. (2018), using a model of expectation formation, conclude of the importance of detailed survey data to address such an issue.

Besides the expectation measure problem, the labour market institutions (like wage coordination or trade union density) are also found to play a role in explaining the relationship that exists between unemployment and inflation (D'Adamo and Rovelli, 2015). According to Bell and Blanchflower (2018), the recent smoother slope may be attributed to an increase in underemployment, lowering the pressure on wages. Underemployment decreases the unemployment weight on inflation, while a significant share of workers seeks to work more hours. Byrne and Zekaite (2020) points to the asymmetric wage elasticity, lower in case of high labour market slack, to explain the impact of the labour market tightness. Del Negro et al. (2020) apply a VAR and a DSGE to capture the recent disconnection between inflation and

3. Inflation expectations are not new in the Phillips curve development (Friedman, 1977).

output and the subsequent role of the labour market.

In a globalized world, inflation development may be partly explained, following Forbes (2019b) and Bobeica and Jarocinski (2019), by the introduction of external factors. In the same vein, Coibion et al. (2019), in an expectations-augmented Phillips curve, highlight the importance of external inflation expectation to draw the Phillips curve. Jašová et al. (2020) estimate a NKPC and find a significant impact of both domestic and global output gaps. However, in emerging economies, the effect of the global output gap on inflation slightly decreased, in the aftermath of the 2008 economic crisis.

Bobeica and Jarocinski (2019) use a structural VAR, to look at spillovers from US to Euro area inflation and to determine the extent to which domestic and global variables (GDP, employment, confidence, consumption and investment) are important to help the policymaker.

Looking at the CEECs, empirical works already highlight some interesting elements, like Jarociński (2010) who found a relatively steeper Phillips curve in the CEECs, compared to the rest of the EU. Country specific focus improves the understanding of inflation dynamics in transition economies. Sznajderska (2012) explains non-linearities in the Phillips curve, in Poland, thanks to asymmetric reactions after economic boom or slack. Fidrmuc and Daniskova (2011) and Milučká (2014) disentangle the Czech Republic Phillips curve and highlight the important role of import price (i.e., external factors), in inflation evolution. Lyziak (2016) and Nagy and Tengely (2018) confirm such arguments respectively in Poland and Hungary. Looking at the Romanian economy, Saman and Pauna (2013) find a relatively equivalent behaviour, from forward and backward-looking component, in the inflation dynamic.

3 Model

The Phillips curve literature recently highlights the identification issue and raises the question upon the inflation behaviour (Mavroeidis et al., 2014; Barnichon and Mesters, 2020a,b; McLeay and Tenreyro, 2020). In an optimal monetary policy framework, McLeay and Tenreyro (2020) describe, at the equilibrium, the seemingly exogenous inflation process (i.e., disconnected from output gap). The model considers two equations, the usual Phillips curve and the optimal monetary policy design. The basic reduced form of the NKPC is defined as:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t \tag{3.1}$$

In Eq. 3.1, π_t refers to how far inflation is from its target; x_t is the difference between output and its potential level, namely the output gap and u_t, according to McLeay and Tenreyro (2020) is a cost-push shock. They assume that u_t follows an autoregressive (order 1) exogenous process, with persistence ρ, such that $u_t = \rho u_{t-1} + \varepsilon_t$, where ε_t are i.i.d. and mean zero.

The coefficient κ is strictly positively defined. Any increase in the output gap leads to a same sign change in inflation. According to McLeay and Tenreyro (2020), the optimal monetary policy framework, set under discretion, blurs this relationship. The policymaker minimizes a quadratic loss-function, considering expected inflation as given:

$$\pi_t = -\frac{\lambda}{\kappa} x_t \tag{3.2}$$

Any cost-push shock induces a trade-off between inflation target and output stabilization. From Eq.(3.1) and Eq.(3.2), inflation path is fully determined into

the model; inflation deviation appear to be proportional, to exogenous cost-push shock. Under the assumption that the monetary policy is constrained by the Phillips curve, the policymaker designs the monetary response, in line with any desired output gap. Pressures on inflation, resulting from undesirable output gap, are prevented by a successful monetary policy.

From there, the basic Phillips curve highlights the correlation between equilibrium inflation and output gap, instead of actual inflation. [4] There is no way to identify the Phillips curve, as this framework do not state any exogenous variable, that would potentially impact the monetary policy.

To get rid of this Phillips curve identification issue, disaggregated data have proven their efficiency. According to McLeay and Tenreyro (2020), the simultaneous bias is partly tackled, using regional level data. The endogenous monetary policy response, to demand shock, disappears. The aggregated Phillips curve previously defined, still holds. However, the regional dimension allows any deviation of inflation or output, at the aggregated level, to depend on the weighted average of each variable deviation, at the regional level. Moreover, every region is endowed with its own Phillips curve, as defined in Eq.(3.1) and suffers from idiosyncratic shocks, with possible spillovers, across regions (the error terms may be correlated across regions). Obviously, in such a framework, there is a single monetary policy response to the weighted average deviation. The Phillips curve in Eq.(3.1) and the IS curve (which determine the regressor and include the interest rate) are expressed

4. In McLeay and Tenreyro (2020), this corresponds to the intersection between equations 3.1 and 3.2.

in terms of regional deviation from the aggregate one:

$$\pi_t^i - \pi_t = \beta E_t(\pi_{t+1}^i - \pi_{t+1}) + \kappa(x_t^i - x_t) + \hat{u}_t^i \tag{3.3}$$

Even in case of optimal monetary policy response, to global deviation, the policy-maker does not consider idiosyncratic regional deviation, such that, the regional Phillips curve suffers from exogenous demand shock that won't alter the aggregated one.

4 Empirical strategy

We estimate the basic reduced form of the NKPC in Eq. 3.1, as derived in Gali and Gertler (1999), Cogley and Sbordone (2008) or more recently McLeay and Tenreyro (2020). We focus on a panel of European Union economies and derive some country heterogeneities. The European Union provides an interesting framework indeed. As a monetary union, the Euro area allows us to deal with a multi-country dimension estimation of the Phillips curve, à la McLeay and Tenreyro (2020), where each EA country is treated as a single region.

To link the regional specification, from McLeay and Tenreyro (2020), to the EA accession process, we use the specific case of Baltic states, namely Estonia, Latvia and Lithuania, plus Slovenia and Slovakia. This group of five countries present some specific peculiarities. Over the 2000-2020 period, they joined the European Union, went through the Exchange Rate Mechanism (ERM-II) and actually entered the Euro area. We expect such monetary changes to have potential impact on the empirical relationship between inflation and unemployment.

The introduction, into a common group of countries, that are not part of the EA, in the first stage, makes sense, as the ERM-II imposes a drastic monetary control. In that way, we refer to the recent work from Jorda et al. (2018) and the international finance trilemma. Under this monetary context, with free capital flows, a country almost gives up, its ability to draw the monetary policy and instead "import" the ECB interest rate shocks. [5]

The regional equation (eq. 3.3) derived from McLeay and Tenreyro (2020), holds some empirical limits. The first lies on the expected inflation measurement. Indeed, the authors fear a less accurate data, at the regional level. However, we circumvent this issue, using country level data and considering a multi-country approach, in the Euro area context.

The second issue states that if the cross-section deviation is similar, a clear identification of κ will be subdued. In the European context, the discretion of the budgetary policy belongs to each member states. We expect different behaviours from both policymakers and the labour market after a shock. The heterogeneous reactions, following the 2008 economic downturn, confirm that we provide a context with enough heterogeneity. [6] Moreover, any permanent cross-section deviation is captured by the introduction of individual fixed effects (μ_i). Invariant regional heterogeneities in unemployment or expected inflation illustrate those cross-section deviations that shall be captured before estimating the model.

The endogenous response of monetary policy, to aggregate cost-push shocks, remains an issue. The regional approach from McLeay and Tenreyro (2020) provides

5. The argument from Jorda et al. (2018) states that under pegging regime, we use the absence of arbitrage and uncovered interest-rate-parity assumptions to conclude of similar returns between similar assets.

6. To be noticed that the 2012 sovereign debt crisis confirms this argument, with increasing idiosyncratic behaviours.

an evident solution. We first transform eq.3.3 to isolate, on the left-hand side, the domestic inflation:

$$\pi_t^i = \beta E_t(\pi_{t+1}^i) + \kappa(x_t^i) + [\pi_t - \beta E_t(\pi_{t+1}) - \kappa(x_t)] + \hat{u}_t^i \tag{4.1}$$

The introduction of a time fixed effect (ν_t) captures monetary policy changes that are, by construction, common to every country in the monetary union.
According to Coibion and Gorodnickenko (2015), Nagy and Tengely (2018) and Bobeica and Jarocinski (2019), the global economic environment cannot be omitted in the Phillips curve estimation. The introduction of a time fixed effect deals with any worldwide shock (such as oil price deviation). The individual fixed effect, under the assumption that the state international openness remains constant, should considers the trade dependency. The following equation is estimated:

$$\pi_{it} = \delta_0 \pi_{it-1} + \delta_1 E_t \pi_{it+1} + \delta_2 x_{it} + \mu_i + \nu_t + \varepsilon_{it} \tag{4.2}$$

where δ_0 captures the persistence of the dependant variable, under the accelerationist hypothesis; δ_1 corresponds to the weight put on expected inflation and is expected to positively impact current inflation deviation. δ_2 illustrates the slope of the Phillips curve and is our coefficient of interest. Using the unemployment gap, we expect a negative coefficient (i.e., $\delta_2 < 0$). To complete the model, we introduce a 'crisis' dummy that takes value '1' (zero otherwise), during the period 2007-2012, to deal with the specific impact of the crisis (2008 downturn and 2012 sovereign debt shock). [7]

7. The start of the crisis dummy in 2007 comes closed to the idea that before the 2008 shock, we start observing some fluctuations in our data. Changing the exact definition of the

The lagged structure imposed on the dependant variable, δ_0, induces, under a simple fixed effects model, biased estimated parameters. As our model counts for endogenous regressors, we opt for an instrumental variable (IV) estimator via generalized method of moments [8] where the unemployment gap and expected inflation are treated as endogenous. [9]

5 Data and preliminary statistics

5.1 Data definition

Following the literature, like in Ball and Mazumder (2011, 2019) or Coibion et al. (2018) and McLeay and Tenreyro (2020), our dependant variable refers to *core inflation* i.e., we consider the harmonized consumer price index (HICP), excluding energy and food items. Core inflation represents the part of inflation not explained by supply shocks (Blanchard and Gali, 2007). According to Forbes (2019a), core inflation remains domestically determined, while the headline counterpart is internationally derived. The HICP index, from OECD database, is available, at a quarterly frequency (HICP index 2015 = 100). We use the year-on year-quarterly inflation rate i.e., percentage change compared to same period, previous year. [10]

The literature suggests the use of expected inflation, as a primo determinant of

dummy, only leads to marginal impact, upon the estimated coefficients.

8. The main results are robust to a two stage least square approach.

9. Expected inflation is alternatively treated as endogenous or exogenous. This won't change our results and their implications. We keep our variable endogenous, as we estimate, it better fits the intuition that expected inflation also relies on past behaviours.

10. As inflation data are not seasonally adjusted, the use of quarter-to-quarter inflation rate introduce seasonality into the data.

current inflation. Inflation expectations surveys have become a usual way, to consider the role of anchoring expectations, into the Phillips curve (Albuquerque and Baumann, 2017; Ball and Mazumder, 2019).

We use consumer surveys data, like in McLeay and Tenreyro (2020). Data, from the European Commission, cover the 1985-2020 period, at a quarterly frequency. From the consumer survey, we extract question 6 "Price trends over the next 12 months". [11] The index is defined over the [-100;100] interval and follows a seemingly normal distribution.

To measure the economic slacks, as defined in the Phillips curve developments, we use data upon the unemployment rate, extracted from OECD database, looking at the usual definition of unemployed, amongst the working age population. We use quarterly seasonally adjusted data, available from 1983 to 2019. To derive the unemployment gap, we consider a Hodrick-Prescott filter, à la Jašová et al. (2020). [12]

5.2 Preliminary statistics

For evident purpose of panel homogeneity and following McLeay and Tenreyro (2020) and Jorda et al. (2018), we only keep countries inside the EA, belonging to the ERM-II or having an exchange rate targeting monetary policy, before their ERM-II entry. Following this, Croatia, Czech Republic, Poland and Romania are kept aside. In 2008, Hungary entered a flexible exchange rate regime. Despite

11. The exact question asked is "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will..."; to answer this question, respondent has a multiple-choice range (++ increase more rapidly; + increase at the same rate; = increase at a slower rate; − stay about the same; −− fall; N don't know. Then the responses are aggregated under the form of an index, regarding the share of each category; the higher the index, the higher the inflation is expected to increase.

12. Our results are robust to the use of the Baxter-King filter instead.

the country could have been kept in our sample, before 2008, we throw it away, as the country did not engage so far, to the ERM-II. As we previously mentioned, during the introduction, Bulgaria recently joined the ERM-II. However, as we want to design the impacts of changing exchange rate regime, Bulgaria do not add any information. The country indeed, entered a currency board arrangement, in the nineties and unilaterally decided to maintain such a regime during the ERM-II.

A clear identification of each EU non-Euro member is needed to understand, to what extent the EMU accession process plays a role. Table 5 gives detail about the exact date of transition from one state, to another. Slovenia and Slovakia were both under floating exchange rate regime, before their ERM-II accession respectively in 2004 and 2006 and remain in the ERM-II for 32(37) months respectively. On another side, Baltic states were under currency board regime (expect for Latvia with a conventional fixed peg), during the initial stage. They entered the ERM-II, for a longer period of time (Estonia for 6.5 years, Latvia, 8.5 years and Lithuania 10.5 years).

Two other countries participate to the ERM-II over the period. Greece entered the EA in 2001-January and Denmark did not adopt the Euro, as a currency, yet and still is participating to the ERM-II. For evident purpose, of very small-time span, Greece is excluded from our analysis. Moreover, Denmark, on purpose, remains outside the EA (imposing very short fluctuation bands). We decided to keep the country aside.

Our panel counts 21 countries (i.e., EA members and EA candidates), over almost 20 years at a quarterly frequency. The table 1 provides the main statistics from our variables. The inflation rate ranges from -5.73 to 13.66 percent, on a year-on-year change, at a quarterly frequency. The largest values are observed in Estonia and

Table 1 – Summary statistics

Variable	Observation	Mean	SD	Min	Max
Inflation rate	1319	1.76	1.51	-5.73	13.66
Unemployment rate	1319	9.08	4.55	1.86	27.83
Expected inflation	1301	22.90	17.94	-37.93	81.2

Latvia suggesting a higher volatility in the inflation rate. Looking at unemployment data, the highest values in unemployment rate are observed in Spain, after the 2008 economic downturn. Unemployment gap are found to be relatively large in Estonia and Latvia. More precisely, the unemployment gap is strongly negative in the period 2007-2008 but highly positive after the 2008 economic downturn (2009-2010) in those two countries. In both cases, this corresponds to opposite reactions in the inflation rate.

There is an overall negative correlation between inflation rate and the unemployment gap (-0.34) and a positive one between inflation and expected inflation. Before going further, we look at the statistical distribution of our variables; we implement Maddala and Wu (1999) and Pesaran (2007) tests, our series are stationary and kept in level.

6 Results

All estimations in the following tables 2 and 3 consider the year-on-year quarterly core inflation rate, as a dependant variable [13]. We implement an IV-GMM estimator, with both individual and temporal fixed effects, plus a dummy,

13. In line with Blanchard et al. (2015), we use headline inflation rate instead of core inflation as a robustness check. Results are presented on table 6 on appendix B and appear relatively stable, with a significant Phillips curve slope in all specifications but CEECs inside the EA.

for the crisis, over the 2007-2012 period. [14]

The first column of table 2 consider the overall EA countries by their date

Table 2 – Main results

	(1) EA	(2) EU-15	(3) CEECs
Unemployment deviation	-0.00789**	-0.00921**	-0.0102*
	(-2.99)	(-3.11)	(-2.56)
Forecasted inflation	0.0110***	0.0114***	0.0197***
	(5.75)	(5.38)	(5.55)
L.Inflation rate	0.857***	0.863***	0.871***
	(36.10)	(34.00)	(30.48)
Crisis	0.00139	-0.000679	0.00452*
	(1.31)	(-0.70)	(2.07)
Observations	1113	940	344
R-sq	0.90	0.91	0.95
Endogeneity test	0.016	0.03	0.09

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
We estimate an IV estimator with both individual and temporal effects (not displayed in the table). All three columns estimate the Phillips curve using quarterly year-on-year inflation from 2000 to 2020, as a dependant variable. Column 1 refers to EA countries, by their respective date of accession; column 2 focuses on EU-15 to derive sub-group heterogeneities; column 3 introduces only the CEECs (i.e., Baltic states plus Slovenia and Slovakia), during the ERM-II and after their Euro adoption. Endogeneity test's p-value below 0.1 supports the IV estimator.

of entrance. The second column, to confirm the results found on the EA, focus on the EU-15 economies, as the main drivers of the ECB monetary policy. The third estimation looks at the CEECs [15] over the global period (i.e., without ERM-II vs EA distinction). This third approach does not seem to be incorrect as the ERM-II may be associated with an exchange rate targeting strategy. Before their

14. Instead of using year-on-year inflation rate, we test whether our results are robust to a quarter-to-quarter inflation rate. Such a measure suffers from a high level of seasonality, we introduce four lags of the dependent variable to partly get rid of it; results are presented in table 7 on appendix B.

15. In the rest of this section, CEECs will refer to Baltic states (i.e., Estonia, Latvia and Lithuania) plus Slovenia and Slovakia.

ERM-II accession, we only consider the Baltic states. As Slovenia and Slovakia adopted a flexible exchange rate before the ERM-II, both are dropped during this first period. In every specification, we find a significant negative Phillips curve coefficient, in line with the literature. The comparison between the CEECs and the rest of the EU does not allow us to conclude on a steeper Phillips curve in the CEECs, as found by Jarociński (2010). The coefficient of the unemployment deviation seems to be relatively stable among the different estimations. As expected, both forecasted inflation and persistence on inflation significantly impact the dependant variable, which corroborates Ball and Mazumder (2019). The dummy crisis is only significant in the CEECs.

From there, we want to disentangle whether changes, according the status inside the EU, do impact the relationship between inflation and unemployment. We postulate that we can directly attribute monetary status changes, [16] to variation in the Phillips curve coefficient, as the adoption of the Euro as a currency, does not represent, in itself, a shock on the labour market. Countries in the ERM-II, already belong to the EU. In such a context, the EA accession is not expected to play a significant, role upon the wage dynamic.

On table 3, we distinguish respectively for column 1 to 3, the period before the EA, a specific focus on the ERM-II [17] and after the EA accession. [18] Columns 3 & 4 are estimated over the same time span to provide a comparison between the

16. Changes in the status inside the EU, refer to ERM-II accession, followed by the EA entry.

17. The time spent on the ERM-II is strongly heterogeneous among our group of five countries. Estonia remains 6.5 years, Lithuania 10.5 years and Latvia almost 9 years. Both Slovenia and Slovakia went through the ERM-II, during a shorter period of time, respectively 11 and 13 quarters.

18. The relatively small number of observations, before the ERM-II entry, does not allow us to provide results on this specific status.

CEECs, after their EA accession and the EU-15.

We observe a relatively stable relationship upon foretasted inflation, as is the

Table 3 – Exchange rate regime

	(1) CEECs before EA	(2) CEECs during ERM-II	(3) CEECs inside EA	(4) EU-15 after 2010
Unemployment deviation	-0.0179*	-0.0254**	0.00496	-0.00888*
	(-2.08)	(-2.79)	(0.69)	(-2.08)
Forecasted inflation	0.0225***	0.0283***	0.0130**	0.0119***
	(4.29)	(4.29)	(2.62)	(3.96)
L.Inflation rate	0.885***	0.931***	0.697***	0.742***
	(24.84)	(22.70)	(12.29)	(22.56)
Crisis	0.00207	0.00692***	0.00651***	0.0000755
	(1.35)	(3.50)	(4.23)	(0.07)
Observations	168	124	160	480
R-sq	0.96	0.97	0.87	0.86
Endogeneity test	0.09	0.14	0.10	0.02

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
This set of estimation refers to the same equation as in the main table. We provide here a distinction upon the *stage* toward the EA accession. Using an IV process, in column 1, we focus on the CEECs before the EA (i.e., before and during the ERM-II for Baltic states and only during the ERM-II for Slovenia and Slovakia). In column 2, we focus only on countries belonging the ERM-II (recall we dropped out Denmark). In columns 4 & 5 we look at EA economies, by sub-group of countries. To allow time consistency comparison, in these last two columns, both time spans begin in 2010.

case for the unemployment deviation coefficient. However, the Phillips curve slope coefficient is no longer significant after the CEECs entry the EA. As the coefficient remains significant, among the EU-15 and in line with the column 2 in table 2, i.e., the overall period, we need to disentangle this missing relationship in the specific case of the CEECs. As suggested by McLeay and Tenreyro (2020), the regional approach seems to give interesting results compared to estimation of the Phillips curve, in the aggregated EA.

Before going further, we need to test the robustness of these results. As Slovenia and Slovakia spent a small amount of time in the ERM-II stage, we run our set of estimations only looking at Baltic states to see whether our results are robust to any individual dimension change. Results, in table 8 on appendix B are in line with previous estimation with a not-significant Phillips curve slope once countries join the EA. Moreover, our results also appear to be robust to the introduction of the output gap, à la Ball and Mazumder (2019), as a measure of economic slack, instead of the usual unemployment gap (see column 1 & 2 of table 9 page 32). To follow Bell and Blanchflower (2018), under the assumption of a decreasing pressure on wages during under-employment period, we introduce a new variable. Instead of looking at the unemployment gap, we introduce the non-employment rate gap computed as deviation from the non-employment rate, itself defined as $1 - \frac{employment}{working-age-population}$. Doing so we capture any variation in the participation rate. [19] This new approach does not lead to any conclusive result before or after the adoption of the Euro as a currency (table 9). Unconclusive results, concerning underemployment issue, in the CEECs are not surprising as underemployed part-time share among the working age population is relatively small in the CEECs compared to the rest of the EU. [20]

Between 2008-2010, we observe a temporary shock, in Latvia and Lithuania, in the EMU convergence rate, such that we introduce this new variable into the model. More precisely, we look at the interest rate spread. The idea, behind the intro-

19. Another interesting measure would have been to introduce the "involuntary temporary employment". However, we only get this at an annual frequency and involuntary temporary employment (as is the case for part-time employment) is relatively low in the CEECs compared to EU-15 such that we do not go further in this direction.

20. Source: Eurostat [lfsi_sup_q], from 2010 to last data available, the share of part-time underemployment in working age population is twice bigger in the EU-15 (4%) than in the CEECs (2%).

duction of the interest rate spread, is to capture the potential impact of financial frictions and their subsequent impact on the Phillips curve Gilchrist et al. (2017). The results, available on table 10 in appendix B.3.2, remain stable.

Under the hypothesis, that small open economies, only marginally impact, the

Table 4 – Leaders economies

	(1) EU-6	(2) EU-6 x DE	(3) Other EU-15
Unemployment deviation	-0.0133***	-0.0120**	-0.0113
	(-3.97)	(-3.16)	(-1.76)
Forecasted inflation	0.00288	0.00318	0.0169***
	(1.11)	(1.30)	(10.82)
L.Inflation rate	0.829***	0.783***	0.601***
	(18.03)	(16.95)	(11.31)
Observations	240	200	160
R-sq	0.84	0.85	0.87
Endogeneity test	0.09	0.08	0.04

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
This set of estimation focus on EU-6 (with and without Germany) and other EU-15 economies to test our assumption under which, economic leaders may indirectly drive the ECB monetary policy. As in the main estimation, we use an IV estimator (endogeneity test support the presence of endogeneity in our series).

monetary policy in the Euro area, we expect to find a significant Phillips curve coefficient, looking at EA economic leaders over the same period. We focus on the six first EU members, namely Belgium, France, Germany, Italy, Luxembourg and the Netherlands (table 4). To draw a coherent comparison, we restrict our time dimension from 2010 to 2020 and find a still significant Phillips curve coefficient, closed to what has been found in previous results. Such a significant negative coefficient holds even when we drop Germany from the panel (column 2 of table 4). Looking at other EU-15 countries, we do not find a significant result, which

tends to support the important role of economic leaders, in the ECB monetary policy design. [21]

According to Schmitt-Grohé and Uribe (2016), currency peg and free capital mobility create negative externalities, in case of nominal wage rigidities. They propose to introduce some controls, upon capital flows, to limit the impact of such externalities. However, in the EU context, the free capital movement prevent such a solution.

Once countries belong to the monetary union, at the frontier of a fiscal union, government spending and/or fiscal deficits shall be used as smoother instruments in case of economic shock (Farhi and Werning, 2017). Our previous results implicitly state that small open economies, in a monetary union, without a fiscal counterpart, shall strongly rely on robust budgetary/fiscal tools to drive their economy. Such results tend to corroborate Del Negro et al. (2020) upon the role of labour market institution.

7 Conclusion

Recent EU non-Euro members agreed on the adoption, in the middle term, of the Euro, as a currency. From EU adhesion to EA accession, the ERM-II represents a voluntary mandatory step to ensure the country is ready to enter the EA. This represents a step toward the loss of the monetary policy where economies pegged their money to the Euro.

21. Under another approach, we derive a South-North heterogeneity, to capture the relative monetary prodigality against austerity. However, this heterogeneity did not end up to any conclusive results.

In light of the Phillips curve, which considers the monetary counterfactual according to the relationship between inflation and unemployment, we question in this paper whether the switch from different exchange rate regime, leads to variation in the Phillips curve coefficient.

We use recent work from Jorda et al. (2018) and McLeay and Tenreyro (2020), to construct a panel of countries inside the EU and to deal with identification issue, usually found in the Phillips curve literature.

We have found that during the ERM-II, the Phillips curve coefficient is as expected, negative and significant. However, after the EA accession, the coefficient becomes not significant. This result is robust to changes in the definition of our variables, using different measure of economic slack and/or inflation.

To drive the monetary policy of the EA, the ECB reacts, to any change, in the weighted average of economic slack. An idiosyncratic shock won't lead to monetary reaction. We look at the Phillips curve among EA members and provide a heterogeneity distinction, between the "economic leaders" and other EU-15 countries. This last approach corroborates our main results. The Phillips curve coefficient is only significant for economic leaders.

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Appendices

A Some figures about EU stages

Table 5 – Country sub-groups

EU-15 - EMU members					
Country	Code	EU	EMU		
Austria	AT	1995	1999		
Belgium	BE	1958	1999		
Germany	DE	1958	1999		
Greece	EL	1981	2001		
Spain	ES	1986	1999		
Finland	FI	1995	1999		
France	FR	1958	1999		
Ireland	IE	1973	1999		
Italy	IT	1958	1999		
Luxembourg	LU	1958	1999		
Netherlands	NL	1958	1999		
Portugal	PT	1986	1999		
EU-15 - non-EMU members					
Country	Code	EU	FX		
Denmark	DK	1973	ERM (1999-)		
Sweden	SE	1995	Floating		
United Kingdom	UK	1973	Floating		
CEECs - EMU members					
Country	Code	EU	ERM	EMU	FX
Cyprus	CY	2004	2005(June)	2008	Pegged
Estonia	EE	2004	2004(August)	2011	Pegged
Lithuania	LT	2004	2004(August)	2015	Pegged
Latvia	LV	2004	2005(August)	2014	Pegged
Malta	MT	2004	2005(June)	2008	Pegged
Slovenia	SI	2004	2004(August)	2007	Flexible
Slovakia	SK	2004	2006(January.)	2008	Flexible
CEECs - non-EMU members					
Country	Code	EU	FX		
Bulgaria	BG	2007	Pegged (ERM 2020)		
Czech Republic	CZ	2004	Floating		
Croatia	HR	2013	Floating (ERM 2020)		
Hungary	HU	2004	Floating (pegged until 2008)		
Poland	PL	2004	Floating		
Romania	RO	2007	Floating		

Notes: "EU" refers to the European Union, "EMU" to the European Monetary Union", "ERM" to the Exchange rate mechanism and "FX" to the exchange rate regime.

B Robustness

B.1 Headline inflation

Table 6 – Headline inflation

	(1) EMU	(2) EU-15	(3) CEECs	(4) CEECs ERM-II	(5) CEECs EMU
Unemployment	-0.00504*	-0.00750**	-0.0135**	-0.0354***	0.00693
	(-1.98)	(-2.71)	(-2.69)	(-3.80)	(0.92)
Forecasted inf.	0.0116***	0.0124***	0.0212***	0.0263***	0.0100
	(6.16)	(6.69)	(4.82)	(3.77)	(1.40)
L.Inflation rate	0.852***	0.852***	0.871***	0.927***	0.721***
	(41.57)	(38.06)	(30.27)	(23.19)	(13.74)
Crisis	0.00399**	0.00235	0.00109	0.00468	0.00957*
	(2.80)	(1.82)	(0.30)	(1.49)	(2.39)
Observations	1113	940	344	120	160
R-sq	0.94	0.94	0.96	0.97	0.94

Notes:t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Columns 1-3 refer to the same estimation as in table 2; the two last estimation correspond to columns 4-5 of table 3. To follow Blanchard et al. (2015), headline inflation correspond to overall HICP. This new inflation measurement do not bring new results and confirm the lack of significant Phillips curve in the last estimation. We reject the idea that inflation measurement significantly drive our results.

B.2 Month to month inflation rate

Table 7 – Month to month data

	(1) EMU	(2) EU-15	(3) CEECs	(4) CEECs ERM-II	(5) CEECs EMU
Unemployment deviation	-0.0281**	-0.0320**	-0.0357*	-0.0754*	0.0172
	(-2.98)	(-3.07)	(-2.36)	(-2.05)	(0.66)
Forecasted inflation	0.0410***	0.0435***	0.0657***	0.0722**	0.0445*
	(6.18)	(5.96)	(4.87)	(2.89)	(2.38)
L.Inflation rate	-0.0756	-0.0584	-0.0127	0.244*	-0.264***
	(-1.78)	(-1.15)	(-0.26)	(2.07)	(-4.16)
L2.Inflation rate	0.122***	0.156***	0.0815	0	-0.140*
	(3.76)	(4.27)	(1.50)	(.)	(-2.43)
L3.Inflation rate	-0.202***	-0.210***	-0.128**	-0.0197	-0.323***
	(-6.15)	(-5.20)	(-2.86)	(-0.25)	(-5.13)
L4.Inflation rate	0.548***	0.529***	0.569***	0.446***	0.472***
	(18.80)	(15.79)	(10.86)	(3.71)	(6.20)
Crisis	0.0114**	0.00510	0.0196*	-0.00526	0.0260***
	(2.72)	(1.21)	(2.38)	(-0.28)	(4.37)
Observations	1083	907	335	118	160
R-sq	0.84	0.85	0.78	0.77	0.88

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
I present here results using the annualised quarter to quarter inflation rate using four lags to deal with the seasonality issue. Results strongly follow what is found in the main estimation or even the one found with headline inflation in table 6.

B.3 Baltic states

Table 8 – Exchange rate regime in Baltic states

	(1) Baltic states before EA	(2) Baltic states inside ERM-II	(3) Baltic states EA
Unemployment deviation	0.0620**	0.0819*	0.0525
	(2.59)	(2.18)	(1.47)
Forecasted inflation	0.0399***	0.0485***	0.000815
	(4.97)	(4.62)	(0.12)
L.Inflation rate	0.755***	0.727***	0.842***
	(16.08)	(10.53)	(5.72)
Crisis	-0.00216	-0.00410	
	(-1.01)	(-1.07)	
Observations	144	99	68
R-sq	0.98	0.98	0.65

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
To derive any country heterogeneities among the CEECs, in this table, we run the sam set of estimation as in table 3 but only looking at Baltic states (Estonia, Latvia and Lithuania), respectively, before EA entry, during the ERM-II and after the Euro adoption.

B.3.1 Output and non-employment

Table 9 – Output gap and non-employment

	(1) CEECs ERM-II	(2) CEECs EA	(3) CEECs ERM-II	(4) CEECs EA
GDP	0.335**	0.0918		
	(2.58)	(1.06)		
Non employment			-0.152	-0.0896
			(-1.36)	(-0.64)
Forecasted inflation	0.00583	0.00497	0.0177***	0.00644
	(1.07)	(1.06)	(3.89)	(1.45)
L.Inflation rate	0.762***	0.871***	0.905***	0.858***
	(9.86)	(15.14)	(22.61)	(15.60)
Crisis	0.00927**		0.00260	
	(3.18)		(0.74)	
Observations	112	92	120	116
R-sq	0.96	0.82	0.96	0.83

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
These two sets of estimations refer to column 4 & 5 of table 3. Columns 1-2 look at the GDP deviation, we find a positive and significant coefficient as expected only in the first case. Looking at the non-employment rate, any significant results are found. Such a result do not corroborate the decreasing wage pressure from Bell and Blanchflower (2018).

B.3.2 Financial integration during the sovereign debt crisis

Table 10 – Interest rate spread

	(1) CEECs ERM	(2) CEECs EA	(3) CEECs ERM	(4) CEECs EA
Unemployment deviation	-0.0571***	0.00209	-0.0571***	-0.00215
	(-5.27)	(0.24)	(-5.32)	(-0.24)
Forecasted inflation	0.0305***	0.0186**	0.0312***	0.0177**
	(4.43)	(3.25)	(4.27)	(3.22)
L.Inflation rate	1.018***	0.701***	1.021***	0.698***
	(26.87)	(10.64)	(26.05)	(10.56)
Crisis	0.00754***	0.00726***	0.0225***	
	(4.07)	(4.93)	(3.38)	
Spread			0.0329	0.121
			(0.55)	(1.78)
Observations	89	124	89	124
R-sq	0.98	0.89	0.98	0.89

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
This set of estimation refers to the same equation as in table 3. We introduce a measure of interest spread to consider financial frictions. Columns 1-2 estimate the same equation as before on the CEECs, dropping Estonia, to allow comparison between the two groups (this new subgroup count for Latvia, Lithuania, Slovenia and Slovakia. Our spread variable is introduced in columns 3-4.

To compute the interest spread, we refer to the difference between the domestic and the German long term interest rate.[22] As no data are available for Estonia, to allow comparison between subgroups, in table 10, we first run the same estimation as in table 3 (columns 1-2) and then introduce our spread measure (column 3-4).[23] The introduction of this new measure do not change the lack

22. Source: Eurostat - "Long term interest rate, used as a convergence criterion for the EMU, based on the Maastricht Treaty." No data are available for Estonia.

23. We alternatively look at column 3 with or without the crisis dummy. Omission of this dummy do not change the results and as the coefficient is statistically significant, we present the results with the crisis dummy.

of significant Phillips curve slope after the countries entered the EA such that we may exclude financial shocks to blur our results.